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The referenced letter provided an "Official Use Only" copy of TDR-WHS-RL-000001, Revision 00, *Identification of Aircraft Hazards*. This letter is to inform you of a change in the status of this report. A second analysis of the report was conducted to determine whether or not the information should continue to be labeled "Official Use Only" and exempt from disclosure under the criteria of Exemption 2 of the Freedom of Information Act (FOIA). As a result of this analysis, we have determined that this document does not contain sensitive information that will cause considerable harm or circumvention of matters of national security. Therefore, there is no statutory requirement under the FOIA to prevent the release of this document to the public.

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OLA&S:TCG-1533

Joseph D. Ziegler, Acting Director
Office of License Application and Strategy

Enclosure:
TDR-WHS-RL-000001, Revision 00,
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TDR-WHS-RL-000001 REV 00

June 2002

Identification of Aircraft Hazards

PREDECISIONAL STUDY DOCUMENT

UNCLASSIFIED – APPROVED FOR PUBLIC RELEASE

Diane Quenell

Diane C. Quenell, May 6, 2003

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~~Reviewed by:~~ Diane Quenell
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ACRONYMS AND ABBREVIATIONS

AFB	Air Force base
AGL	above ground level
AGM	air-to-ground missile
AMSL	above mean sea level
API	armor-piercing incendiary
ATCAA	air traffic control assigned airspace
CBU	cluster bomb unit
DOE	U.S. Department of Energy
EC	electronic combat
ECR	electronic combat range
FAA	Federal Aviation Administration
FSU	former Soviet Union
GBU	glide bomb unit
GLOC	gravity-induced loss of consciousness
GPS	global positioning system
HEI	high-explosive incendiary
IFR	instrument flight rules
IR	IFR routes
KCAS	knots calibrated airspeed
LANTIRN	low altitude navigation tracking infrared for night
LATN	low altitude training and navigation
MGR	monitored geologic repository
MOA	military operations area
MTR	military training route
NTS	Nevada Test Site
NTTR	Nevada Test and Training Range
PFSF	Private Fuel Storage Facility
TP	target practice
TTR	Tonopah Test Range

ACRONYMS AND ABBREVIATIONS (Continued)

UAV	unmanned aerial vehicle
USAF	United States Air Force
VFR	visual flight rules
VORTAC	very high frequency omnidirectional range station and/or tactical air navigation
VR	VFR routes
WP RX	white phosphorous rocket

1. PURPOSE

Aircraft hazards were determined to be potentially applicable to a repository at Yucca Mountain in the *MGR External Events Hazards Analysis* (CRWMS M&O 2000). That determination was conservatively based on limited knowledge of flight data in the area of concern and the crash data on aircraft of the type flying near Yucca Mountain. The purpose of this report is to identify potential aircraft hazards using Section 3.5.1.6 of NUREG-0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants* (NRC 1987) as guidance for the inclusion or exclusion of identified aircraft hazards. This report will identify potential aircraft hazards that may be applicable to a repository at Yucca Mountain. The intended use of this report is to provide inputs for further screening and analysis of the identified aircraft hazards based on the criteria that apply to Category 1 and 2 event sequence analyses. Section 11 describes the intended analyses that will build on the results of this report.

This report was developed in accordance with the *Technical Work Plan for: Preclosure Safety Analysis* (BSC 2001a) and AP-3.11Q, *Technical Reports*. The scope of this technical report includes the evaluation of military, private, and commercial use of airspace in the 100-mile regional setting of the Monitored Geologic Repository (MGR) at Yucca Mountain. The scope of this technical report does not include the following: (1) reliability, availability, constructability, fabrication, and operability; (2) human factors, radiological safety, and hazards requirements; (3) high energy sources, environmental impacts, and life cycle costs; and (4) security.

No software routines, macros, or models as defined by AP-SI.1Q, *Software Management*, are used in this report. Electronic management of information is controlled as identified in the *Technical Work Plan for: Preclosure Safety Analysis* (BSC 2001a).

2. QUALITY ASSURANCE

This report is subject to the requirements of *Quality Assurance Requirements and Description*, DOE/RW-0333P (DOE 2002) because it determines whether identified aircraft hazards should be considered as initiators of Category 1 or Category 2 event sequences that require detailed accident analyses. The subsequent detailed accident analyses could potentially identify quality-affecting items subject to quality assurance program controls.

3. APPLICABLE CRITERIA AND REQUIREMENTS

The regulatory standard for determining event sequences for which the geologic repository must be designed is 10 CFR Part 63. Based on frequency of occurrence, event sequences are categorized as Category 1 or Category 2 or beyond Category 2, as described in 10 CFR 63.2. Category 1 event sequences are "those event sequences that are expected to occur one or more times before permanent closure" (10 CFR 63.2). This is equal to an annual frequency of one chance in one hundred (0.01 per year), based on a 100-year preclosure operational period (BSC 2001b, Section 4.4.1.2.1) (Assumption 4.2). Category 2 event sequences are "other event sequences that have at least one chance in 10,000 of occurring before permanent closure" (10 CFR 63.2). This is equal to an annual frequency of one chance in one million (1.0E-06 per year), based on a 100-year preclosure operational period (BSC 2001b, Section 4.4.1.2.1) (Assumption 4.2). Event sequences that have less than one chance in 10,000 of occurring before

permanent closure of the repository are considered beyond Category 2 event sequences. 10 CFR Part 63 does not require analyses of beyond Category 2 event sequences.

Event sequences that are less probable than 1.0E-06 per year are beyond Category 2 event sequences. In promulgating a probability bound of 1.0E-06 per year for 10 CFR Part 63, the Nuclear Regulatory Commission specifically distinguished the risks of a high-level waste repository from the risks associated with operating nuclear reactors. The conditions are not present at a repository to generate a radioactive source term of a magnitude that however unlikely, is conceivable at a nuclear power plant. Because NUREG-0800 (NRC 1987) guidance was established for operating nuclear power plants, the 10 CFR Part 63 probability bound of 1.0E-06 per year is applicable rather than the NUREG-0800 guidance of 1.0E-07 per year probability of exceeding 10 CFR Part 100 dose limits.

4. ASSUMPTIONS

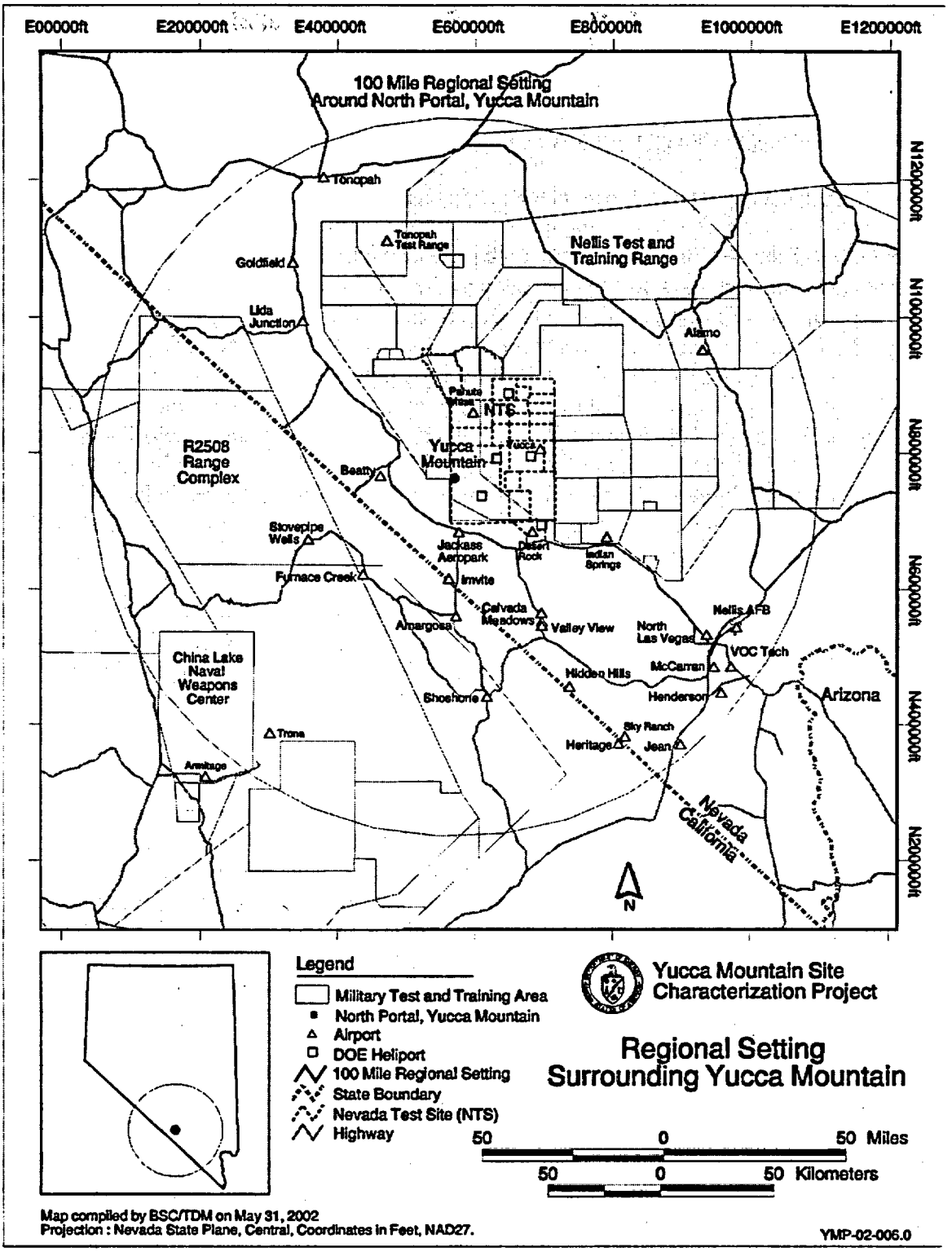
1. Airport operations in the 100-mile regional setting of the MGR are assumed to increase five percent each year through 2040. *Basis*: This assumption is used to demonstrate that if airports greater than ten miles from the MGR increase operations by five percent per year, the operations will not exceed NUREG-0800 acceptance criteria for site-to-airport distance, *D*. This assumption does not require confirmation because the results of Appendix F were not used to screen out any airports from consideration as a hazard to the MGR. Appendix F is presented as information only. This assumption is used in Section 6.3.3 and Appendix F.

2. The preclosure period (from the beginning of repository operations to permanent closure) is assumed to be 100 years. *Basis*: This assumption is conservative and does not require confirmation. Monitoring activities before permanent closure of the emplacement drifts may exceed 100 years, but waste handling and emplacement activities are expected to span less than 40 years (BSC 2001b, Section 4.4.1.2.1). This assumption is used in Section 3.

5. AIRSPACE-RELATED FACILITIES, EQUIPMENT, AND ACTIVITIES

The 100-mile regional setting depicted on Figure 1 covers the airspace within 100 miles of the North Portal at Yucca Mountain. Unless otherwise stated, miles are statute miles. The 100-mile regional setting was selected to fully describe the extensive military presence in the airspace surrounding the MGR. The 100-mile regional setting is not intended to infer that airspace-related activities 100 miles from the site would result in credible hazards to repository surface facilities. The airspace within the 100-mile regional setting of Yucca Mountain can be used for a number of airborne activities involving military, private, and commercial aircraft, missiles, and aerospace vehicles. Several military operations areas (MOAs) and restricted areas surround Yucca Mountain. A number of airports and airfields are located within the regional setting. This section describes these airspace-related activities and their associated facilities and equipment. Sections 6 and 7 will determine whether these activities are credible hazards to the MGR and require further evaluation.

Figure 1 is an illustration of information obtained from various sources. The location of the North Portal at Yucca Mountain (36°51'8" north latitude and 116°25'35" west longitude) was



Sources: DTN: MO0004YMP00017.000; NIMA 2001; USAF 2001a.
See Section 5 for further description of sources.

Figure 1. Regional Setting Surrounding Yucca Mountain

determined from DTN: MO0004YMP00017.000. The layout of the Nevada Test and Training Range (NTTR) was determined from the *Nevada Test and Training Range Chart* (NIMA 2001). The layout of the R-2508 Complex was determined from the *2002 R-2508 Complex User's Handbook* (USAF 2001a). The locations of airports were determined from *Las Vegas Sectional Aeronautical Chart* (NACO 2002b) and *Nevada Test and Training Range Chart* (NIMA 2001).

5.1 NEVADA TEST AND TRAINING RANGE

The NTTR includes airspace, land, and infrastructure dedicated to military uses. The lands dedicated to military uses and the airspace of the NTTR shown in Figure 2 (USAF 1999a, Figure 3.1-1, p. 3.1-6) are composed of the Desert and Reveille MOAs with overlying Air Traffic Control Assigned Airspace (ATCAA) and five restricted areas of the NTTR: R-4806E, R-4806W, R-4807A, R-4807B, and R-4809 (not including R-4809A which is U.S. Department of Energy [DOE] airspace). The infrastructure includes radar and communication sites as shown on Figure 3 (USAF 1999a, Figure 1-4, p. 1-19), and three major facilities at Indian Springs, Tolicha Peak, and the Tonopah Test Range (TTR), including two airfields shown on Figure 4 (USAF 1999a, Figure 1-2, p. 1-17). The infrastructure also includes 177 tactical target complexes containing more than 1,300 simulated targets described in Section 5.1.2 (USAF 1999a, pp. 1-16 and 1-21).

In specific locations on or near the NTTR, civilian air traffic can be present. Figure 5 (USAF 1999a, Figure 3.1-3, p. 3.1-11) shows the Federal Airways (Victor Airways) and Jet Routes that border the NTTR. Section 5.6 provides a description of these Federal Airways and Jet Routes.

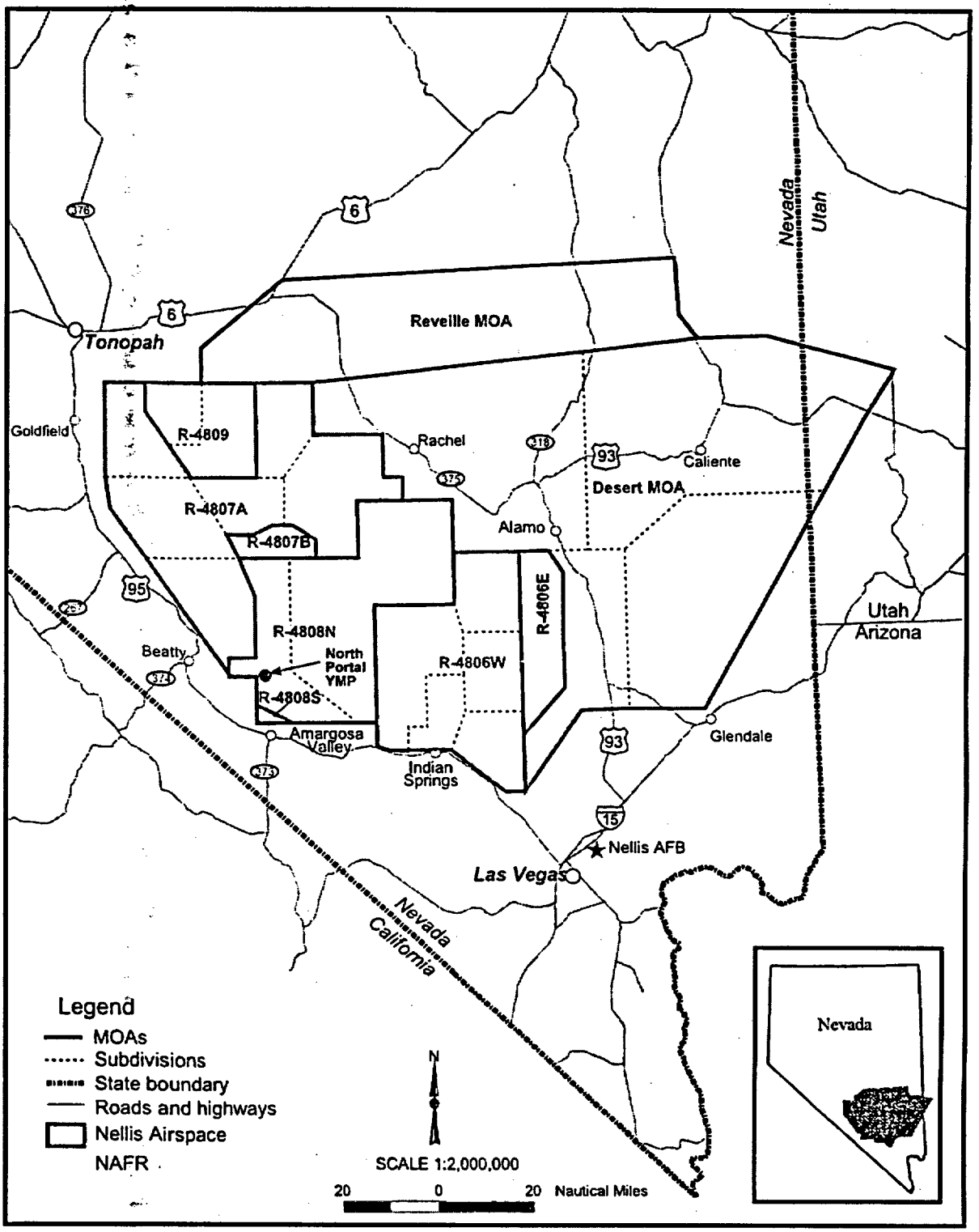
5.1.1 Military Operations Areas

An MOAs is an airspace established to separate or segregate certain military activities from other civilian air traffic. The Desert and Reveille MOAs shown on Figure 2 are used for conducting air-to-air intercept training, which consists of high altitude operations, abrupt maneuvers, and supersonic flight at and above 5,000 feet above ground level (AGL). The base of each MOA is 100 feet AGL. The ceiling is up to 18,000 feet above mean sea level (AMSL), however ATCAA can be provided on an as-needed basis by the Federal Aviation Administration (FAA) to extend airspace from 18,000 feet AMSL to higher altitudes needed to accommodate flight training requirements. Information reproduced in this section can be found in USAF (1999a, pp. 3.1-4 and 3.1-5).

5.1.1.1 Reveille Military Operations Area

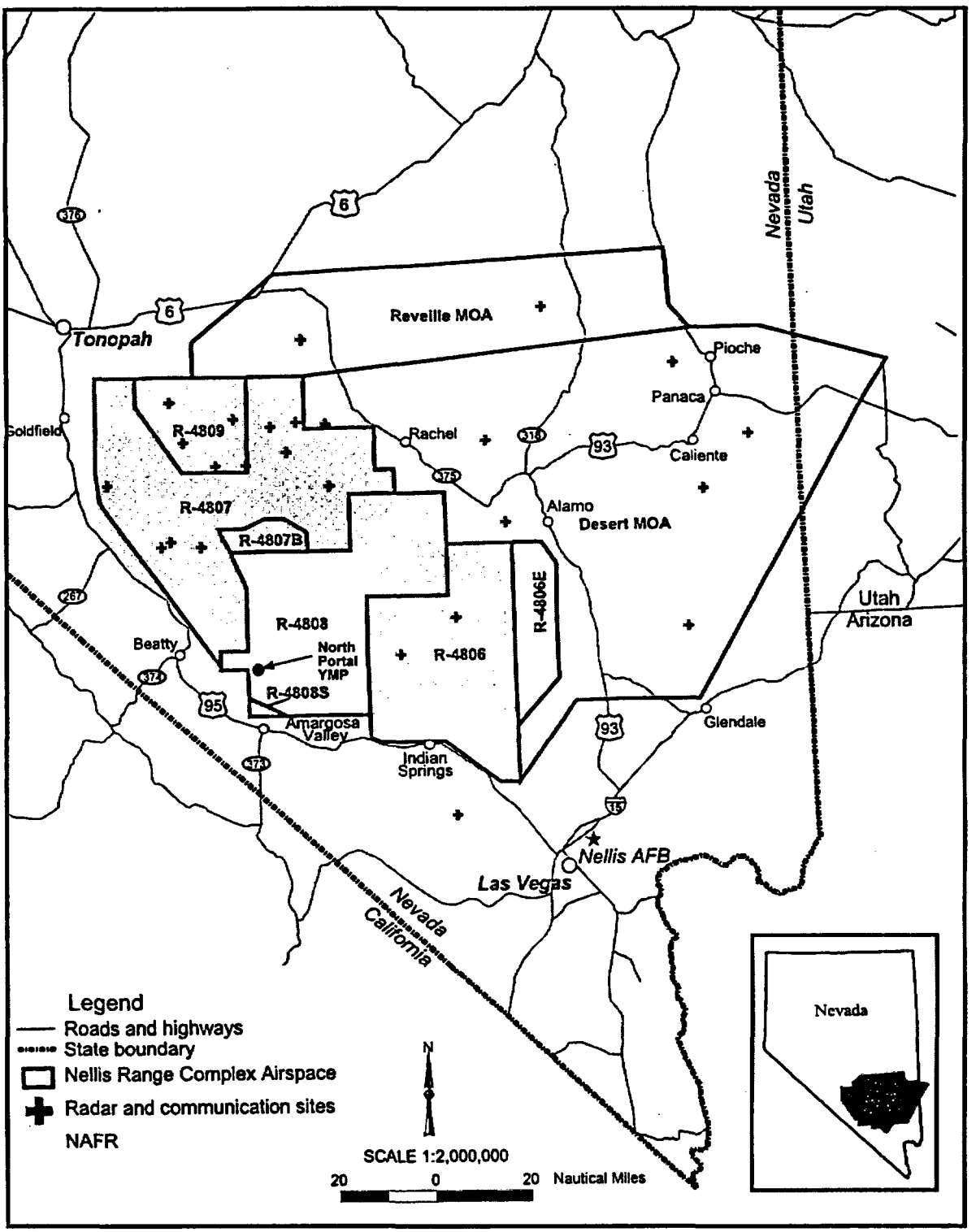
The Reveille MOA airspace comprises the northern portion of the NTTR and is normally controlled by the FAA's Salt Lake Air Route Traffic Control Center. The ATCAA overlays this MOA. Nellis must schedule use of this airspace in advance since it includes FAA jet routes and federal airways used for east-west transit of Instrument Flight Rules (IFR) traffic (USAF 1999a, pp. 3.1-4 and 3.1-5).

Use of the ATCAA airspace above 18,000 feet AMSL requires 11 days advance notice because of civilian air traffic; therefore, military air traffic is generally located below 18,000 feet AMSL



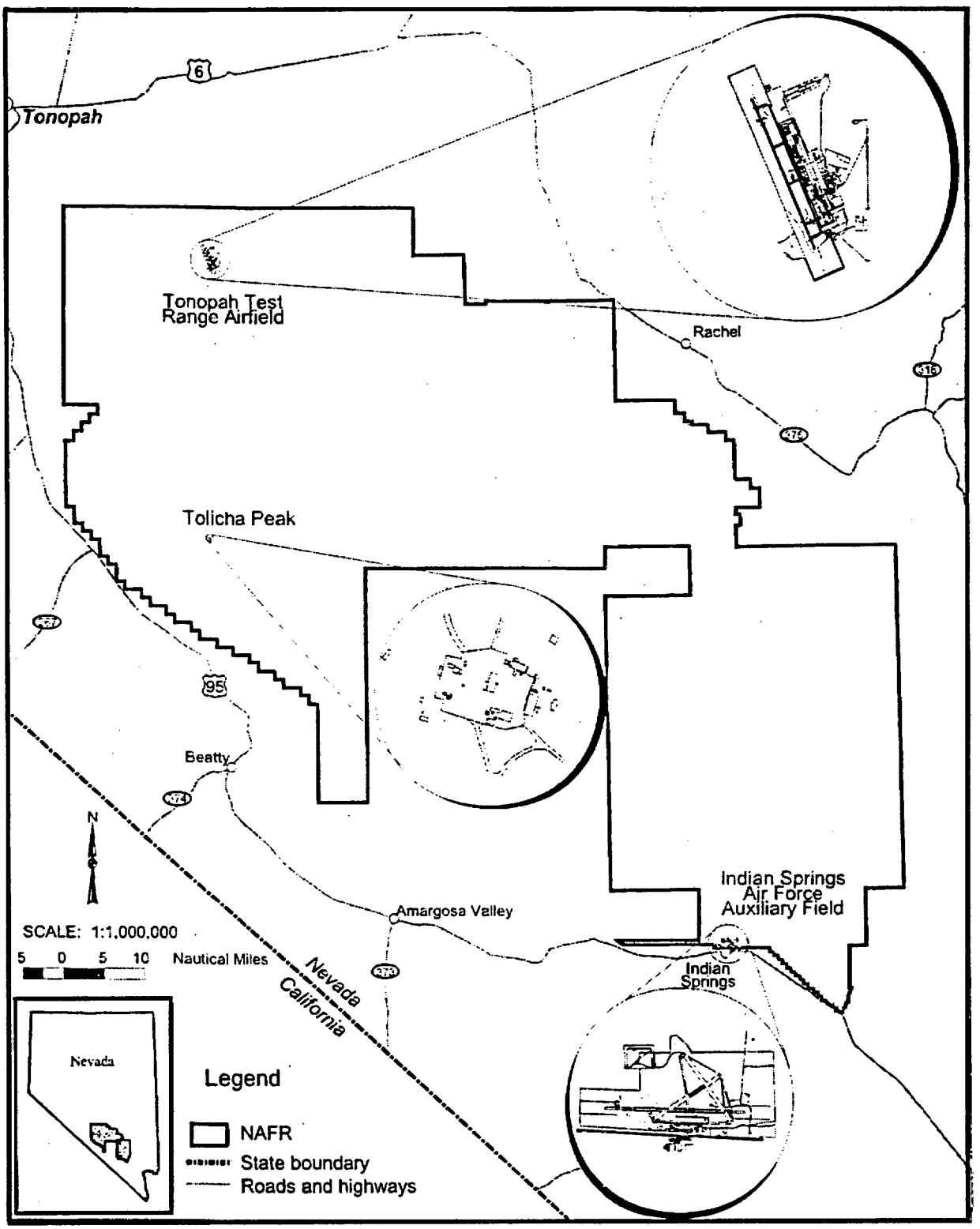
Source: USAF 1999a, Figure 3.1-1, p. 3.1-6.
Note: Figure is for illustration only. Image has been scanned; scale may be inaccurate.

Figure 2. NTTR Airspace



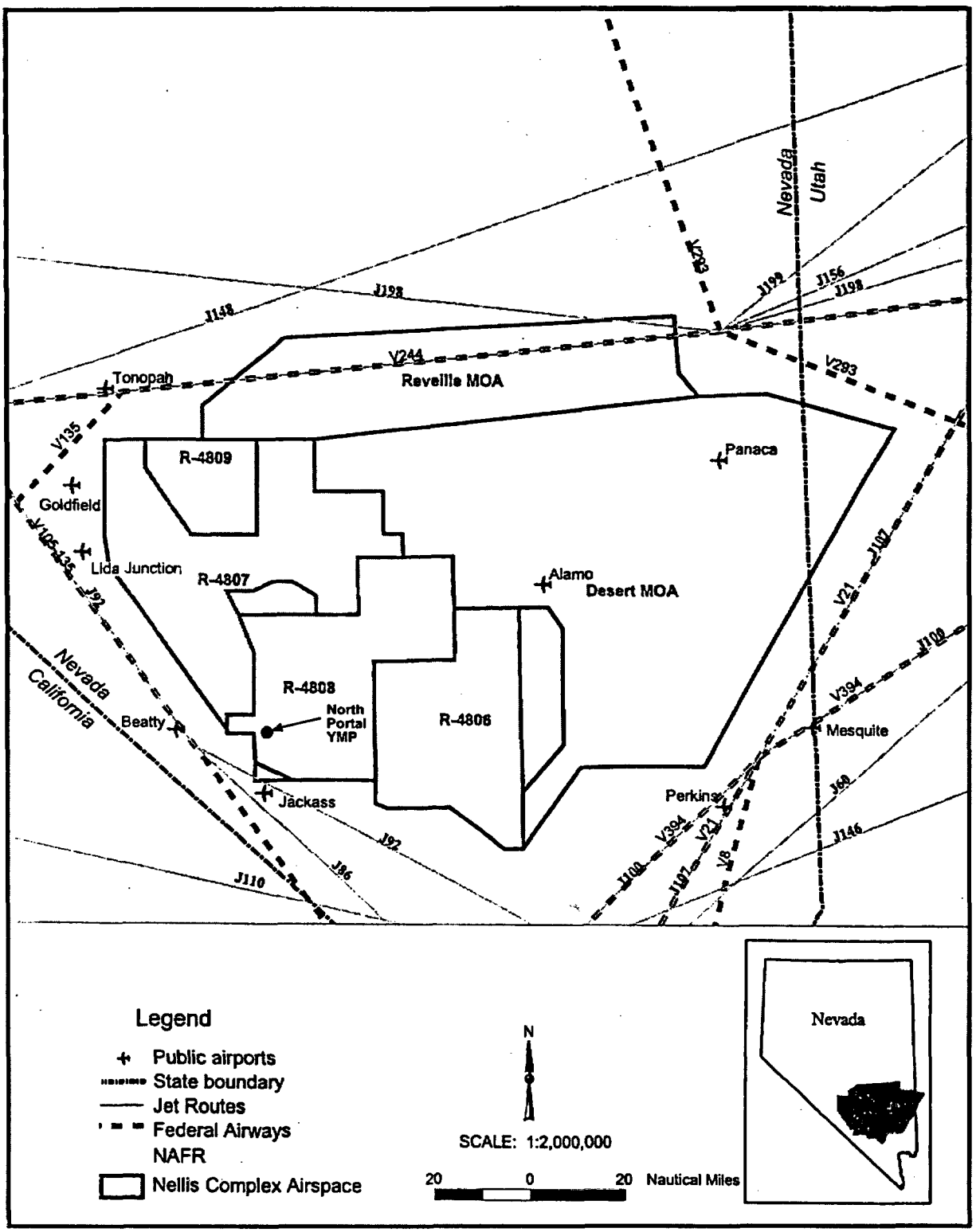
Source: USAF 1999a, Figure 1-4, p. 1-19
Note: Figure is for illustration only. Image has been scanned; scale may be inaccurate.

Figure 3. Radar and Communication Sites



Source: USAF 1999a, Figure 1-2, p. 1-17.
Note: Figure is for illustration only. Image has been scanned; scale may be inaccurate.

Figure 4. NTTR Supporting Airfields and Facilities



Source: USAF 1999a, Figure 3.1-3, p. 3.1-11.
Note: Figure is for illustration only. Image has been scanned; scale may be inaccurate.

Figure 5. Federal (Victor) Airways, Jet Routes, and Airports within the YMP Region

unless large mission employment exercises need additional airspace for staging purposes (USAF 1996, Section 1.2.3.2). The closest boundary of the Reveille MOA is about 71 miles from the North Portal at Yucca Mountain (NIMA 2001).

5.1.1.2 Desert Military Operations Area

The Desert MOA is the eastern half of the NTTR and is active with military traffic during daylight hours Monday through Saturday, and by Notice to Airmen during other hours. It is divided into the following four subsections. Information reproduced in this section can be found in USAF (1999a, pp. 3.1-4 and 3.1-5). As shown in Appendix B Table B-1, training will generally occur between 300 feet AGL and 50,000 feet AMSL to avoid mountain ranges in the area.

- **Sally** corridor is a transition route between Nellis Air Force Base (AFB) and portions of the NTTR (see Figure 6 for an illustration of information found in *Weapons Range Management* [USAF 1996, Section 1.2.4.2.5]). The closest boundary of the Sally corridor to a repository surface facility is about 64 miles (NIMA 2001).

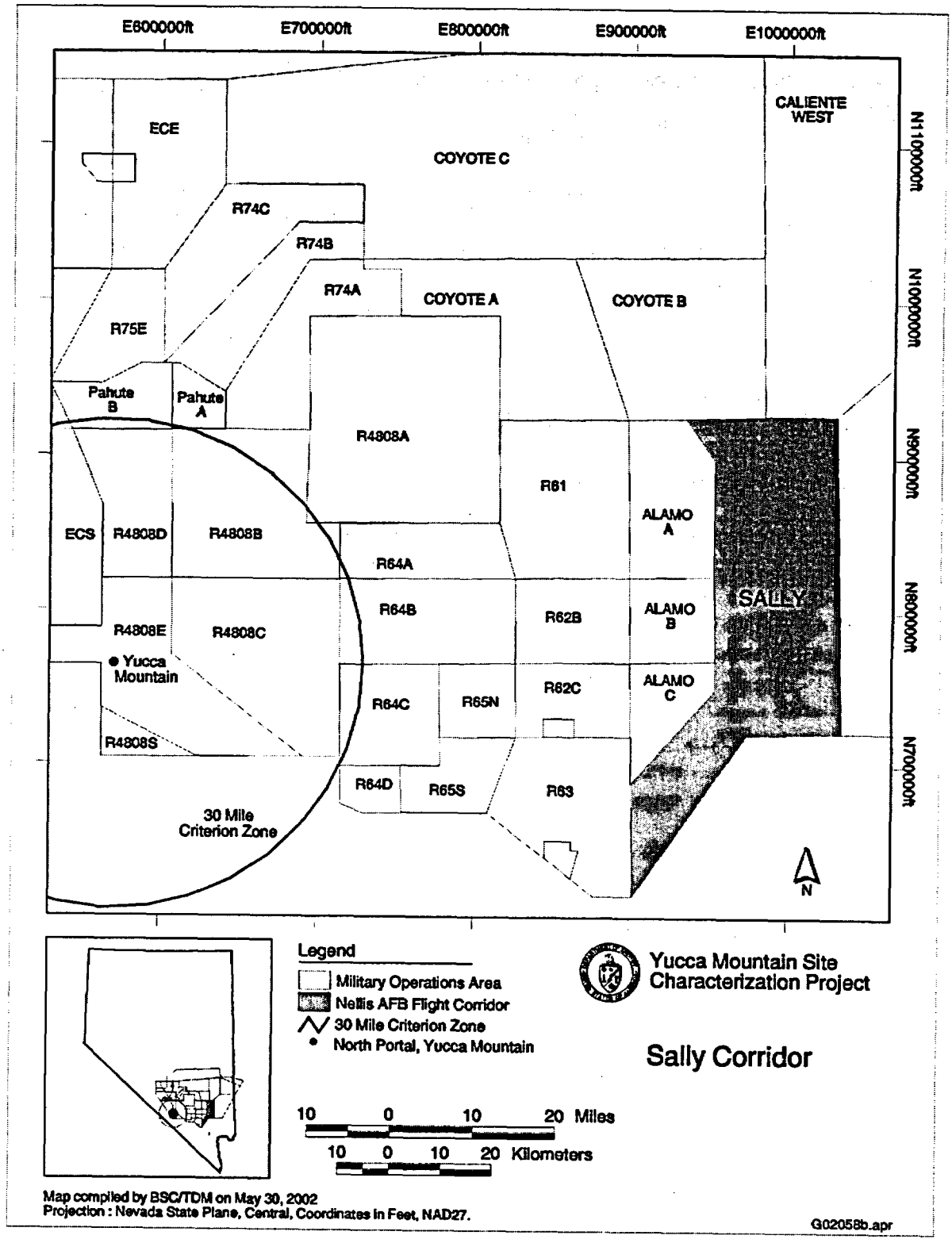
- **Elgin** is primarily an air-to-air training area and contains the Nellis training range which, through a system of aircraft transmitters and ground receivers, allows recording of flight maneuvers for real-time flight monitoring and later replay and flight debriefing. It is normally entered and exited via the Sally Corridor. The closest boundary of the Elgin MOA to a repository surface facility is about 88 miles (NIMA 2001).

- **Caliente** is primarily an air-to-air training area with west entry/exit via Sally corridor and east entry/exit via military training routes (MTRs) or Sally corridor. The Cedar ATCAA overlies the northern portion of Caliente. The closest boundary of the Caliente MOA to a repository surface facility is about 84 miles (NIMA 2001).

- **Coyote** provides airspace for tactical training maneuvers. The closest boundary of the Coyote MOA to a repository surface facility is about 55 miles (NIMA 2001).

- **Range 75** is located in the central portion of R-4807A and contains numerous targets consisting of missile sites, convoys, signal platoons, air defense artillery units, infrared targets, and other array targets. The closest boundary of Range 75E/W to a repository surface facility is about 34 miles (NIMA 2001).

- **Range 76** is located in west central R-4807A and contains numerous targets consisting of airfields, missile sites, industrial areas, a railroad complex, convoys, command and control centers, and tank arrays designed for infrared training. Live ordnance is allowed on some targets and inert training ordnance is allowed on all targets. Manned threat emitters are sometimes located in these zones. The closest boundary of Range 76 to a repository surface facility is about 33 miles (NIMA 2001).



Source: USAF (1999a, pp. 3.1-4 and 3.1-5). See Section 5.1.1.2.

Figure 6. Sally Corridor

5.1.2 Restricted Areas and Range Subsections

A restricted area is airspace wherein the flight of aircraft, while not wholly prohibited, is subject to restrictions during scheduled periods when hazardous activities are being performed. Restricted airspace may be designated as joint use, whereby non-participating civil or military aircraft may be routed through this airspace by air traffic control when there is no conflict with scheduled activities. If not designated as joint use, non-participating aircraft are normally not permitted at any time. Within the NTTR, restricted areas R-4806, R-4807, and R-4808S are joint use and R-4808N and R-4809 are not joint use. The restricted areas of the NTTR are divided into the North Range and the South Range. These two ranges are separated by the Nevada Test Site (NTS). The restricted areas and range subsections have recently been modified. No modifications are being considered in the near future. Information reproduced in this section can be found in USAF (1999a, pp. 1-16 to 1-21 and 3.1-3).

5.1.2.1 North Range

The North Range is approximately 1.8 million acres of withdrawn land. It contains four unmanned weapons delivery subranges, three electronic combat ranges, the TTR, and Pahute Mesa, which is used by DOE. The four unmanned subranges contain over 1,000 targets within over 100 tactical target complexes and threat sites as shown on Figure 7.

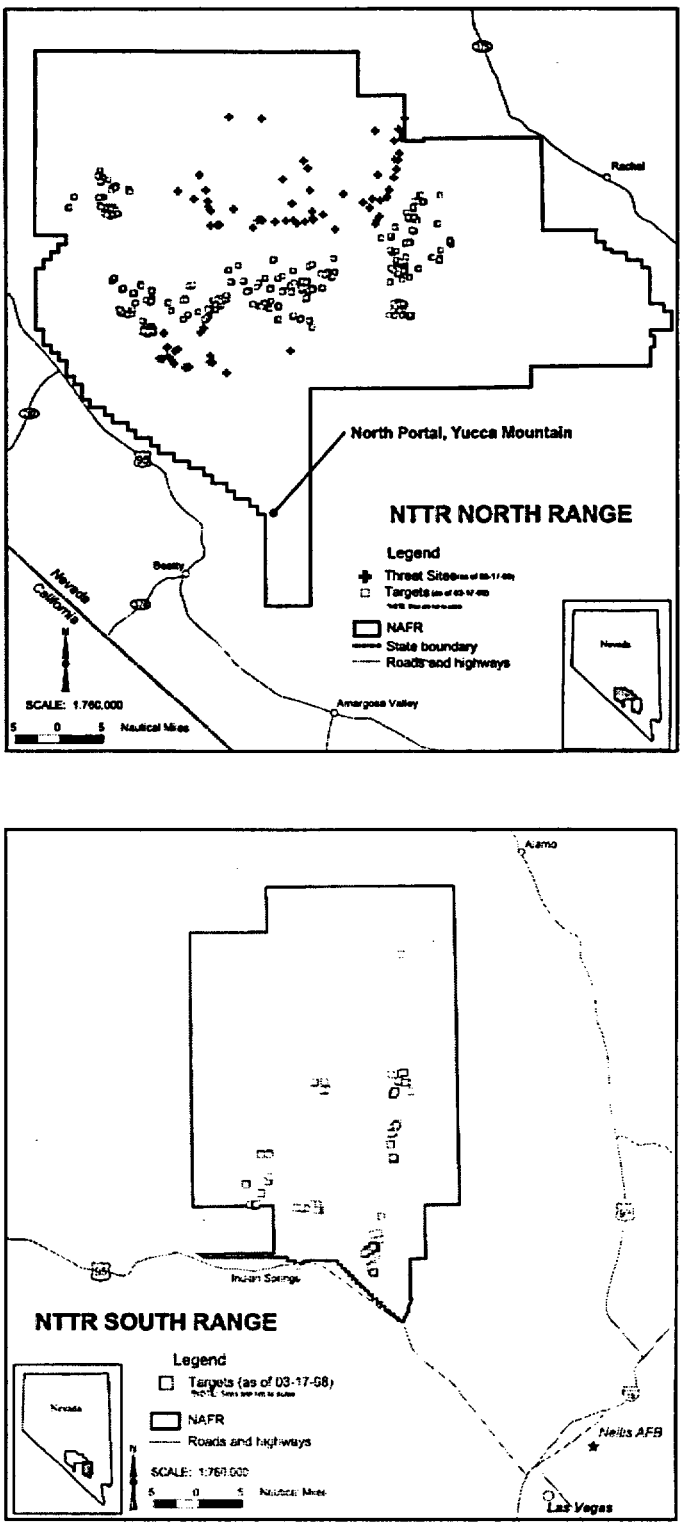
A description of the target and threat sites can be found in *Weapons Range Management* (USAF 1996, Sections C and D), and Figure 7 is an illustration of those sites (USAF 1999a, pp 1-22 and 1-23). The types of weapons used are described in Section 5.1.4. The subranges are shown on Figure 2 and described below (USAF 1999a, pp. 1-16 to 1-21).

5.1.2.1.1 R-4807A

R-4807A includes the 70 Series ranges (see Figure 2) and the Electronic Combat Ranges (ECRs) and is divided into several subsections as described below (USAF 1999a, pp. A-8 and A-9).

- **Range 71** is located in the northwest corner of R-4807A and contains aircraft targets. It is subdivided into Range 71N and 71S. The closest boundary of Range 71N/S to a repository surface facility is about 52 miles (NIMA 2001).

- **Range 74** is located in the eastern portion of R-4807A and is divided into three subareas; 74A, 74B, and 74C. Range 74A contains no targets. Ranges 74B and 74C contain numerous tactical targets. The closest boundaries of Range 74A and 74B/C to a repository surface facility are about 32 and 36 miles respectively (NIMA 2001).



Source: See Section 5.1.2.1.

Figure 7. NTTR Targets and Threat Sites

- **Tolicha Peak** ECR is a manned electronic combat threat simulator range located in the southwest corner of R-4807A (USAF 1996, Section 1.19). There are no bombable targets and no ordnance is expended on this range. The closest boundary of the Tolicha Peak ECR to a repository surface facility is about 30 miles (NIMA 2001).

- **Tonopah** ECR is a manned electronic combat threat simulator range located in the eastern portion of R-4809 and the northern portion of R-4807A (EC East and EC West on Figure 2). No bombable targets are located within this range; therefore, aircrews are prohibited from expending ordnance anywhere within the range complex. The closest boundary of the Tonopah ECR to a repository surface facility is about 49 miles (NIMA 2001).

- **EC South Range** is an electronic combat range located in the southwest corner of R-4807A. It is divided into eastern and western areas and is a manned electronic combat threat simulator range containing no bombable targets. Aircrews are prohibited from dropping any ordnance anywhere within the EC South range. The eastern area extends from the surface to 13,000 feet AMSL to allow overlying corridor (Caesar Corridor) above 14,000 feet AMSL to transition aircraft from the northern ranges for recovery to Nellis AFB. The closest boundary of EC South to a repository surface facility is about five miles (NIMA 2001).

5.1.2.1.2 R-4807B

R-4807B (Pahute Mesa) is used by DOE as an annex to the Nevada Test Site in support of the nation's nuclear weapons test program and the United States Air Force (USAF) uses the airspace for overflights. Helicopter traffic extends up to 500 feet AGL (USAF 1999a, p. A-9). The closest boundary of R-4807B to a repository surface facility is about 30 miles (NIMA 2001). Information reproduced in this section can be found in USAF (1999a, p. A-9).

5.1.2.1.3 R-4809

R-4809 contains EC threat simulators and equipment used by Sandia Corporation for DOE. The TTR Airfield, located within R-4809A, can be used as a divert base for in-flight emergencies. The closest boundary of the TTR to a repository surface facility is 49 miles (NIMA 2001). Information reproduced in this section can be found in USAF (1996, Section 1.22).

5.1.2.2 Nevada Test Site

The NTS, operated by the DOE as the nation's on-continent nuclear weapons test site, is protected by restricted areas R-4808N and R-4808S. R4808N is designated non-joint use by the FAA and the DOE retains exclusive, continuous control. R4808S was created as a joint-use area to permit joint use by the NTS, Nellis Air Traffic Control Facility, and the FAA Los Angeles ATRCC (USAF 1996, Sections 1.26.1 and 1.27.1). The NTS airspace R-4808 is controlled by DOE for NTS activities and is not part of the NTTR. However, agreements with the USAF and the FAA allow specific uses by military and civilian aircraft. Since these uses are closely related to the NTTR, they will be described here.

The DOE allows military aircraft to transit R-4808 across the NTS for entry/exit into the NTTR ranges north of the NTS. As seen on Figure 8, the NTS corridor runs south of the NTTR between Nellis AFB and various entry/exit points over the NTS allowing some flights over the area where repository surface facilities may be located. Aircraft flying through the R-4808 airspace are not assigned to fly in specific corridors.

5.1.2.2.1 R-4808S

R-4808S is used jointly by the NTS, Nellis AFB, and the FAA Los Angeles Air Route Traffic Control Center to accommodate DOE activities and permit military and civilian aircraft to overfly the southwest corner of R-4808. The closest boundary of R-4808S to a repository surface facility is about seven miles (NIMA 2001).

5.1.2.2.2 R-4808N

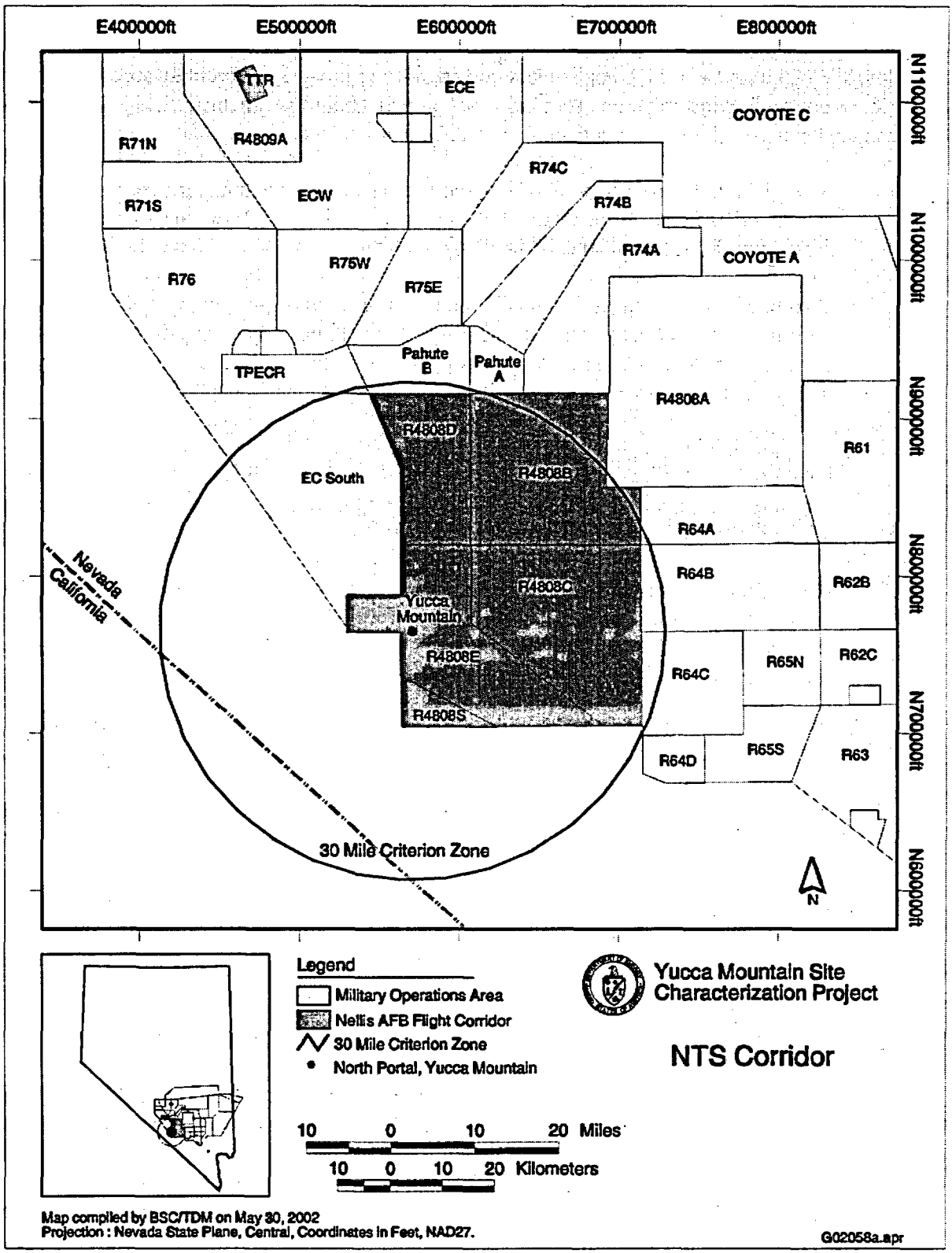
R-4808N is divided into R-4808A, R-4808B, R-4808C, R-4808D, and R-4808E and is controlled by the DOE. Nellis AFB is allowed to use R-4808B through R-4808E and R-4808S to transition aircraft from Nellis AFB to the NTTR (see Figure 8). The recommended site for a repository surface facility (i.e., Yucca Mountain) is located in R-4808E. R-4808A is not used for NTTR flight training operations and any overflights are restricted to emergency aircraft and other DOE approved missions subject to restrictions. The closest boundary of this area to a repository surface facility is about 32 miles.

5.1.2.3 South Range

The South Range is approximately 1.2 million acres of withdrawn land. It contains five weapons-delivery areas, which are subdivided into over 40 target complexes containing almost 300 targets as shown on Figure 7 (USAF 1999a, Figure 1-7, p. 1-23). These areas include two manned subranges and three unmanned subranges. The types of weapons used are described in Section 5.1.4. The subranges are shown on Figure 2 and described below. Information in this section was obtained from USAF (1999a, p. 1-21).

5.1.2.3.1 R-4806E

R-4806E (Alamo), located west of Sally, is primarily an air-to-air training area, with entry and exit via the Sally corridor. It consists, from north to south, of Alamo Alpha, Alamo Bravo, and Alamo Charlie. There are no targets in Alamo Alpha, Bravo, or Charlie. Information in this section was obtained from USAF (1996, Section 1.18). The closest boundary of the Alamo range to a repository surface facility is about 62 miles (NIMA 2001).



Source: NIMA 2001. See Section 5.1.1.2.

Figure 8. NTS Corridor

5.1.2.3.2 R-4806W

R-4806W contains the 60 Series Ranges and is divided into 11 different subsections that are used for conventional bombing and gunnery testing and training. Information in this section was obtained from USAF (1996, Sections 1.4 to 1.9).

- **Range 61** is located in R-4806W (see Figure 2) and contains anti-personnel interdiction targets utilized by helicopters. The closest boundary of Range 61 to a repository surface facility is about 50 miles (NIMA 2001).

- **Range 62** is located in R-4806W (see Figure 2) and contains targets for attack aircraft include bomb circles, an airfield, supply area, convoys, antiaircraft artillery sites, a surface-to-air missile site, and a cluster bomb unit. The closest boundary of Range 62B/C to a repository surface facility is about 48 miles (NIMA 2001).

- **Range 63/63A** is a manned bombing range located in the southern portion of R-4806W (see Figure 2). The range can accommodate live or inert, conventional, and nuclear training air-to-ground deliveries. The closest boundary of Range 63/63A to a repository surface facility is about 48 miles (NIMA 2001).

- **Range 65** is a manned bombing range located in R-4806W (see Figure 2). The range contains several tactical targets. The USAF Air Demonstration Squadron (Thunderbirds) frequently practices in this area. The closest boundary of Range 65 to a repository surface facility is about 37 miles (NIMA 2001).

- **Range 64A and D** are located in the western portion of R-4806 and are used primarily as training areas for helicopter operations and a transition area for aircraft going into R-65. No ordnance is authorized in R-64A. The closest boundary of Range 64A to a repository surface facility is about 29 miles; and the closest boundary of Range 64D to a repository surface facility is about 30 miles (NIMA 2001).

- **Range 64B and C** are located in the western portion of R-4806 and contain tactical targets such as tanks, convoys, and simulated antiaircraft artillery/missile sites. The closest boundary of Range 64B and C to a repository surface facility is about 27 miles (NIMA 2001).

5.1.3 Aircraft Operating at the Nevada Test and Training Range

This section identifies typical aircraft and their missions that are currently or projected to be operational (USAF 1999a, pp. 1-45 to 1-50). The NTTR airspace used for the different missions flown by each aircraft is provided in Appendix B. The missions and aircraft configurations described in Appendix B are intended to be representative of ongoing activities in the NTTR. Aircraft testing and training in the NTTR will change as different needs are addressed and new weapons systems are introduced.

5.1.3.1 Current Aircraft

5.1.3.1.1 F-15C Eagle

The F-15C Eagle is an air-to-air fighter that carries heat-seeking and radar-guided missiles, a cannon, an array of complex avionics, and a powerful radar (USAF 1999a, p. A.3-3).

5.1.3.1.2 F-15E Strike Eagle

F-15E Strike Eagle is a variation of the F-15 fighter with the addition of a weapons system officer located behind the pilot; large fuel tanks molded to the fuselage; sophisticated avionics that permit low-altitude, all-weather precision strikes; and various bomb loads.

5.1.3.1.3 F-16C/D Fighting Falcon

F-16C/D Fighting Falcon is a highly maneuverable, single-engine strike fighter. With an attached low altitude navigation tracking infrared for night (LANTIRN) pod, it can fly low-altitude night attack missions. It is also equipped to suppress enemy air defenses.

5.1.3.1.4 A-10 Thunderbolt II

A-10 Thunderbolt II was designed specifically to defeat enemy armored vehicles. The A-10 is built around a large 30-mm GAU-8/A Gatling gun equipped with armor-piercing projectiles. The aircraft has titanium armor, two engines, and redundant control systems. Designed to fly at low altitudes, it carries a wide range of electronic warfare pods and external weapons, including air-to-air missiles. The OA-10 is a variant of the A-10 Thunderbolt, and is flown in the same training missions as the A-10.

5.1.3.1.5 HH-60G Pave Hawk

HH-60G Pave Hawk is a variant of the Black Hawk utility helicopter configured to provide combat search and rescue and other support missions. It is equipped with sophisticated navigational gear and an air refueling system and removable long-rang internal fuel tanks for rapid-response, long-range rescue missions.

5.1.3.1.6 Predator Unmanned Aerial Vehicle

Predator unmanned aerial vehicle (UAV) is an unmanned aerial vehicle used for reconnaissance, surveillance, and target acquisition. The UAV performs a variety of reconnaissance, surveillance, target acquisition, and battle damage assessment missions. Predator provides real-time images of the battlefields or targets. Several other versions are under development.

5.1.3.1.7 B-52H Stratofortress

B-52H Stratofortress is a long-range, high altitude strategic bomber with eight engines. B-52Hs fly in the NTTR when participating in large-force exercises such as Red Flag/Green Flag and the Mission Employment/Strike phases of B-52 Weapons School.

5.1.3.1.8 B-1B Lancer

B-1B Lancer is a supersonic low-altitude bomber that carries a large internal bomb load and can fly low altitude in all weather. B-1Bs fly in the NTTR when participating in large-force exercises such as Red Flag/Green Flag and the Mission Employment/Strike phases of B-1B Weapons School.

5.1.3.1.9 B-2 Spirit

B-2 Spirit is a stealth technology, long-range, penetrating bomber. The B-2 was originally conceived as a highly survivable strategic bomber with a large nuclear bomb load. The USAF focus is now on the conventional capabilities of the bomber. The B-2 has a crew of two pilots.

5.1.3.1.10 Other Aircraft that May Participate in Red Flag

- KC-135R Stratotanker for airborne refueling
- KC-10A Extender for airborne refueling
- C-141 Starlifter for cargo and troop transport (retirement expected by 2006)
- C-17A Globemaster III for cargo and troop transport
- C-130 Hercules provides transport, tanker, gunship, communications, command and control
- E-3 Sentry for airspace command and control of aircraft using NTTR
- E-8C Joint-STARS provides a flying radar system on a Boeing 707 airframe
- RC-135 River Joint provides surveillance to monitor enemy electronic activity
- F-117A Night Hawk (stealth fighter) carries two laser-guided bombs
- EA-6B Prowler provides electronic warfare capability
- F/A-18C/D Hornet, the Navy and Marine twin-engine jet fighter
- AV-8B Harrier, a Marine short-takeoff and vertical-landing aircraft
- F-14 Tomcat, a Navy swing-wing fighter
- Tornado, supersonic swing-wing aircraft used by foreign air forces
- F-4 Phantom, twin-engine fighter-bomber used by foreign air forces
- Mirage 2000, a French-built fighter bomber used by foreign forces

5.1.3.2 Future Aircraft

Three aircraft have been identified by the *Renewal of the Nellis Air Force Range Land Withdrawal: Legislative Environmental Impact Statement* (USAF 1999a, Section 1.6.2) as possible aircraft that may be used in future NTTR operations.

5.1.3.2.1 F-22 Raptor

The F-22 Raptor will combine stealth, high speed, and sophisticated avionics to eventually replace the many functions of the F-15. It is able to cruise at supersonic speeds without the use of afterburners.

5.1.3.2.2 Joint Strike Fighter

The Joint Strike Fighter is a stealth strike fighter that will replace the USAF F-16 and other similar Navy, Marine, and British Royal Navy aircraft.

5.1.3.2.3 Unmanned Combat Aerial Vehicles

Unmanned Combat Aerial Vehicles are being developed that are capable of undertaking combat operations while being flown by a pilot in a remote location.

5.1.4 Ordnance Used at the Nevada Test and Training Range

A list of typical ordnance that could be carried by aircraft in the NTTR is provided in Appendix C. Ordnance can be considered captive or launchable, may contain explosives and penetrators or be dummies/blanks, and may be armed or unarmed. The configuration of the weapons systems for each aircraft and mission is provided in Appendix B. Summary descriptions of each class of ordnance is provided in the following sections (USAF 1999a, pp. 1-50 to 1-54).

USAF (2001b, Section 4.3.1) states that the range operating agency must ensure that weapon safety footprints exist for all aircraft, weapons, and tactics authorized for a given target and event on the range. The Safe-Range Program Methodology uses a weapon safety footprint area defined in USAF (2001c, Attachment I) as a closed contour that defines the land area containing 99.99 percent (at a 95 percent confidence level) of all initial impacts and ricochets, resulting from the release of a specified weapon type during air-to-surface weapon delivery events.

5.1.4.1 Air-to-Ground Ordnance

Air-to-Ground Missiles—Deployment of air-to-ground missiles occurs in the 60 Series and 70 Series ranges as part of the weapons missions of various aircraft. Rockets (i.e., 2.75-inch and 5.0-inch) are used by helicopters and attack aircraft. Bombers are equipped to test cruise missiles, which are long-range, subsonic missiles that are programmed for precision attack on surface targets. Air-to-ground missiles are described in Appendices A and C.

Bombs—Training exercises using bombs are also conducted in the 60 Series and 70 Series ranges. General-purpose bombs (i.e., steel cases, filled with high explosives, fuzes at each end, and fins for stabilization in flight), general purpose bombs fitted with a glide bomb unit (GBU) kit (i.e., laser seeker and control section attached to the front of the warhead and a set of steerable fins attached to the end of the weapon), and cluster bombs (i.e., bombs that break up in mid-air spreading the sub-munitions over wide areas). These bombs are further described in Appendices A and C.

5.1.4.2 Air-to-Air Missiles

Training occurs on the NTTR with a variety of captive missiles but due to safety concerns, NTTR does not support the actual launching of air-to-air missiles. NTTR does support high-fidelity simulated missile employment. Air-to-air missiles are described in Appendices A and C.

5.1.4.3 Next-Generation Ordnance

The ordnance described previously will be augmented on an ongoing basis as research and development operations identify new weapons for testing and training. The NTTR will ensure that weapon safety footprints exist for all weapons used on the NTTR.

5.1.4.4 Chaff and Flares

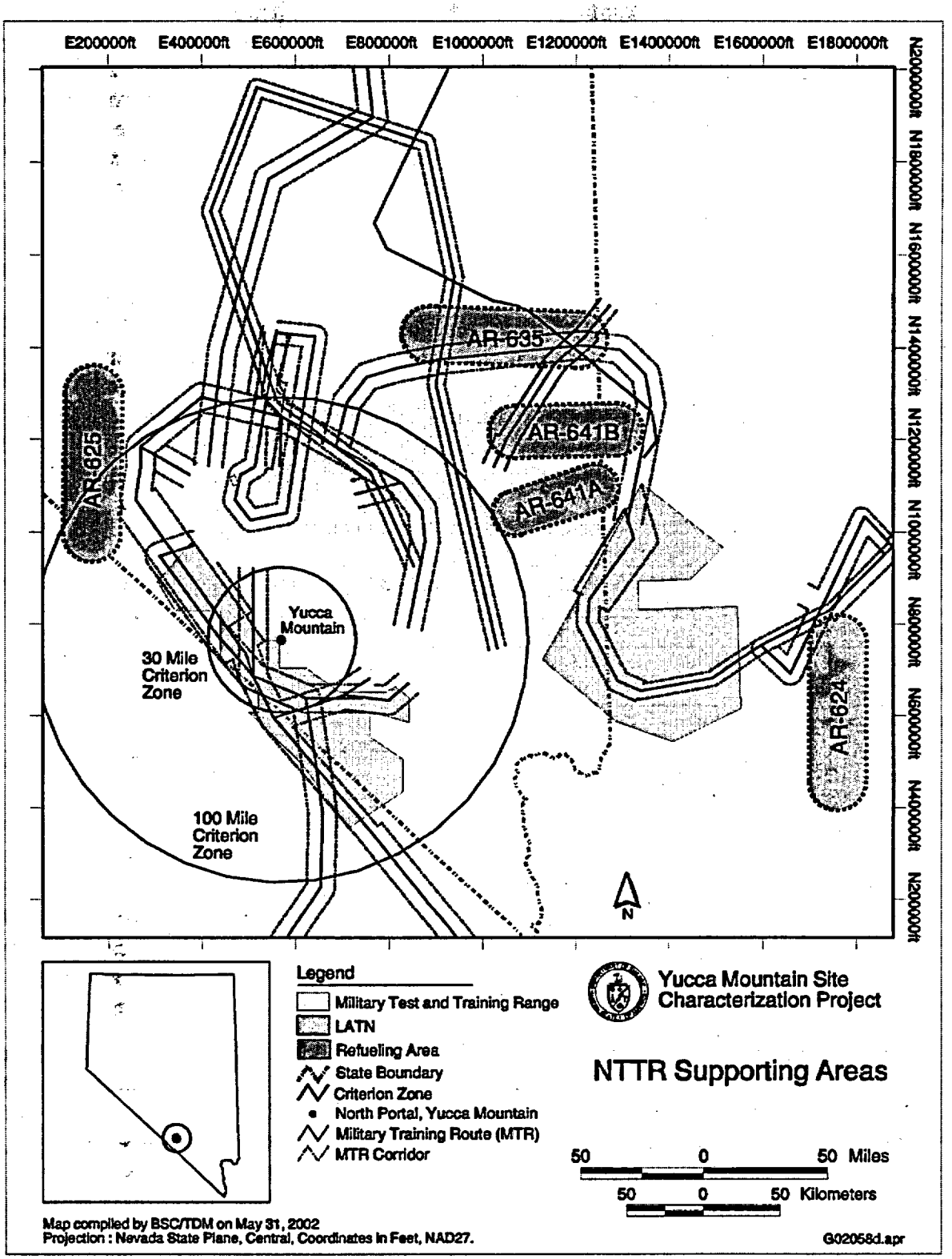
Although not considered ordnance, chaff and flares are carried and released by aircraft flying in the NTTR. Chaff consists of small fibers that reflect radar signals to temporarily hide the aircraft from radar detection. Flares provide high-temperature heat sources ejected from aircraft that mislead heat-sensitive or heat-seeking targeting systems.

5.2 AIRSPACE AREAS THAT SUPPORT NTTR

The general locations of airspace areas that support NTTR are shown on Figure 9. These include low altitude training navigation areas (LATNs), MTRs, and air refueling tracks. Figure 9 is an illustration of information that can be found in *Nevada Test and Training Range Chart* (NIMA 2001) and *Area Planning Military Training Routes North and South America* (DOD 2002a, p. 4-2).

5.2.1 Low Altitude Training Navigation Areas

LATN areas are unrestricted airspace areas established on the east and southwest sides of the NTTR for A-10s and helicopters to practice random selection of navigation points and low altitude tactical formations between 100 and 1,500 feet AGL and at speeds below 250 knots (USAF 1999a, p. 3.1-8) (see Figure 9). These areas are normally used when no airspace is



Source: NIMA 2001, DOD 2002a. See Section 5.2.

Figure 9. NTTR Supporting Areas

available for this type of training within the NTTR complex. LATNs are not depicted on aeronautical charts; however, local airports and aviation groups have been advised of their existence and associated operations. About 40 to 50 sorties are conducted weekly in the LATN by Nellis AFB A-10 units and 75 percent of these sorties are in the southwest LATN. Those areas to the east of the NTTR are about 106 miles from a repository surface facility, and those areas to the southwest are more than one mile from a repository surface facility (NIMA 2001).

5.2.2 Military Training Routes

MTRs permit military flight training at airspeeds in excess of 250 knots below 10,000 feet AMSL while providing training in low altitude tactics and navigation (USAF 1999a, pp. 3.1-5 to 3.1-8). MTRs are established as IFR routes (IRs) or visual flight rules (VFR) routes (VRs). MTRs in the region have floor segments as low as 100 feet AGL, but they are normally flown between 500 and 1,000 feet AGL. Five MTRs exist within NTTR restricted airspace. Table 1 is a reproduction of the information provided in *Renewal of the Nellis Air Force Range Land Withdrawal* (USAF 1999a, Table 3.1-1, p. 3.1-8) and identifies these five routes, the scheduling agency, portion of the route within restricted airspace, and the estimated annual sorties.

Table 1. Military Training Routes that Access Nevada Test and Training Range

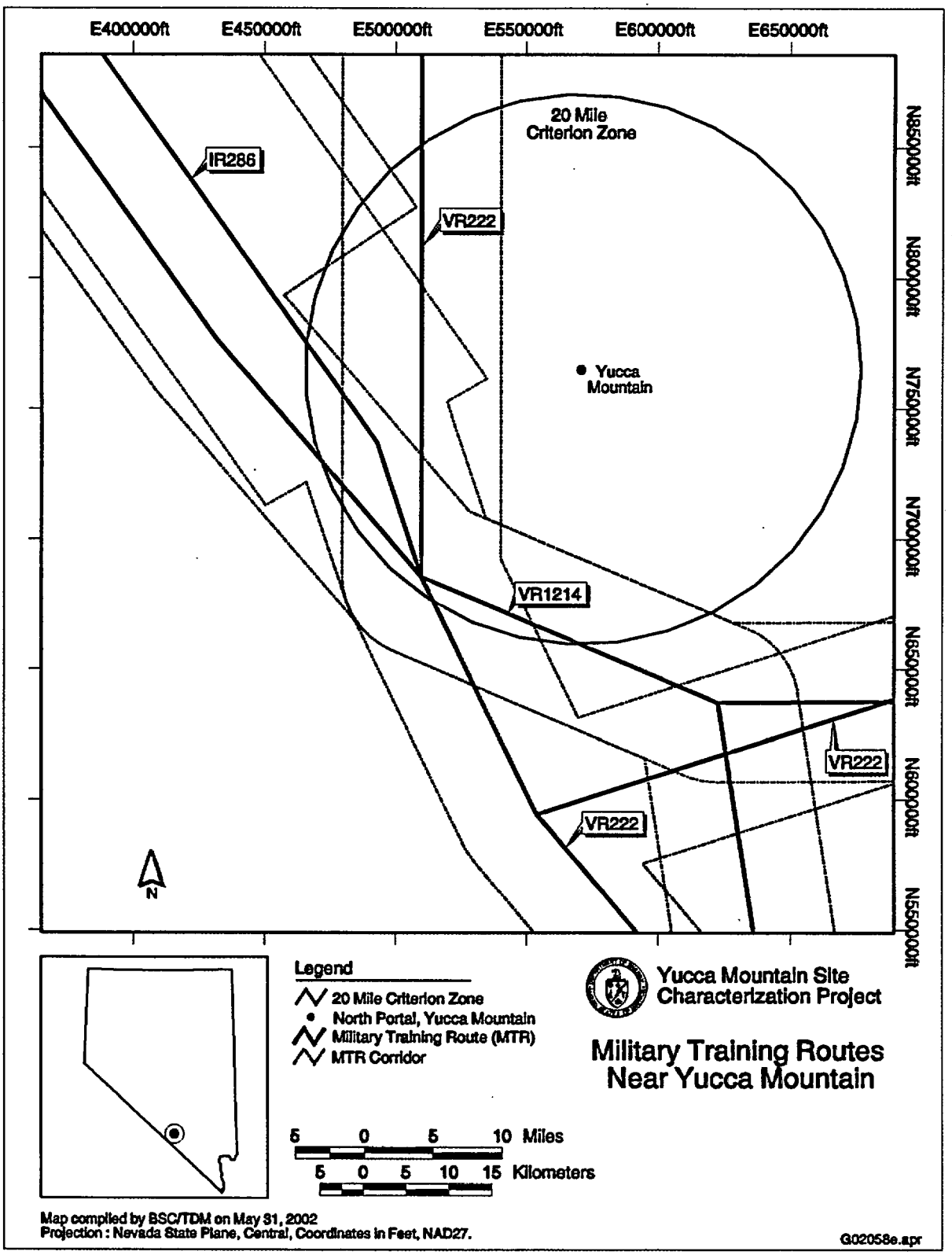
MTR	Scheduling Agency	NTTR Airspace Accessed	Estimated Annual Sorties
IR-286	Nellis AFB	Final segment in R-4806W	21
VR-222	Nellis AFB	Final segment in R-4807A	550
VR-1214	Edwards AFB	Last segment enters R-4807A	300
IR 279	Offutt AFB	Last segment enters R-4809	115
IR 282	Mountain Home AFB	Last segment enters R-4807A	12

Source: USAF 1999a, Table 3.1-1, p. 3.1-8.

Some of the MTR routes may be used when ingressing/egressing NTTR range target areas, during routine training and exercise. Of the five MTRs, three located west of the NTTR near the North Portal at Yucca Mountain are described in more detail below and shown on Figure 10. Detailed descriptions of MTRs are provided in *Area Planning, Military Training Routes, North and South America* (DOD 2002a).

5.2.2.1 IR-286

IR-286 is scheduled by Nellis AFB. The distance from the North Portal at Yucca Mountain to the IR-286 centerline is 14 miles (NACO 2002a) and the width on either side of its centerline is eight nautical miles (9.2 miles) (DOD 2002a, p. 1-98). This places the closest edge of the MTR approximately five miles from the North Portal at Yucca Mountain. See Figure 10.



Source: DOD 2002a, pp 1-98, 2-38, and 2-129.

Figure 10. Military Training Routes Near Yucca Mountain

5.2.2.2 VR-222

VR-222 is scheduled by Nellis AFB. The distance from the North Portal at Yucca Mountain to the VR-222 centerline is ten miles (NACO 2002a) and the width on either side of its centerline is five nautical miles (5.8 miles) (DOD 2002a, 2-38). This places the closest edge of the MTR approximately four miles from the North Portal at Yucca Mountain. See Figure 10.

5.2.2.3 VR-1214

VR-1214 is scheduled by Edwards AFB (USAF 1999a, Appendix A.2). The distance from the North Portal at Yucca Mountain to the VR-1214 centerline is 19 miles (NACO 2002a) and the width on either side of its centerline is five nautical miles (5.8 miles) (DOD 2002a, 2-129). This places the closest edge of the MTR approximately 13 miles from the North Portal at Yucca Mountain. See Figure 10.

5.2.3 Air Refueling Tracks

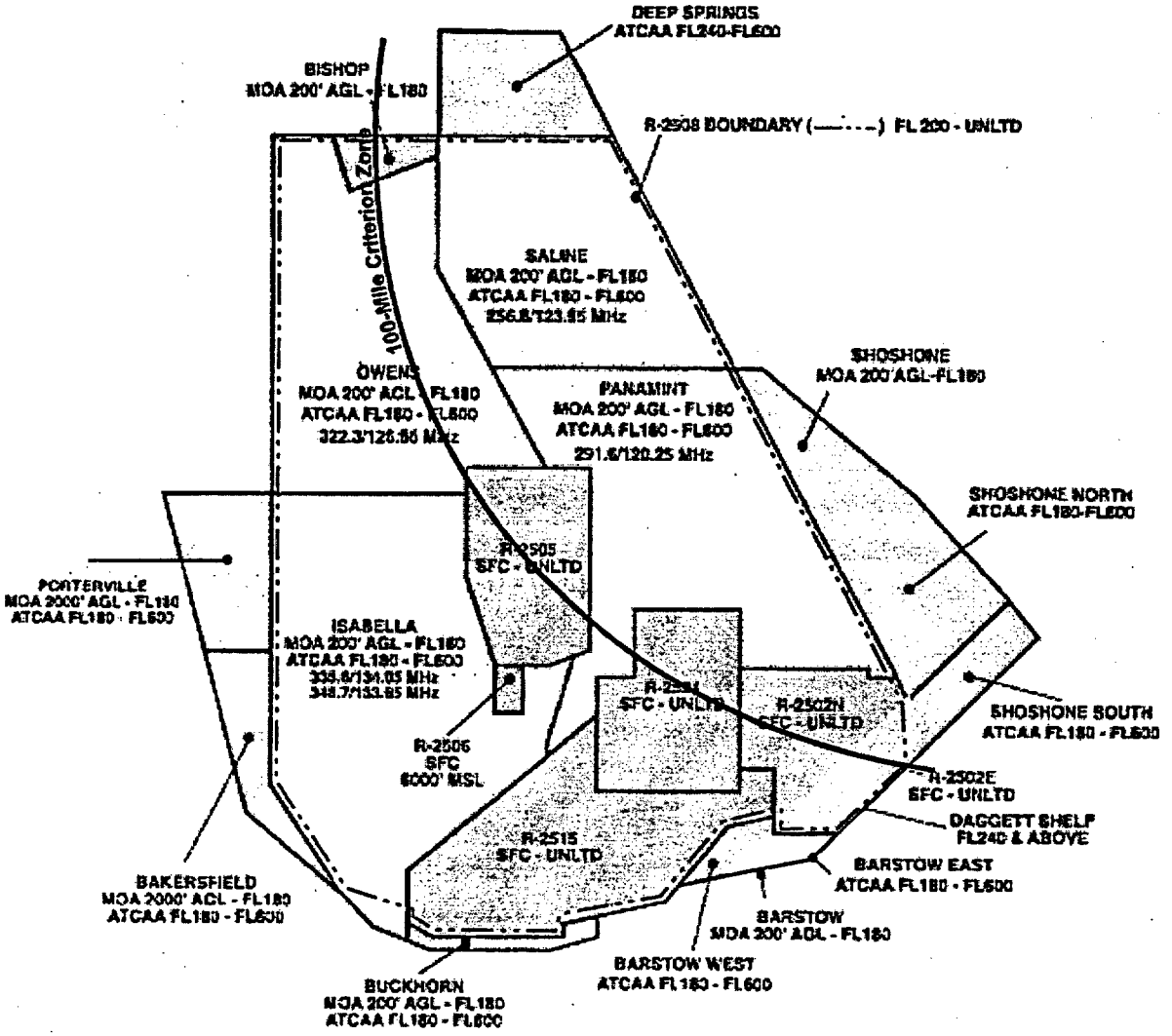
Air refueling (AR) tracks consist of roughly rectangular blocks of airspace that are used to refuel aircraft. ARs in the general area are shown on Figure 9 (DOD 2002a, p. 4-2). Those ARs within or immediately adjacent to the NTTR complex used to sustain aircraft operations during training activities/exercises are listed in the following paragraphs (USAF 1999a, p. 3.1-9). Three other AR tracks (AR-624, AR-641B, and AR-635) support NTTR operations, but are outside the 100-mile regional setting of this report.

- **AR-625H and AR-625L**—are located near the northwest corner of the NTTR complex. The closest edge of AR-625 to a repository surface facility is approximately 78 miles to the west. See Figure 9.

- **AR-641A**—is located within the Desert MOA and ATCAA (USAF 1999a, Section A-2.2.3). This AR cannot be used simultaneously with AR-641B. The closest edge of AR-641A to a repository surface facility is about 99 miles to the northeast.

5.3 R-2508 COMPLEX

A large area of airspace, referred to as the R-2508 Complex, exists to the west and southwest of Yucca Mountain and is composed of MOAs and ATCAAs (see Figure 11). The R-2508 Complex includes the airspace and associated land presently used and managed by Edwards AFB, National Training Center, Fort Irwin, and Naval Air Warfare Center Weapons Division, China Lake (USAF 2001a, Section 2.3). Figure 11 is an overview of this airspace. The airspace is divided both horizontally and vertically with MOAs being overlapped by ATCAAs and restricted areas.



Source: USAF 2001a.

Figure 11. Overview of R-2508 Complex Airspace

The MOAs and ATCAAs combine with R-2508 to form four major work areas (USAF 2001a, Section 7.1.2). Peripheral areas made up of MOAs and ATCAA airspace increases the size of the usable airspace. Typical operations within the R-2508 Complex include (USAF 2001a, Section 7.2):

- Aircraft research and development in all stages of flight
- Operational weapons test and evaluation flights
- Student pilot training
- Air combat maneuvering and proficiency flights

- Civilian test aircraft in direct support of U.S. Department of Defense and/or defense training.

5.3.1 R-2508 Complex Military Operations Areas

The four major MOAs within the lateral boundaries of the R-2508 Complex are shown on Figure 11 and described below.

5.3.1.1 Isabella

Isabella is more than 100 miles from the North Portal at Yucca Mountain and is not included in this evaluation.

5.3.1.2 Owens

Owens is made up of the Owens MOA and the Owens ATCAA (USAF 2001a, Section 4.2). The area includes crossing of several MTRs and marshalling or holding points for large-scale strikes departing AR625 and R-2508 in addition to the typical operations listed in Section 5.3. The closest edge of the Owens MOA is located about 78 miles from the North Portal at Yucca Mountain.

5.3.1.3 Saline

Saline is made up of the Saline MOA and the Saline ATCAA (USAF 2001a, Section 4.3). The area includes low and high-altitude refueling activities (Saline Valley), crossing of several MTRs, and special platform aircraft orbits in addition to the typical operations listed above (see Figure 12). The closest edge of the Saline MOA is located about 36 miles from the North Portal at Yucca Mountain.

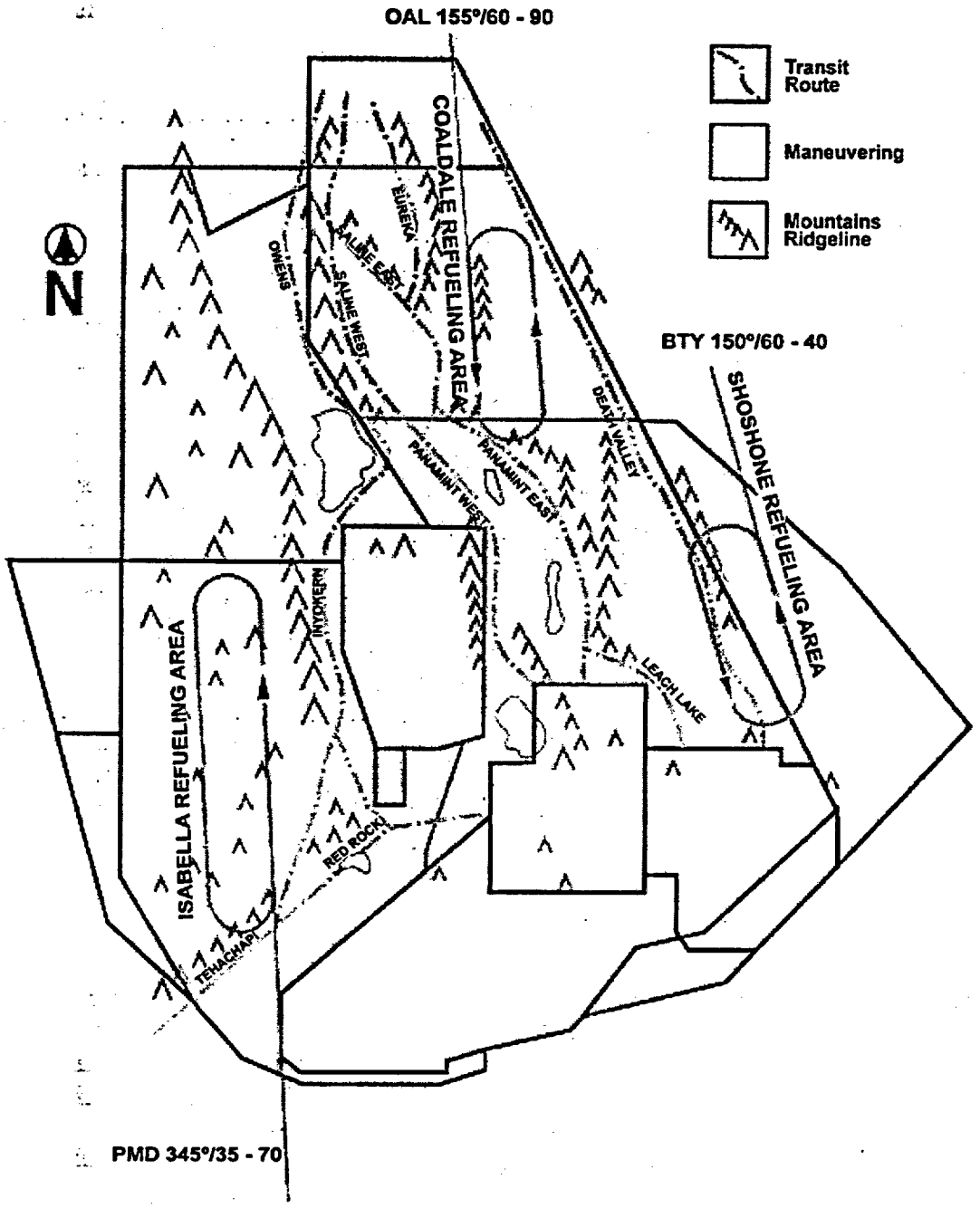
5.3.1.4 Panamint

Panamint is made up of the Panamint MOA and the Panamint ATCAA (USAF 2001a, Section 4.4). This area includes low and high-altitude refueling, crossing of several MTRs, low altitude training, large scale exercises, and support of R-2502N, R-2502E, and R-2524 operations by Nellis AFB, Naval Air Weapons Station China Lake, Fresno ANG, and Edwards AFB.

The closest edge of the Panamint MOA is located about 36 miles from the North Portal at Yucca Mountain.

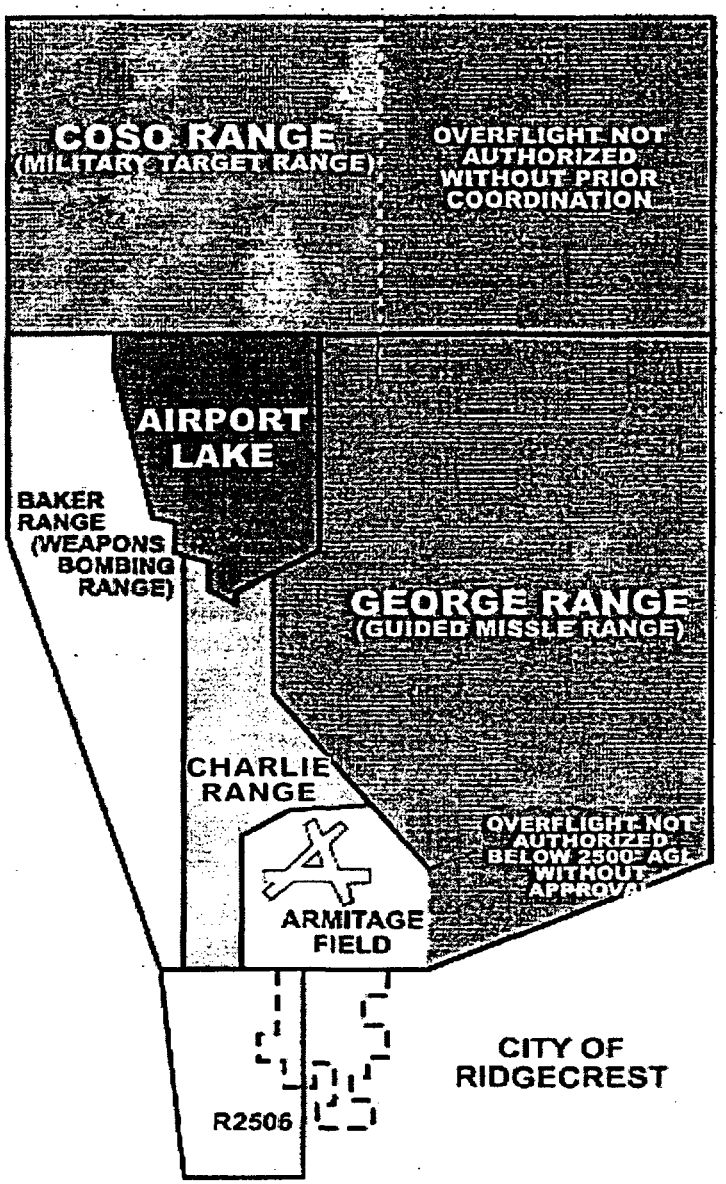
5.3.2 R-2505

R-2505 airspace is restricted on a continuous basis and is subdivided into five primary ranges shown on Figure 13. The primary mission of these ranges is the research, development, test, and evaluation of weapons and weapons systems. R-2505 includes six bombing ranges, one guided-missile range, and numerous ground ranges and arenas. The six bombing ranges contain instrument targets for air-to-air, air-to-ground, and surface-to-air firings. Remotely piloted aircraft with no live operator on board are sometimes used as targets. Information in this section



Source: USAF 2001a.

Figure 12. R-2508 Complex Refueling Areas



Source: USAF 2001a.

Figure 13. R-2505 Ranges

can be found in USAF (2001a, Section 6.2). The closest edge of the R-2505 is about 70 miles from the North Portal at Yucca Mountain.

5.3.3 R-2524

R-2524 airspace is restricted on a continuous basis and encompasses the Superior Valley and the Mojave B North target area as shown on Figure 14. This area includes an ECR that provides a simulated hostile land and sea surface-to-air weapons installation. Mojave B North contains two convoy targets and a simulated airfield that are for use with inert ordnance only. Information in this section is from USAF (2001a, Section 6.4).

The Superior Valley Tactical Training Range has over 60 diverse targets, including surface-to-air missiles, anti-aircraft artillery, and convoy targets. Targets are available to inert ordnance only. Information in this section is from USAF (2001a, Section 6.5).

The closest edge of the R-2524 is about 79 miles from the North Portal at Yucca Mountain.

5.3.4 Aircraft Operating in the R-2508 Complex

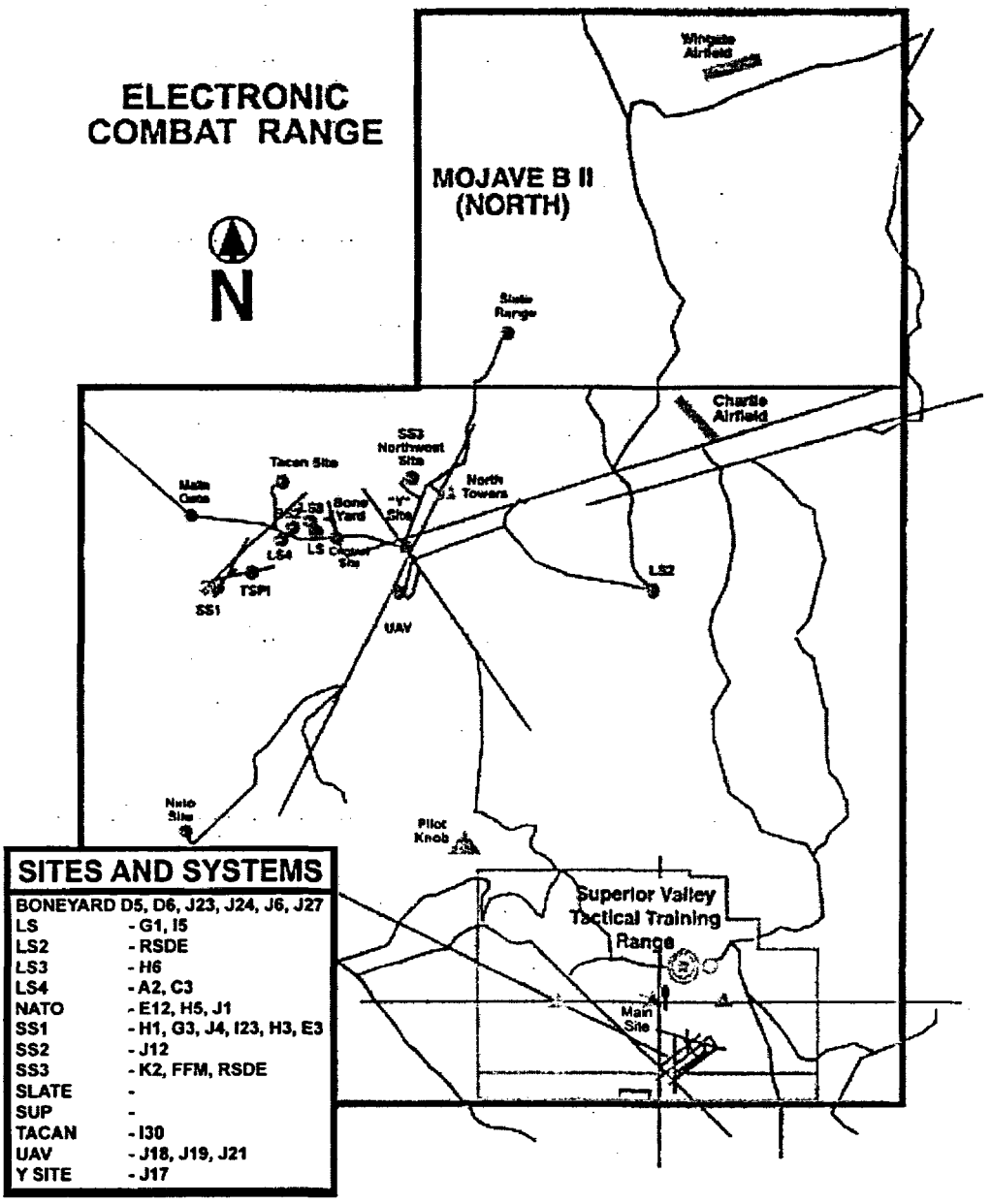
Aircraft types operating in the R-2508 Complex include rotary wing, fixed wing, and remotely operated aircraft (Porter 2002). Aircraft activities performed by the USAF, U.S. Navy, and U.S. Army include simulated combat, combat support, combat service support training, weapons testing, and research and development. The research and development activities may include aircraft types not yet identified. The aircraft types operated in the R-2508 Complex are similar to those used in the NTTR and described in Section 5.1.3.1.

5.3.5 Ordnance Used at the R-2508 Complex

Ordnance delivery is only allowed in the restricted areas located near the center or the southern edge of the R-2508 complex (USAF 2001a, Chapter 6). This includes R-2502, R-2505, R-2506, R-2524, and R-2515 (see Figure 11). Some of these restricted areas are inside the 100-mile regional setting. These restricted areas are used for testing and training of new and existing ordnance such as the weapons described in Appendix C. No ordnance is used at the R-2508 Complex closer than 70 miles to the North Portal at Yucca Mountain (i.e., the closest point to the North Portal is the Shoshone MOA [see Section 5.4.2]).

5.3.6 Air Refueling Tracks

The R-2508 Complex has three unpublished (i.e., not published in DOD 2002a) air refueling tracks shown on Figure 12 available for use during R-2508 Complex activities (USAF 2001a, Section 2.5.4). The Shoshone and Coaldale air refueling tracks are within the 100-mile regional setting of Yucca Mountain. The closest edge of the Shoshone Refueling Track is located about 46 miles from the North Portal at Yucca Mountain. The closest edge of the Coaldale Refueling Track is located about 44 miles from the North Portal at Yucca Mountain.



Source: USAF 2001a.

Figure 14. R-2524. ECR and Superior Valley Ranges

5.4 R-2508 COMPLEX PERIPHERAL AREAS

Two peripheral areas within the R-2508 Complex are located within the 100-mile regional setting of Yucca Mountain.

5.4.1 Deep Springs Air Traffic Control Assigned Airspace

Deep Springs ATCAA provides additional work areas for segregation of military operations from IFR traffic (see Figure 11). The closest edge of the Deep Springs ATCAA is located about 56 miles from the North Portal at Yucca Mountain.

5.4.2 Shoshone Military Operations Area/Air Traffic Control Assigned Airspace

Shoshone MOA activities include operational testing and evaluation, air combat maneuvering, low altitude training, and large-scale exercises (USAF 2001a, Section 5.8). Shoshone North and South ATCAAs, located above the Shoshone MOA, provide airspace for segregation of military operations from IFR traffic. The closest edge of the Shoshone ATCAAs is about 31 miles from the North Portal at Yucca Mountain.

5.5 CIVILIAN, FEDERAL, AND MILITARY AIRPORTS

A number of airports or airfields are located within the regional setting of Yucca Mountain as shown in Figure 1. These include military, DOE, and civilian airports as discussed in the following sections.

5.5.1 Military Airports

There are three military airports within 100 miles of Yucca Mountain as shown on Figure 1.

5.5.1.1 Indian Springs Air Force Auxiliary Field

Indian Springs Air Force Auxiliary Field, located on the southern boundary of R-4806, provides basing for UAV operations, aircraft staging support, and emergency/divert recovery for NTTR operations. It is also the primary training location for the Thunderbirds Air Demonstration Squadron. Appendix D lists the flight activity for 1990 through 1995 and shows that 36 percent (1168/3254) of the activity was from helicopters during that period. This Appendix is reproduced from *Renewal of the Nellis Air Force Range Withdrawal Area* (USAF 1999a, Appendix A.1, Table A.1-2, p. A.1-15). The airfield is about 45 miles from the North Portal at Yucca Mountain (NACO 2002b). There were 4,000 flight operations for the Indian Springs Air Holloman AFB, New Mexico (USAF 1999a, Table A.1-3, p. A.1-16). Flight activity at this airfield can change as new test and development programs are introduced.

5.5.1.2 Tonopah Test Range Airfield

There were 200 flight operations for the TTR Airfield for 2001 (GCR 2002g). The TTR Airfield is about 66 miles from the North Portal at Yucca Mountain (NACO 2002b).

5.5.1.3 Nellis Air Force Base

Nellis AFB is surrounded by the Las Vegas airspace (see Section 5.5.3.5). The total number of takeoffs and landings during 2001 for Nellis AFB was 62,421 (Takenaka 2002).

The Nellis AFB is about 90 miles from the North Portal at Yucca Mountain (NACO 2002b).

5.5.1.4 China Lake Naval Air Warfare Center

Aircraft operations at the China Lake Naval Air Facility are at least 70 miles from the North Portal at Yucca Mountain and largely are within the 100-mile regional setting of Yucca Mountain. Armitage Field (for China Lake Naval Air Facility operations) is outside the 100-mile regional setting of Yucca Mountain.

5.5.2 U.S. Department of Energy Airfields

There are three DOE airports within the 100-mile regional setting of Yucca Mountain as shown on Figure 1. As discussed below, activity at the NTS airfields has been minimal since the moratorium on underground nuclear testing. There are no plans to resume nuclear testing at this time although the NTS is maintaining its capability for such testing.

5.5.2.1 Desert Rock Airport

Small commuter aircraft that fly staff and equipment to and from various national laboratories and the NTS use the Desert Rock Airport. Because of the moratorium on underground nuclear testing, commuter aircraft activity at this airfield is minimal. Helicopters based on the NTS also use this airfield. No accurate records are maintained for this airfield. The DOE Airspace office estimates the current number of flight operations for both fixed-wing and helicopter operations at 330 per year since 1995 (Langendorf 2002).

The Desert Rock Airport is about 27 miles from the North Portal at Yucca Mountain (NACO 2002b). The runway is oriented such that landings and takeoffs are in the northeast/southwest direction (DOD 2002b, p. 89).

5.5.2.2 Pahute Mesa Airstrip

Pahute Mesa Airstrip is currently used very infrequently and the DOE Airspace Office (Langendorf 2002) estimates an average of 80 annual operations.

The Pahute airfield is about 18 miles from the North Portal at Yucca Mountain (NACO 2002b). The runway is oriented such that landings and takeoffs are in the north/south direction (DOD 2002b, p. 215).

5.5.2.3 Yucca Airstrip

The Yucca Airstrip has been unused since 1995 (Langendorf 2002). The Yucca Strip is about 22 miles from the North Portal at Yucca Mountain (NACO 2002b). The runway is oriented such

that landings and takeoffs are in the south-southwest/north-northwest direction (DOD 2002b, p. 303).

5.5.2.4 Helipads

Helicopter operations are conducted from helipads at Mercury, Area 6, Area 29, Area 12, and the Field Operations Office in Area 25, as well as Desert Rock Airfield and Pahute Mesa (Langendorf 2002). The distances to the helipads are as follows: Mercury is about 27 miles, Area 6 is about 22 miles, Area 29 is about 13 miles, Area 12 is about 28 miles, and the Field Operations Office is about nine miles from the North Portal at Yucca Mountain (NACO 2002b).

5.5.3 Civilian Airports and Airfields

Appendix F lists civilian, military, and DOE airports and airfields within 100 miles of the North Portal at Yucca Mountain. Existing facilities range from small private landing strips to a major international airport. Aircraft activity ranges from 0 to 0.5 million operations per year. Figure 1 shows the locations of each of these facilities and, as can be seen, many of the high-volume facilities are located to the south of Yucca Mountain near Las Vegas. Airports or airfields that are based within reasonable proximity to Yucca Mountain or have high operational levels were selected for detailed discussion in the following sections.

5.5.3.1 Beatty Airport

The Beatty Airport, located on the outskirts of the town of Beatty, is a public facility owned by Nye County, Nevada. The airport serves approximately four locally owned single-engine aircraft as well as air taxi service for Beatty and Death Valley National Park. Annual operations totaling 1,005 aircraft include 75 air taxi, 100 local aircraft, 800 itinerant private aircraft, and 30 military aircraft operations (Appendix F). The 2005 and 2015 forecast for annual operations at the Beatty Airport is expected to be about the same as current operations (USAF 1999a, Table 3.1-2, p. 3.1-12).

The Beatty Airport does not have a control tower and is unattended. Pilots are expected to be in radio contact with other aircraft in the area and use visual flight rules during takeoffs and landings. The Beatty Airport is about 21 miles west of the North Portal at Yucca Mountain. The runway is oriented such that landings and takeoffs are in the north/south direction (DOD 2002b, p. 37). Information about the Beatty Airport can be found in GCR (2002a).

5.5.3.2 Jackass Aeropark

The Jackass Aeropark, located in Amargosa Valley, is a public facility owned by the U.S. Bureau of Land Management. The airport serves approximately four locally owned single-engine aircraft and one multi-engine aircraft. Annual operations totaling 604 aircraft include 100 local aircraft, 500 itinerant aircraft, and four military aircraft operations (Appendix F). The 2005 and 2015 forecast for annual operations at the Jackass Aeropark is expected to be the same as current operations (USAF 1999a, Table 3.1-2, p. 3.1-12). The Jackass Aeropark does not have a control tower and is unattended. Pilots are expected to be in radio contact with other aircraft in the area and use visual flight rules during takeoffs and

landings. The Jackass Aeropark is about 15 miles south of the North Portal at Yucca Mountain. Information about the Jackass Aeropark can be found in GCR (2002b).

5.5.3.3 Furnace Creek Airport

The Furnace Creek Airport, located in Death Valley National Park, is a public facility owned by the U.S. Department of Interior, National Park Service. The airport serves approximately two locally owned single-engine aircraft. Annual operations totaling 10,200 aircraft include 200 local aircraft and 10,000 itinerant aircraft operations (Appendix F). Because the Furnace Creek Airport is mainly for itinerant use for Death Valley National Park, a forecast that the annual operations are expected to remain approximately the same as current operations is reasonable. The Furnace Creek Airport does not have a control tower and is unattended. Pilots are expected to be in radio contact with other aircraft in the area and use visual flight rules during takeoffs and landings. The Furnace Creek Airport is about 37 miles southwest of the North Portal at Yucca Mountain. Information about the Furnace Creek Airport can be found in GCR (2002c).

5.5.3.4 Imvite Airfield

The Imvite Airfield, located in Amargosa Valley, is a private facility owned by IMV, a division of the Floridin Company. The airport serves approximately one locally owned single-engine aircraft. Annual operations are listed as zero (Appendix F). Because the Imvite Airfield is privately owned, it is reasonable to forecast that the annual operations are expected to remain approximately the same as current operations. The Imvite Airfield does not have a control tower but is attended between 7:00 a.m. and 5:30 p.m. Pilots are expected to be in radio contact with other aircraft in the area and use visual flight rules during takeoffs and landings. The Imvite Airfield is about 28 miles south of the North Portal at Yucca Mountain. Information about the Imvite Airfield can be found in GCR (2002d).

5.5.3.5 McCarran International Airport

The McCarran International Airport, located in Las Vegas, Nevada, is a public facility owned by Clark County, Nevada. Approximately 141 locally-owned single-engine aircraft, 116 multi-engine aircraft, 80 jets, and 8 helicopters are based at McCarran. Annual operations totaling 476,511 aircraft include 281,214 air carriers, 71,998 air taxi, 15,777 local aircraft, 89,038 itinerant private aircraft, and 18,484 military aircraft operations.

McCarran has a control tower attended at all times and is surrounded by the Las Vegas airspace which is a class of airspace that is characteristic of any airport environment having a high volume of air traffic. This irregular shaped airspace extends from 20-25 nautical miles south and east of Las Vegas/Nellis AFB to the southern boundary of the Desert MOA (Sally Corridor). Aircraft entering or transiting through this charted airspace must be in contact with and under the positive control of either Nellis or McCarran radar approach control facilities. The positive protective nature of this airspace enhances flight safety of civilian aviation transiting through this high air traffic density area. Information in this paragraph can be found in reference USAF (1999a, p.A-2.3.3) and GCR (2002e).

McCarran is about 89 miles east-southeast of the North Portal at Yucca Mountain (NACO 2002b).

5.5.3.6 North Las Vegas Airport

The North Las Vegas Airport, located in North Las Vegas, Nevada, is a public facility owned by Clark County, Nevada. Approximately 421 single-engine aircraft, 132 multi-engine aircraft, 14 jets, and 11 helicopters are based at North Las Vegas. Annual operations totaling 275,386 aircraft include 77,559 air taxi, 116,264 local aircraft, 81,479 itinerant private aircraft, and 84 military aircraft operations (Appendix F).

The North Las Vegas Airport has a control tower attended between 5:30 a.m. and 9:30 p.m. The North Las Vegas Airport is surrounded by the Las Vegas airspace (see Section 5.5.3.5). Information about the North Las Vegas Airport can be found in GCR (2002f).

The North Las Vegas Airport is about 82 miles east-southeast of the North Portal at Yucca Mountain.

5.6 FEDERAL AIRWAYS AND JET ROUTES

FAA designated federal airways and jet routes used by air traffic in the region are shown on Figure 5. Federal airways are established below 18,000 feet AMSL and are normally used by unpressurized propeller aircraft or aircraft not equipped for long distance, high altitude flight. Generally overlying those federal airways bordering the NTTR are jet routes on which the greatest majority of IFR air traffic conducts flight at or above 18,000 feet AMSL. This includes airliners, air cargo, corporate jets, and other high performance aircraft. The previous information was taken from *Renewal of the Nellis Air Force Range Land Withdrawal: Legislative Environmental Impact Statement* (USAF 1999a, Section 3.1.3) Table 2 lists the federal airways and jet routes in the regional setting of Yucca Mountain and distances from the North Portal at Yucca Mountain (NACO 2002a and 2002b). Federal airways and jet routes that are within reasonable proximity of Yucca Mountain were selected for detailed discussion in the following sections.

Table 2. Jet Routes and Federal (Victor) Airways

Jet Routes and Federal Airways	Approximate Centerline Distance from North Portal, Yucca Mountain
J9	86
J58-J80	82
J72	88
J76	88
J86	18
J92	15
J100	86
J110	41
J146	86
J148	95
V105	16
V135	16
V244	85
V394	88
V538	89

5.6.1 J110 Jet Route

Routes J110 and J86 are combined and depart from McCarran International Airport heading northwest. The route splits into J86 and J110 at a point approximately 54 miles from the North Portal at Yucca Mountain and J110 continues in the same direction placing it approximately 41 miles from the North Portal at its closest point (see Figure 5). Distances in this section can be determined from NACO (2002a).

5.6.2 J86 Jet Route

After routes J110 and J86 split, J86 continues toward the Beatty Very High Frequency Omnidirectional Range Station and/or Tactical Air Navigation (VORTAC) where it joins with J92. The centerline distance from the North Portal at Yucca Mountain is approximately 18 miles (NACO 2002a). As noted in Shively (2002), the FAA allows flights to use the entire width between R-2508 and R-4808/R-4807. Therefore, the closest point aircraft can fly in this jet route is about seven miles, which is the closest distance from the North Portal at Yucca Mountain to the R-4808S boundary (see Section 5.1.2.2.1).

5.6.3 J92 Jet Route

J92 continues toward the Coaldale VORTAC and then on to Reno, NV (see Figure 5). The centerline distance from the North Portal at Yucca Mountain is approximately 15 miles (NACO 2002a). According to the FAA, civilian aircraft are allowed to use the airspace between the R-2508 and R-4800 restricted areas (Shively 2002). Therefore, the closest point aircraft can fly in this jet route is about seven miles, which is the closest distance from the North Portal at Yucca Mountain to the R-4808S boundary (see Section 5.1.2.2.1 and Figure 5).

5.6.4 V105-135 Airway

This airway begins south of the NTS (see Figure 5). V105-135 then heads northwest paralleling the NTTR, then heads northwest paralleling the NTTR and then splits off (see Figure 5). V105 continues to the Coaldale VORTAC and then on to Reno, NV. V135 heads northeast and terminates at the Tonopah Airport. The centerline distance from the North Portal at Yucca Mountain is approximately 16 miles (NACO 2002b). According to the FAA, civilian aircraft are allowed to use the airspace between the R-2508 and R-4800 restricted areas (Shively 2002); therefore, the closest point on V105-135 to the North Portal at Yucca Mountain is about seven miles (see Figure 5).

5.7 GROUND-TO-GROUND MISSILE TESTING AT NEVADA TEST SITE

The last Army Tactical Missile System launch was conducted at the NTS in Area 26 in June of 2000. No launches are anticipated in the near future and since this was the last launch for the Redstone Arsenal's surveillance program, there are no forecasts as to when future ground-to-ground missile testing could occur (Childers 2002). Area 26 is about 14 miles from the North Portal at Yucca Mountain.

5.8 COMMERCIAL ROCKET LAUNCH AND RETRIEVAL

The Kistler Aerospace Corporation is developing a fully reusable space launch system to put communications satellites into orbit (see the Federal Register for May 3, 2002, 67 FR 22479). However, Kistler is awaiting FAA approval for their operations in Area 18 of the NTS and no operations can begin until FAA approval is received. No Kistler operations are anticipated at the NTS anytime in the near future (Childers 2002).

6. QUALITATIVE EVALUATIONS AND HAZARD SCREENING

Section 5 presented a description of airspace-related activities and their associated facilities and equipment within the regional setting extending approximately 100 miles from the North Portal at Yucca Mountain. Section 6 evaluates these activities to determine their potential hazard to the MGR.

6.1 QUALITATIVE APPROACH TO HAZARD SCREENING

The process for screening out event sequences considered not credible uses criteria based on qualitative and quantitative bases that include distance, flight characteristics, and pilot actions. The qualitative approach used in the evaluation of the airspace-related activities is based on the following considerations:

- Descriptions and characteristics of the facilities and equipment
- Distance of the activity from the North Portal at Yucca Mountain
- Off-normal events that could occur during the activity
- Identification of probable event sequences following the initiating event
- Determination of the credibility of these off-normal event sequences impacting the MGR.

The hazards that can be clearly shown to pose negligible risk to the MGR due to the location of the off-normal event initiation, the characteristics of the facilities and equipment involved, and the distance between event termination and Yucca Mountain are screened from further quantitative evaluation.

6.2 QUALITATIVE SCREENING CRITERIA

The following criteria have been selected to screen out activities that pose negligible hazards to a surface facility at Yucca Mountain.

6.2.1 Military Test and Training Ranges

6.2.1.1 Training More than 30 Miles from the North Portal at Yucca Mountain

Criterion: Aircraft training activities in restricted areas and MOAs located more than 30 miles from the North Portal at Yucca Mountain do not pose a hazard to that facility.

Basis: Appendix G provides the bases for screening from consideration those aircraft disabled while conducting military training activities more than 30 miles from the North Portal at Yucca Mountain. Range safety practices will preclude the activities from having an adverse impact on YMP operations.

6.2.1.2 Aircraft Refueling More than 30 Miles from the North Portal at Yucca Mountain

Criterion: Aircraft refueling activities in restricted areas and MOAs located more than 30 miles from the North Portal at Yucca Mountain do not pose a hazard to that facility.

Basis: Aircraft refueling activities are considered routine operations and required safety practices are expected to prevent abnormal flights that result in crash potential initiating events. Aircraft separation is inherent between the refueling tanker and the aircraft to be refueled. Refueling tankers are multi-engine aircraft that can maintain flight if an engine fails. Potential damage to the fighter aircraft being refueled would be localized and the aircraft could return to a suitable airfield. In the unlikely event of a loss of aircraft control due to an abnormal refueling event or other events considered in Section 6.2.1.1, the 30-mile criterion provides an adequate buffer to accommodate an aircraft crash. It is anticipated that such a crash would occur near the established refueling area.

6.2.1.3 Ordnance Fired from Aircraft

Criterion: Ordnance does not pose a hazard to the MGR.

Basis: Air Force Instruction 13-212 (USAF 1996, Section 1.1.2.1) states that the majority of bombable targets on Ranges 74, 75, and 76 lie north of the rise in terrain associated with Tolicha Peak ECR and east through Pahute Mesa, but not including either Tolicha Peak ECR or Pahute Mesa. Other bombable targets are located in Range 71, which is north of Ranges 74 and 75 (USAF 1996, Section 1.1.2.2) (see Figure 8). The closest target in the 70 Series ranges is no closer than the northern edge of the rise in terrain mentioned previously (i.e., about 35 miles [NIMA 2001]). Ranges 64B, 64C, and 64D located east of the North Portal contain bombable targets; no ordnance is expended in Range 64A (USAF 1996, Section 1.9). The closest target to the North Portal is no closer than the edge of Range 64 (i.e., about 27 miles [NIMA 2001]). No bombable targets are located in the four EC ranges or the named ranges (e.g., Alamo, Pahute Mesa); only numbered ranges such as R75 and R76 are bombable (USAF 1996, Section 1.1.2.5.4).

Figure 7 shows the locations of the north and south range target sites in the NTTR. The Safe-Range Program Methodology described in Air Force Instruction 13-212 (USAF 2001b, Section 4.3.1) requires all ranges to address issues involved in air-to-ground weapon operations.

The methodology relies on the use of weapons safety footprints that define the minimum land requirements needed to safely employ given munitions from specific aircraft. Safety footprints are defined for each weapon, aircraft, and target to insure that any impact from the deployment of these weapons is contained within the footprint. Section 1.4, Step 3 of the Safe-Range Program Methodology ensures that the hazard from training weapons will not extend beyond the boundaries of the range to be employed (USAF 2001c). If it is determined in the operational planning phase that a safety footprint would extend beyond the boundary of a range, an effort will be made to change the parameters of the training mission (e.g., relocation of the target, changing the allowable run-in to the target, selection of a different set of release parameters, or performing the training on another range or target) (USAF 2001c, Section 1.4, Steps 4b and 4c). In the event that changing the parameters of the mission does not eliminate the off-range hazard, a hazard assessment is conducted so that the range operating agency can make an informed decision on the acceptability of the hazard (USAF 2001, Section 1.4, Step 4c).

6.2.1.4 Hung Ordnance

Criterion: Hung ordnance does not pose a hazard to the facility.

Basis: Ordnance with an attempt to release that malfunctions and fails to leave the aircraft is considered hung ordnance. Nellis Air Force Base Instructions (USAF 1999b, Chapter 5) contain procedures for jettisoning hung ordnance. Inert or live ordnance that is hung unsecured must be jettisoned from the aircraft. Live ordnance is jettisoned on target areas if possible. If unable to jettison inert ordnance, the aircraft will return to Nellis AFB. If unable to jettison live ordnance, the aircraft will land at Indian Springs Air Force Auxiliary Field. R-4808N overflights with hung ordnance are prohibited except for critical inflight emergencies (USAF 1996, Sections 1.28.2.6 and 1.29.3.6).

6.2.1.5 Large Multi-Engine Aircraft within the 30-Mile Criterion Zone

Criterion: Large multi-engine aircraft that enter the 30-mile criterion zone at or above 18,000 feet AMSL do not pose a hazard to the facility.

Basis: Abnormal flights generally involve engine failure that is not considered an abnormal flight with crash potential because these aircraft have the capacity to return to base. Aircraft crash risk due to high altitude overflights (at or above 18,000 feet AMSL) is considered a minor contributor to the overall aircraft crash frequency (Kimura et al. 2002, Section 4).

6.2.2 Military Range Supporting Airspace Areas

6.2.2.1 Aircraft Refueling 30 Miles from the North Portal at Yucca Mountain

The criterion in Section 6.2.1.2 applies to aircraft refueling activities more than 30 miles from the North Portal at Yucca Mountain.

6.2.2.2 Military Training Routes

Criterion: Aircraft flying on MTRs located more than 20 miles from the North Portal at Yucca Mountain do not pose a hazard to that facility.

Basis: As described in Section 5.2.2, aircraft flying in MTRs are below 10,000 feet AMSL and generally fly between 500 and 1,000 feet AGL. According to the lift/drag ratio discussed in Appendix G, the small attack and fighter aircraft will glide less than 17 miles if power is lost at 10,000 feet [(8.58 × 10,000 feet)/5,280 feet/mile = 16.25 miles). At 1,000 feet, it will glide less than two miles [(8.58 ×1,000 feet)/5,280 feet/mile = 1.63 miles). See Appendix G for further discussion of the glide capability.

NUREG-0800 (NRC 1987, Section 3.5.1.6) provides an acceptance criterion and a model that addresses MTRs. The acceptance criterion that deals with MTRs, Criterion (b), states "the plant is at least five statute miles from the edge of MTRs, including low-level training routes, except for those associated with a usage greater than 1,000 flights per year, or where activities (such as practice bombing) may create an unusual stress situation". The traffic on the MTRs as shown in Table 1 in Section 5.2.2 is considerably less than the NUREG-0800 criterion of 1,000 flights per year.

The model for calculating the probability per year of an aircraft crashing into the plant while flying in aviation corridors, such as MTRs, that pass through the 20-mile criterion zone is defined in Section 3.5.1.6.III.2, *Airways* (NRC 1987). The extent of the "vicinity" is not defined in that section but it can be inferred that the probability of a crash on the plant would be insensitive to flights outside the vicinity. The vicinity must include MTRs that could significantly increase the cumulative annual crash probability. Selecting a distance of 20 miles as a screening criterion is conservative given Criterion (b) of five miles and the number of flights currently in the MTRs. This will allow inclusion of those MTRs that border the restricted areas near Yucca Mountain as potential hazards for follow-on crash frequency analysis but eliminates those outside the vicinity of Yucca Mountain that would not significantly increase the cumulative annual crash probability.

6.2.2.3 Training Activities 30 Miles from the North Portal at Yucca Mountain

The criterion in Section 6.2.1.1 applies to training activities more than 30 miles from the North Portal at Yucca Mountain.

6.2.3 Civilian and Military Airports

Criterion: Aircraft that takeoff and land from airports located more than ten miles from the North Portal at Yucca Mountain and meet the applicable acceptance criterion of NUREG-0800 Section 3.5.1.6.II.1(a) (NRC 1987) with respect to current and projected airport operations do not pose a hazard to that facility. The NRC acceptance criterion states that an airport located a distance D of more than ten miles from a site presents an acceptably low risk if the annual number of operations at the airport is less than $1{,}000D^2$.

Basis: An aircraft may be in the ascending or descending mode significantly far away from the runway. However, historical data on crash locations suggest that the crash probability of an aircraft during landing or takeoff from an airport becomes negligible more than 10 miles from the end of the runway (NRC 2000 p. 15-42). It should be noted that the values provided in NUREG-0800 Section 3.5.1.6.III.3 for crash probability per square mile for aircraft in takeoff and landing become negligible past ten miles from the end of the runway (NRC 1987,

Section 3.5.1.6.III.3). At distances greater than ten miles, the aircraft is in a flight mode on an established federal airway or MTR and the crash probability will be determined using the methodology defined in NUREG-0800 Section 3.5.1.6.III.2.

6.2.4 Federal Airways and Jet Routes

Criterion: Aircraft flying on federal airways and jet routes whose edges are located more than 25 miles from the North Portal at Yucca Mountain do not pose a hazard to that facility.

Basis: NUREG-0800 (NRC 1987, Section 3.5.1.6) provides both an acceptance criterion and a model that addresses federal airways. The acceptance criterion that deals with federal airways, Criterion (c), states "the plant is at least two statute miles beyond the nearest edge of a federal airway, holding pattern, or approach pattern".

The airways model for calculating the probability per year of an aircraft crashing into the plant while flying in federal airways or aviation corridors that pass through the vicinity of the site is defined in Section 3.5.1.6.III.2 (NRC 1987). The extent of the "vicinity" is not defined in that section but it can be inferred that the probability of a crash on the plant would be insensitive to flights outside the vicinity. The vicinity must include federal airways and jet routes that could significantly increase the cumulative annual crash probability.

The NUREG-0800 airways model states that the crash probability per year, P, is determined using the following equation.

$$P = N \times C \times A_{eff} \times 1/w \qquad \text{(Eq. 1)}$$

where:

N = number of flights per year

C = crash probability per mile

A_{eff} = effective area of the facility (in square miles)

w = the width of the airway plus twice the distance from the airway edge to the facility, if outside the airway (miles).

From the model defined above it is clear that the size of the vicinity is addressed in the $1/w$ variable. Given that other factors are equal, the NUREG-0800 model assumes that the crash frequency at the target is inversely proportional to w. The *ACRAM Modeling Technical Support Document* (Sanzo et al. 1996, p. 4-6) discusses different in-flight models and observes that the NUREG-0800 model probability density function is limited to two miles orthogonal from the center of the airway. Although the model can probably predict reasonable probability density functions further than two miles, predictions out to long distances become overly conservative. The Solomon model and the Sandia National Laboratory models (which do not have a two-mile limitation) are also discussed in Sanzo et al. (1996, p. 4-6). The Sandia model is presented in *A Methodology for Calculation of the Probability of Crash of an Aircraft into Structures in Weapon Storage Areas* (Smith 1983). It proposes that the crash frequency decreases

exponentially to the distance from the centerline of the airway. Table F-2 provides a parametric analysis of the crash probability at orthogonal distances out to 25 miles. It can be seen from this table that the crash probability density function becomes negligible beyond five miles.

A criterion of 25 miles from the closest edge of the airway was selected to provide for uncertainties in these models and allows for consideration of variation in airway width. It can be concluded that selecting a criterion zone that extends 25 miles from the North Portal at Yucca Mountain will ensure that any airways screened out will have no impact on the cumulative crash probability.

6.3 QUALITATIVE EVALUATIONS

6.3.1 Military Test and Training Ranges

6.3.1.1 Nevada Test and Training Range

Figures 15 and 16 depict the portions of the NTTR in the vicinity of the North Portal at Yucca Mountain. Based on Section 6.2.1 screening criteria, the following MOAs and restricted area subranges do not pose a hazard to the MGR and are screened out from further evaluation. The following sections provide range-specific bases for screening out these areas.

6.3.1.1.1 Reveille MOA

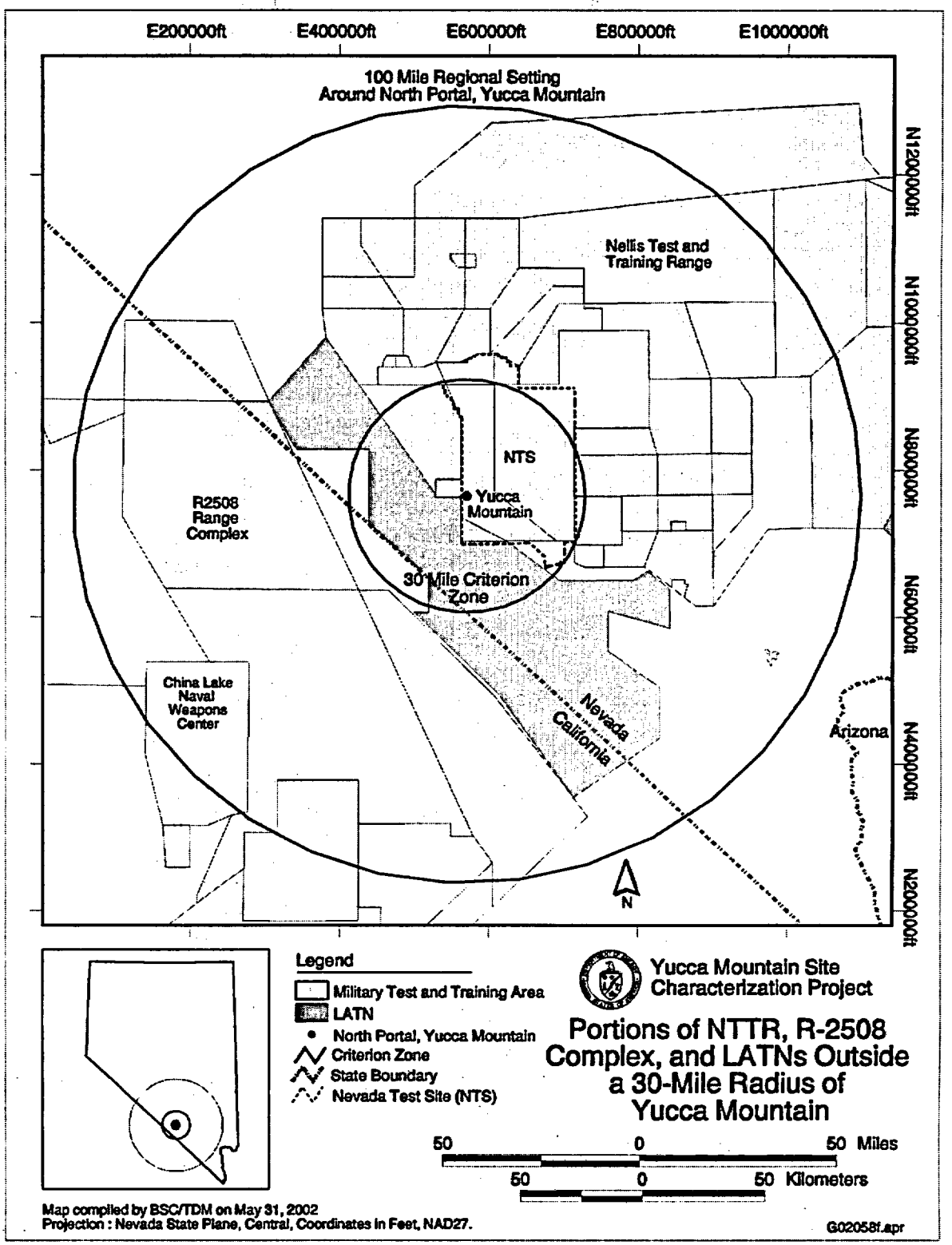
Aircraft training activities in the Reveille MOA are located beyond the 30-mile criterion zone. Section 6.2.1.1 provides the basis for screening out these activities. Abnormal events with crash potential would typically be resolved on the MOA, but in the unlikely event that the aircraft would continue to glide toward Yucca Mountain, the maximum glide distance would be less than 30 miles (see discussion of engine failure in Appendix G) placing a crash from the worst case event sequence 41 miles away from repository surface facilities. Therefore, aircraft training activities in this MOA will not pose a credible hazard to the MGR.

6.3.1.1.2 Desert MOA

The training areas within the Desert MOA are located beyond the 30-mile criterion zone. Section 6.2.1.1 provides the basis for screening out these MOAs. Off-normal initiating events resulting in abnormal flights with crash risk in the Coyote MOA are midair collisions or malfunctions of the aircraft. If the aircraft has glide capability and depending on the altitude, the pilot will direct the aircraft away from the range boundaries to a suitable ejection area within one of the several valleys located in the Coyote MOA; the pilot would eject and the aircraft would most likely crash into the surrounding mountains of the Coyote MOA (see discussion of engine failure in Appendix G). Therefore, aircraft training activities in these MOAs will not pose a credible hazard to the MGR.

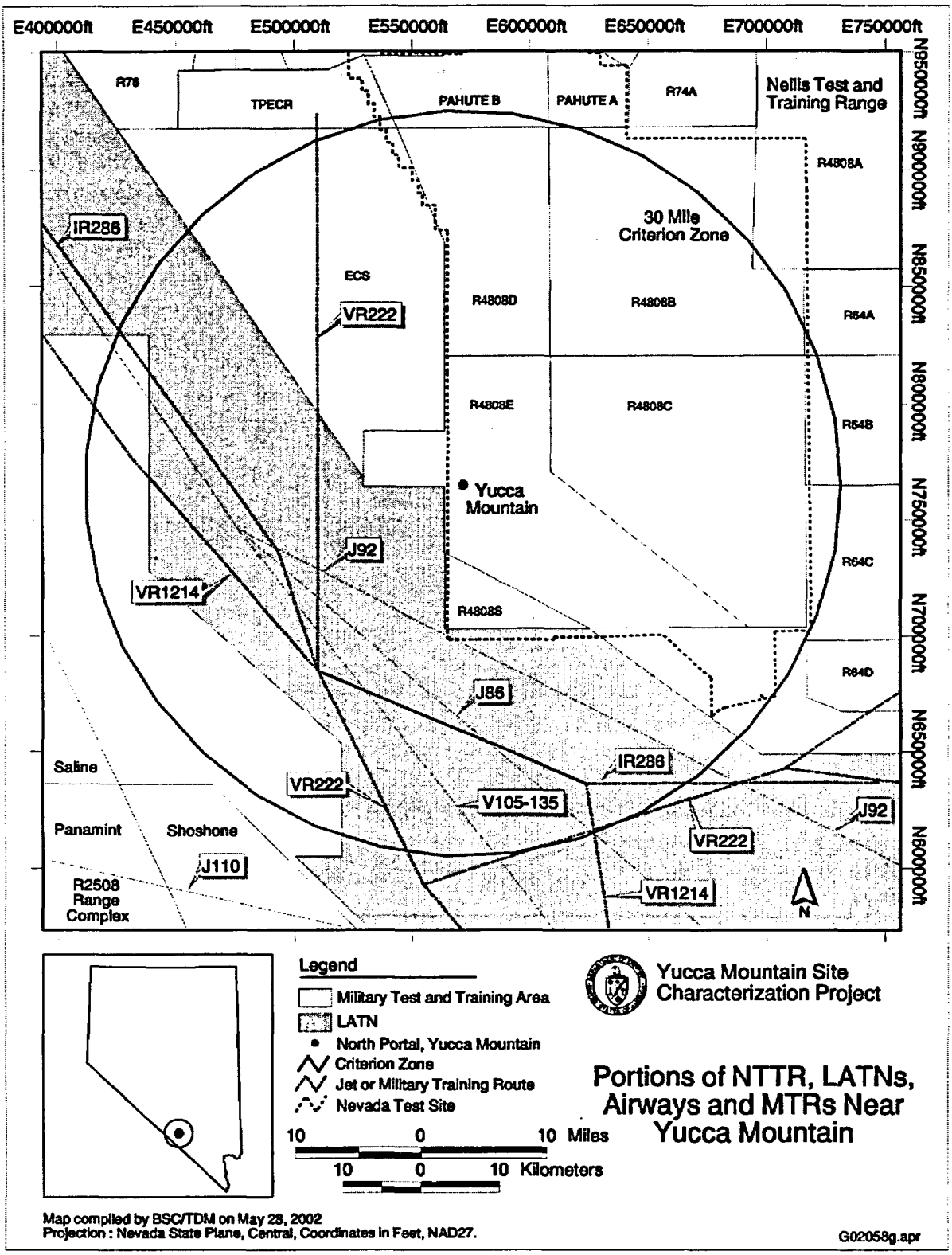
6.3.1.1.3 70 Series Ranges

The 70 Series ranges are located beyond the 30-mile criterion zone. Section 6.2.1.1 provides the basis for screening out these ranges. If the aircraft has glide capability and depending on the



Source: USAF 1996, USAF 2001a.

Figure 15. Portions of NTTR, R-2508 Complex, and LATNs Outside a 30-Mile Radius of Yucca Mountain



Source: USAF 1996, USAF 2001a, DOD 2002a, and NACO 2002a.

Figure 16. Portions of NTTR, LATNs, Airways, and MTRs Near Yucca Mountain

altitude, the pilot will direct the aircraft away from the mountainous terrain of R74A and the southern and western boundaries of R74B/C towards a suitable ejection area within the flatter terrain found in R74B/C.

Range 75E/W has a mountain range that borders the eastern boundary and several radioactive contaminated areas adjacent to the southern border (Pahute Mesa) that make those areas unattractive for pilot ejection. Therefore, if the event sequence includes glide capability and pilot control, the pilot would attempt to drop down and eject in an area to the north or west of the range southern boundaries.

Range 76 is to the west of Range 75 and provides various ground targets. Mountains are located throughout the range. Forward Air Controllers Alpha and Bravo are ground party safety zones within R76 and pilots must comply with specific requirement to maintain safety in those areas. The event sequences with crash potential are essentially the same as Range 74. Because of the terrain, Forward Air Controller A/B, and the existence of Pahute Mesa to the southeast with its radioactive contaminated areas, the only attractive area for ejection would be within the range or easterly toward range 75.

Therefore, aircraft activities in these ranges will not pose a credible hazard to the MGR.

The 70 Series ranges have a number of target locations where various air-to-ground ordnance is deployed. The qualitative evaluation of these deployments is provided in Section 6.3.1.1.5.

6.3.1.1.4 Electronic Combat Ranges

The Tolicha Peak Electronic Combat Range is a manned electronic combat threat simulator range and has no bombable ground targets. Mountains are on the western and southern borders. Appendix B , Table B-5 lists the different day and night missions conducted in ECRs. These include tactical intercepts, surface attacks, combat tactics, and search and rescue. Altitudes flown range from 75 feet AGL to 50,000 feet AMSL. The event sequences with crash potential are essentially the same as Range 74 (see Section 6.3.1.1.3). The 30-mile criterion zone extends into the TPECR less than one mile. Flight counts within that 1-mile area will be approximated based on input from Nellis AFB and will be included in the crash frequency analysis of the EC South range.

Pilots preparing to eject would avoid the mountainous western and southern areas resulting in the aircraft moving away from Yucca Mountain. The location of ejection, regardless of altitude, would be over 30 miles from the North Portal at Yucca Mountain and will not pose a credible hazard to that facility.

The EC South Range is within the 30-mile criterion zone and will be included in Section 8. Other ECRs are located north of the 70 Series ranges placing them further away from Yucca Mountain and, as such will not pose a credible hazard to surface facilities located there.

6.3.1.1.5 Ordnance

Ordnance fired from aircraft does not pose a hazard to the MGR (see Section 6.2.1.3). The required use of USAF instructions *Safe-Range Program Methodology* (USAF 2001c),

Weapons Range Management (USAF 1996), *Flying Operations, Local Operating Procedures* (USAF 1999b), and other applicable range activity instructions by the operating and controlling agencies of the NTTR ranges provide assurance that weapon training activities on the NTTR will not pose a credible hazard the MGR.

6.3.1.1.6 60 Series Ranges

The 60 Series ranges are within R-4806W as described in Section 5.1.2.3.2 and shown on Figure 8. The subranges closest to a repository surface facility at Yucca Mountain are ranges 64A/B/C/D. The next closest ranges are 65N/S. Ranges 61, 62, and 63 are considerably further. The ground elevation for these ranges is between about 3,000 and 7,000 feet AMSL (USAF 1999a, Sections 1.5.3, 1.6.3, 1.7.3, 1.8.3, and 1.9.3).

Ranges 64A and D contain no targets. The other 60 Series ranges contain numerous tactical targets. A number of different missions can be conducted in the 60 Series ranges as listed in Appendix B, Table B-2. These missions include both low- and high-altitude tactical training with ordnance. Ordnance events are evaluated in Section 6.2.1.3. Missions can include up to a 4-aircraft strike force and a multi-ship adversary.

According to Appendix B, tactical training maneuvers will occur between different altitude bands depending on the mission and type of aircraft involved. Since these are tactical missions involving ground targets, many of the missions involve dropping down to altitudes ranging from 75 to 5,000 feet AGL from altitudes ranging from 25,000 to 50,000 feet AMSL. Off-normal initiating events resulting in abnormal flights with crash risk are midair collision or malfunctions of the aircraft. If the aircraft has glide capability and depending on the altitude, the pilot will direct the aircraft away from mountainous terrain (see discussion of engine failure in Appendix G).

The targets in 64B and 65N/S are located in the Indian Springs Valley that is bounded on the west by the Spotted Range that rises to about 6,500 feet MSL (USAF 1996, Section 1.9.5). A suitable ejection area is within the flatter terrain found in Indian Springs Valley. The pilot would eject at an altitude below 15,000 feet AMSL and the aircraft would crash near the point of ejection. The location of ejection, regardless of altitude, would be over 40 miles from surface facilities at Yucca Mountain (NIMA 2001) and will not pose a credible hazard to that facility.

Ranges 61, 62, and 63 are located in the eastern portion of the R-4806 restricted area. The event sequences with crash potential are essentially the same as those in Range 65N/S with a mountain range that borders the western boundary that make those areas unattractive for pilot ejection. Therefore, if the event sequence includes glide capability and pilot control, the pilot would attempt to drop down and eject in the northern portion of the Three Lakes Valley to avoid manned sites in the southern portion. The location of ejection, regardless of altitude, would be about 50 miles or more (NACO 2002b) from the North Portal at Yucca Mountain (Section 5.1.2.3.2) and will not pose a credible hazard to that facility (NIMA 2001).

A suitable ejection area is within the flatter terrain found in Indian Springs Valley. The pilot would eject at an altitude below 15,000 feet AMSL and the aircraft would crash near the point of ejection. The location of an ejection within the Indian Spring Valley, regardless of altitude,

would be about 40 miles or more (NACO 2002b) from the North Portal at Yucca Mountain and will not pose a credible hazard to that facility.

The 60 Series ranges have a number of target locations where various air-to-ground ordnance is deployed. The qualitative evaluation of these deployments is provided in Section 6.3.1.1.5. Aircraft training activities in Ranges 61, 62, 63, and 65 are entirely located beyond the 30-mile criterion zone. Section 6.2.1.1 provides the basis for screening out these activities. Small portions of Ranges 64A, 64B, and 64C are within the 30-mile criterion zone. The 30-mile criterion zone extends approximately three miles into Ranges 64B and 64C and less than two miles into Range 64A. Flight counts within those small portions of R-64A, R-64B, and R-64C will be approximated based on input from Nellis AFB and these will be included in the crash frequency analysis for the NTS corridor.

Therefore, aircraft activities in the excluded portions of these ranges will not pose a credible hazard to the MGR.

6.3.1.1.7 Large Multi-Engine Aircraft within the 30-Mile Criterion Zone

Large multi-engine aircraft within the 30-mile criterion zone are being staged for large mission employment at altitudes at or above 18,000 feet AMSL. Abnormal flights that result in an event sequence will not pose a credible hazard to facilities at Yucca Mountain according to the criterion in Section 6.2.1.5.

6.3.1.2 R-2508 Range Complex

Figur 16 shows that the entire R-2508 Complex is outside the 30-mile criterion zone of the North Portal at Yucca Mountain. Based on Section 6.2.1 screening criteria, because R-2508 is outside the 30-mile criterion zone, it does not pose a credible hazard to the MGR, and is screened out from further evaluation. According to Section 5.2, ordnance fired within the R-2508 Complex is over about 70 miles from the MGR. Based on Section 6.2.1.3, ordnance fired from aircraft in the R-2508 Complex does not pose a credible hazard to the MGR, and is screened out from further evaluation.

6.3.2 Military Range Supporting Airspace Areas

6.3.2.1 Low Altitude Training Navigation Areas

LATNs are described in Section 5.2.1. The screening criterion for training in supporting airspace areas is described in Section 6.2.1.3. Figure 16 shows that some portions of the LATNs are inside the 30-mile criterion zone surrounding the North Portal at Yucca Mountain. Other LATN areas shown in Figure 15 are screened from further evaluation.

6.3.2.2 Military Training Routes

MTRs are described in Section 5.2.2. Section 6.2.2.2 specifies the screening criterion for MTRs as those MTRs located greater than 20 miles from the North Portal at Yucca Mountain. Figure 10 shows that most of the MTRs within the 100-mile regional setting are outside a 30-mile radius which is larger than the 20-mile criterion zone, and therefore, do not pose a

hazard to a surface facility at Yucca Mountain. MTRs IR-286, VR-222, and VR-1214 located west of the NTTR as shown on Figure 10 cross the 20-mile criterion zone and will be evaluated in a future analysis.

6.3.2.3 Aerial Refueling Areas

Figure 9 depicts the refueling areas in and around the regional vicinity of Yucca Mountain. The closest edge of the only refueling area located in the regional setting northwest of the North Portal at Yucca Mountain is approximately 40 or more miles away. The screening criterion provided in Section 6.2.1.2 states that aircraft refueling activities located greater than 30 miles from the North Portal at Yucca Mountain do not pose a hazard to that facility. Therefore, existing refueling areas have been screened out from further analysis.

6.3.3 Civilian and Military Airports

Appendix F lists the civilian, DOE, and military airports within the regional setting of Yucca Mountain. The projected airport operations in this table are assumed to increase five percent each year through 2040 (Assumption 4.1). This assumption is conservative because it results in larger numbers for the projected operations than those shown in the *Renewal of the Nellis Air Force Range Land Withdrawal: Legislative Environmental Impact Statement* (USAF 1999a, Table 3.1-2), which is a larger operations number for comparison to $1{,}000D^2$.

As shown in Appendix F, the year 2040 projected operations for McCarran International Airport is less than half the value of $1{,}000D^2$, and North Las Vegas Airport is less than one-third of the value of $1{,}000D^2$. It is not expected that these two airports could double their present operations using the land area that is available. Therefore, the five percent increase in yearly operations assumption is conservative, and these two airports will not impact the MGR.

There are no airports less than ten miles from the North Portal at Yucca Mountain. The table shows the distance from the airports to the North Portal at Yucca Mountain, along with current and projected number of operations for the years 2010 (i.e., the year the MGR is expected to begin receipt of high-level radioactive waste) and 2040 (i.e., the last year high-level radioactive waste is expected to be received). As can be seen from this table, none of the numbers of airport operations are close to the $1{,}000D^2$. Therefore, airports in the regional setting do not pose a credible hazard to the MGR.

6.3.4 Federal Airways and Jet Routes

FAA designated federal airways and jet routes used by air traffic in the regional setting are shown on Figure 5. Aircraft flying on federal airways and jet routes located greater than 25 miles from the North Portal at Yucca Mountain do not pose a hazard to that facility (see the criterion in Section 6.2.4). Table 2 lists the shortest distance between the edge of each airway and the North Portal at Yucca Mountain. It is not credible for an aircraft disabled while flying in those airways to impact the MGR.

Also, as can be seen in Table 2, only the V105-135 airway and the J92 and J86 jet routes are within the 25-mile criterion zone and require further evaluation.

7. QUANTITATIVE EVALUATIONS AND HAZARD SCREENING

Quantitative evaluations for hazard screening were not performed for this report. Available information on aircraft counts, crash rates, and other characteristics specific to the potential hazard did not warrant further screening and the airspace activities included in Section 8 will be included in future analyses discussed in Section 11.

8. SELECTION OF AIRCRAFT HAZARDS

Section 5 described the airspace-related activities within the regional setting of Yucca Mountain, Nevada. A large regional setting (i.e., 100-mile radius) was selected to fully describe the numerous military and commercial airspace activities surrounding Yucca Mountain. This includes two major military test and training ranges, the NTS, several military, DOE, and commercial airports, and various civilian and military airways and flight corridors. Section 6 evaluated the airspace activities within this regional setting with defensible criteria and screened out those activities with acceptably low probability of impact to the MGR. The airspace activities not screened out in Section 6 are considered aircraft hazards and their event sequences require crash frequency determination and summation to determine the total crash frequency for aircraft hazards. The aircraft hazards identified in this report are listed in the following sections.

8.1 HAZARDS FROM SMALL ATTACK/FIGHTER MILITARY AIRCRAFT

The following hazards from small attack/fighter military aircraft will require crash frequency analyses.

- Aircraft that enter and exit the R-4808 airspace as described in Section 5.1.2.2. Aircraft operating in small portions of R-64A, R-64B, and R-64C will be included in this category as described in Section 6.3.1.1.6.
- Aircraft that conduct test and training missions in the EC South Range as described in Sections 5.1.2.1.1, 5.1.3, and 6.3.1.1.4 and Table B-5.
- Aircraft that fly the following MTRs as described in Sections 5.2.2, 6.3.2.2, and 6.3.4.
  - IR-286
  - VR-222
  - VR-1214
- Aircraft that fly in the LATN areas within the 30-mile criterion zone as described in Sections 5.2.1 and 6.3.2.1.

8.2 HAZARDS FROM LARGE MILITARY AIRCRAFT

Aircraft that fly within the 30-mile criterion zone at altitudes below 18,000 feet AMSL will require crash frequency analyses (see Sections 5.6 and 6.3.1.1.7).

8.3 DOE AIRCRAFT HAZARDS

DOE helicopters flying within the NTS will require crash frequency analyses (see Sections 5.1.2.3.2, 5.5.2.1, and 5.5.2.4).

8.4 CIVILIAN AIRCRAFT HAZARDS

Aircraft that fly on J92, J86, and V105-135 will require crash frequency analyses as shown in Section 6.3.4.

9. FINAL VICINITY MAP

NUREG-0800 uses terms such as "near the proposed site," "through the vicinity of the site," and "sufficiently distant from the plant." Because of the many airspace activities within the regional setting of Yucca Mountain, the objective of this report was to establish the vicinity where detailed crash frequency analyses were needed to establish a cumulative annual crash frequency with reasonable assurance that it reflected the airspace activities within the region. Section 8 lists the aircraft and their related airspaces where activities could result in hazards to a facility at Yucca Mountain. A final vicinity map is shown on Figure 16, which displays the various areas where airspace-related activities need to be analyzed to determine the total crash frequency.

10. CONCLUSIONS

A large regional setting of 100-miles radius around the North Portal at Yucca Mountain was chosen for evaluation of both civilian and military airspace-related activities. Although the setting is larger than normally considered for NUREG-0800 Section 3.5.1.6 evaluations, this report provides a comprehensive description of the two large military range complexes existing within the regional setting. The large setting also allowed the development of defensible bases for evaluating airspace-related activities within the regional setting to determine those activities that do not result in a credible hazard to the MGR. The remaining activities were identified as potential hazards for further analysis (see Section 8).

It can be concluded from this evaluation that airspace-related activities occurring beyond 30 miles from the North Portal at Yucca Mountain will not pose a credible hazard to those facilities. Most of the sub-ranges within the two range complexes are situated beyond 30 miles, therefore, most of the airspace activities within the range complexes will have no impact on the MGR. Activities in the sub-ranges within the 30-mile criterion zone were identified for further analysis.

MTRs, refueling areas, jet routes, airways, and other training areas were identified within the regional setting. Defensible screening criteria based on NUREG-0800 inputs were developed. Based on the evaluation, it can be concluded that airspace activities within these various flight corridors that are located outside of the screening criteria do not pose a credible hazard to the MGR. Activities in the corridors generally close to Yucca Mountain located west the NTTR were identified for further analysis.

Several civilian, DOE, and military airports were identified within the regional setting. None were sufficiently close to facilities at Yucca Mountain to pose a credible hazard to the MGR.

11. FUTURE ANALYSES

This report performed an extensive evaluation of the aircraft activities within a 100-mile regional setting of Yucca Mountain. The aircraft hazards to a surface facility at Yucca Mountain resulting from this evaluation were identified in Section 8. These hazards require quantitative frequency crash frequency analyses to determine if an aircraft or ordnance impact on such a facility is a credible event based on the criteria provided in 10 CFR Part 63. The following will discuss the information needed to perform the analyses, the methodologies to be used to determine the crash frequencies for each hazard identified, and an approach for evaluating impacts to these results from future changes to the inputs used.

11.1 INFORMATION NEEDED

Each methodology to be used requires specific inputs to perform the analysis. These include the following information needs for the specific airspace under evaluation.

- Aircraft types
- Flight counts for each aircraft type and flight mode
- Aircraft altitudes
- Crash rates for each aircraft type and flight mode
- Location of airspace relative to surface facilities at Yucca Mountain
- Effective areas used by the specific crash frequency methodology
- Projections of future flight counts after proposed repository is licensed
- Weapons carried by military aircraft

This input will be collected as required to support the proposed license application for Construction Authorization and for Receive and Possess.

11.2 CRASH FREQUENCY METHODOLOGIES

The crash frequencies of aircraft that fly published airways such as MTRs and civilian routes will be estimated using the NUREG-0800 Section 3.5.1.6.III.2 airways model. This model provides reasonable results for airways located within the screening criteria selected in Section 6.2.

The crash frequencies of military aircraft that fly through the NTS corridor, in LATN areas, and in military test and training ranges identified within the 30-mile criterion zone will be determined using the model as defined in Kimura et al. (2002). This model has already been used by the DOE (Kimura et al. 2002) in the R-4808 area to determine the frequency of a crash onto existing NTS facilities.

11.3 EVALUATION OF FUTURE CHANGES IN INPUTS USED

The crash frequency analysis will evaluate current and anticipated air traffic in the different airspaces discussed in the previous sections. Sensitivity analysis will determine the impact of changes in the inputs used in these analyses. This will establish the necessity for evaluating future changes in these inputs. It will also provide a basis for setting 10 CFR 63.2 design bases

for the surface facilities depending on whether the results indicate a credible or beyond credible aircraft hazard.

The inputs used in the crash frequency analysis discussed in Section 11.1 will be based on information provided by the Air Force, the FAA, and DOE. Aircraft counts of military flights in the NTS corridor are currently being monitored and this monitoring will continue for the foreseeable future. If the frequency analysis results are sensitive to the FAA and DOE aircraft counts, periodic requests for information will be made to those organizations during the licensing and construction of the MGR, and further analyses will be conducted as warranted.

12. REFERENCES

12.1 DOCUMENTS CITED

BSC (Bechtel SAIC Company) 2001a. *Technical Work Plan for: Preclosure Safety Analysis.* TWP-MGR-SE-000010 REV 01 ICN 0. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20011105.0325.

BSC 2001b. *Preliminary Preclosure Safety Assessment for Monitored Geologic Repository Site Recommendation.* TDR-MGR-SE-000009 REV 00 ICN 03. Las Vegas, Nevada: Bechtel SAIC Company. ACC: MOL.20010705.0172.

Childers, M.J. 2002. "Re: NTS Airspace." E-mail from M.J. Childers to R. Morissette, January 31, 2002. ACC: MOL.20020515.0094.

CRWMS M&O (Civilian Radioactive Waste Management System Management and Operating Contractor) 1999. *MGR Aircraft Crash Frequency Analysis.* ANL-WHS-SE-000001 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.19981221.0203.

CRWMS M&O 2000. *MGR External Events Hazards Analysis.* ANL-MGR-SE-000004 REV 00. Las Vegas, Nevada: CRWMS M&O. ACC: MOL.20000310.0069.

DOD (U.S. Department of Defense) 2002a. *Area Planning, Military Training Routes, North and South America.* AP/1B. St. Louis, Missouri: National Imagery and Mapping Agency. ACC: MOL.20020510.0069.

DOD 2002b. *VFR - Supplement United States.* Flight Information Publication (Enroute). St. Louis, Missouri: National Imagery and Mapping Agency. ACC: MOL.20020510.0066.

DOE (U.S. Department of Energy) 2002. *Quality Assurance Requirements and Description.* DOE/RW-0333P, Rev. 11. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20020506.0915.

GCR (G.C.R. & Associates, Inc.) 2002a. "Airport Master Record, Beatty Airport. FAA Form 5010." New Orleans, Louisiana: GCR. & Associates, Inc. Accessed June 3, 2001. ACC: MOL.20020607.0297. http://www.gcr1.com/5010WEB/main.cfm?Site=BTY.

GCR 2002b. "Airport Master Record, Jackass Aeropark. FAA Form 5010." New Orleans, Louisiana: GCR. & Associates, Inc. Accessed June 3, 2002. ACC: MOL.20020607.0300. http://www.gcr1.com/5010WEB/main.cfm?Site=U75.

GCR 2002c. "Airport Master Record, Furnace Creek Airport. FAA Form 5010." New Orleans, Louisiana: GCR. & Associates, Inc. Accessed June 3, 2002. ACC: MOL.20020607.0298. http://www.gcr1.com/5010WEB/main.cfm?Site=L06.

GCR 2002d. "Airport Master Record, Imvite Airport. FAA Form 5010." New Orleans, Louisiana: GCR. & Associates, Inc. Accessed June 3, 2002. ACC: MOL.20020607.0299. http://www.gcr1.com/5010WEB/main.cfm?Site=NV36.

GCR 2002e. "Airport Master Record, McCarran Intl Airport. FAA Form 5010." New Orleans, Louisiana: GCR. & Associates. Accessed June 3, 2002. ACC: MOL.20020607.0301. http://www.gcr1.com/5010WEB/main.cfm?Site=LAS.

GCR 2002f. "Airport Master Record, North Las Vegas Airport. FAA Form 5010." New Orleans, Louisiana: GCR. & Associates, Inc. Accessed June 3, 2002. ACC: MOL.20020607.0302. http://www.gcr1.com/5010WEB/main.cfm?Site=VGT.

GCR 2002g. "Aircraft Summary and Activity Data for 100-Mile Regional Area of MGR." New Orleans, Louisiana: GCR & Associates. Accessed June 11, 2002. ACC: MOL.20020610.0300. http://www.gcr1.com/5010WEB/default.htm.

Jackson, P.; Munson, K.; and Peacock, P., eds. 2001. *Jane's All the World's Aircraft.* Alexandria, Virginia: Jane's Information Group. TIC: 250899.

Kimura, C.Y, Sanzo, D.L., and Sharirli, M. 2002. *Accidental Aircraft Crash Hit Frequency Analysis of Overflights of the Nevada Test Site (NTS) and the Device Assembly Facility (DAF).* UCRL-ID-131259 Rev. 2. Livermore, California: Lawrence Livermore National Laboratory. MOL.20020515.0090.

Langendorf, J.B. 2002. "Re: DOE Airfields." E-mail from J.B. Langendorf to R. Morissette, January 30, 2002. ACC: MOL.20020515.0093.

NACO (National Aeronautical Charting Office) 2002a. *IFR Enroute High Altitude–U.S.* H-4 Southeast, H-2 Southwest (Central H-2/H-4). Washington D.C.: U.S. Department of Transportation, Federal Aviation Administration. TIC: 252333.

NACO 2002b. *Las Vegas Sectional Aeronautical Chart.* 67th Edition. Washington, D.C.: U.S. Department of Transportation, Federal Aviation Administration. TIC: 252331.

NIMA (National Imagery and Mapping Agency) 2001. *Nevada Test and Training Range Chart.* NTTRCO1. Bethesda, Maryland: National Imagery and Mapping Agency. TIC: 252639.

NRC (U.S. Nuclear Regulatory Commission) 1987. *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants.* NUREG-0800. LWR Edition. Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 203894.

NRC 2000. *Safety Evaluation Report Concerning the Private Fuel Storage Facility, Docket No. 72-22.* Washington, D.C.: U.S. Nuclear Regulatory Commission. TIC: 249827.

NRC 2002. *State of Utah's Prefiled Testimony of Colonel Hugh Horstman (U.S.A.F. Ret.) for Contention Utah K/Confederated Tribes B.* Docket No. 72-22-ISFSI. Washington, D.C.: U.S. Nuclear Regulatory Commission. ACC: MOL.20020607.0303.

PFSF (Private Fuel Storage) 2000. *Aircraft Crash Impact Hazard at the Private Fuel Storage Facility: Report to Nuclear Regulatory Commission, Revision 4.* Salt Lake City, Utah: Private Fuel Storage. TIC: 252276.

Porter, R.D. 2002. "FW: R-2502N/E AUR." E-Mail from R.D. Porter to J. Ziegler, March 27, 2002, with attachments. ACC: MOL.20020515.0095.

Sanzo, D.; Bolig, R.; Stack, D.; Mensing, R.; and Glaser, R. 1996. *ACRAM Modeling Technical Support Document.* LA-UR-96-2460. Los Alamos, New Mexico: Los Alamos National Laboratory. TIC: 252577.

Shively, B.W. 2002. "Fwd[2]: Re: Information Request." E-mail from B.W. Shively to R. Morissette, March 29, 2002. ACC: MOL.20020515.0092.

Smith, R.E. 1983. *A Methodology for Calculation of the Probability of Crash of an Aircraft into Structures in Weapon Storage Areas.* SAND82-2409. Albuquerque, New Mexico: Sandia National Laboratories. ACC: NNA.19910315.0124.

Takenaka, W.H. 2002. "Re: Nellis Information w/Another Question." E-mail from W.H. Takenaka (USAF) to R. Morissette, May 1, 2002. ACC: MOL.20020515.0097.

USAF (U.S. Air Force) 1996. *Weapons Range Management.* AFI 13-212, Volume 2/NAFB Supplement 1. Washington, D.C.: U.S. Department of the Air Force, Space Missile Command and Control. TIC: 252274.

USAF 1999a. *Renewal of the Nellis Air Force Range Land Withdrawal: Legislative Environmental Impact Statement.* Washington, D.C.: U.S. Department of the Air Force. ACC: MOL.20010726.0068.

USAF 1999b. *Flying Operations, Local Operating Procedures.* NAFBI 11-250. Washington, D.C.: U.S. Department of the Air Force, Nellis Air Force Base. ACC: MOL.20020510.0073.

USAF 2001a. *2002 R-2508 Complex User's Handbook.* Washington, D.C.: U.S. Air Force. ACC: MOL.20020510.0072.

USAF 2001b. *Range Planning and Operations.* AFI 13-212, Volume 1. Washington, D.C.: U.S. Department of the Air Force, Space Missile Command and Control. ACC: MOL.20020510.0065.

USAF 2001c. *Safe-Range Program Methodology*. AFI 13-212, Volume 3. Washington, D.C.: U.S. Department of the Air Force, Space Missile Command and Control. ACC: MOL.20020510.0071.

USAF 2001d. *2001 Updated Weapons File*. Eglin Air Force Base, Florida: U.S. Department of the Air Force, Office of the Armament Product Group Manager. ACC: MOL.20020510.0074.

12.2 CODES, STANDARDS, REGULATIONS, AND PROCEDURES

10 CFR 100. Energy: Reactor Site Criteria. Readily available.

10 CFR 63. Energy: Disposal of High-Level Radioactive Wastes in a Geologic Repository at Yucca Mountain, Nevada. Readily available.

14 CFR 95. Aeronautics and Space: IFR Altitudes. Readily available.

67 FR 22479. Finding of No Significant Impact. Readily available.

AP-SI-1Q, Rev. 3, ICN 4. *Software Management*. Las Vegas, Nevada: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20020520.0283.

AP-3.11Q, Rev. 3, ICN 1. *Technical Reports*. Las Vegas, Nevada: U.S. Department of Energy, Office of Civilian Radioactive Waste Management. ACC: MOL.20020404.0078.

12.3 SOURCE DATA, LISTED BY DATA TRACKING NUMBER

MO0004YMP00017.000. Exploratory Studies Facility and Cross Drift. Submittal date: 05/18/2000.

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APPENDIX A

GLOSSARY

APPENDIX A

GLOSSARY

Air-to-Air Guided Missile—An air-launched guided missile for use against air targets.

Air-to-Ground Guided Missile—An air-launched guided missile for use against surface targets.

Airway—A control area or portion thereof established in the form of a corridor marked with radio navigational aids.

Arming—As applied to explosives, weapons, and ammunition, the changing from a safe condition to a state of readiness for initiation.

Armor Piercing Incendiary (API)—A 30-mm round consisting of a 0.66 pound extruded depleted uranium projectile, alloyed with 0.75 weight percent titanium, encased in a 0.8 mm-thick aluminum shell and windscreen.

Captive Ordnance—Ordnance is inert (no explosives) and non-launchable.

Chaff—Radar confusion reflectors, consisting of thin, narrow metallic strips of various lengths and frequency responses, which are used to reflect echoes for confusion purposes. Causes enemy radar guided missiles to lock on to it instead of the real aircraft, ship, or other platform.

Cluster Bomb—American cluster bombs, generally known as "cluster bomb units", or CBUs, are organized around several general canisters that can be filled with a variety of different submunitions. See dumb bombs.

Cruise Missile—Guided missile, the major portion of whose flight path to its target is conducted at approximately constant velocity; depends on the dynamic reaction of air for lift and upon propulsion forces to balance drag.

Deployable Ordnance—Ordnance capable of being launched from an aircraft.

Dumb Bombs—Aerial dumb bombs come in a variety of forms. They can be in the shape of finned spindles or pills, teardrops, or cans, and a few have been built in the form of a sphere. They can consist of a single unit, making them "unitary" bombs, or can carry hundreds of small "submunitions" that are scattered over a target area after release, making them "cluster" bombs. Bombs can be as small as a few kilograms, but the largest one ever dropped in combat weighed ten tonnes (22,000 pounds). Common modern bomb sizes are 500 (MK-82), 1,000 (MK-83), and 2,000 pounds (MK-84).

Dummy Ordnance—contain small phosphorescent charge to indicate site of hit.

Electronic Combat Range (ECR)—An electronic warfare test environment for developmental and operational test and evaluation of airborne electronic warfare devices and systems, development of aircraft tactics, and training of aircrews. ECR equipment may consist of surface-

to-air missile simulators, anti-aircraft artillery simulators, surface-to-air launch simulator, and ground-based jamming systems.

Flare—Aircraft flares are used to illuminate large areas for bombardment, reconnaissance, emergency aircraft landing, or any other purpose where a high-intensity light is required.

Flight Level—Surfaces of constant atmospheric pressure which are related to a specific pressure datum. Flight levels are expressed in three digits that represent hundreds of feet (e.g., flight level 250 represents a barometric altimeter indication of 25,000 feet and flight level 255 is an indication of 25,500 feet).

Fuze—A fuze is a device that causes the detonation of an explosive charge at the proper time after certain conditions are met. A bomb fuze is a mechanical or an electrical device. It has the sensitive explosive elements (the primer and detonator) and the necessary mechanical/electrical action to detonate the main burster charge.

Glide Bomb—A bomb fitted with airfoils to provide lift and which is carried and released in the direction of a target by an airplane.

Glide Capability—The distance an aircraft can travel without powered acceleration. This distance is the product of the maximum lift-drag ratio of the aircraft times the altitude of the aircraft.

Guided Weapon—A weapon that has no propulsion but does have guidance control capability.

Glide Bomb Unit—GBUs are general-purpose bombs configured with a wing assembly and a computer guidance system.

Hung Ordnance—Ordnance with an attempt to release that malfunctions and fails to leave the aircraft.

Inert Filling—A prepared non-explosive filling of the same weight as the explosive filling.

Inert Ordnance—Any full scale ordnance (other than training ordnance) with explosive or incendiary material removed.

Joint Use—Joint usage of specific airspace by civilian aircraft and various United States armed forces units authorized with concurrence of the military controlling unit.

Live Munitions [training ordnance]—Munitions containing a fuze and high explosive material designed to detonate either prior to or upon impact with the Target Area. Munitions range from bombs, to missiles, rockets, and bullets.

Live Ordnance—Combat type ordnance with explosive or incendiary material, including night illumination flares. Self protection flares and spotting charges are not considered live ordnance. Aircraft configured with mixed ordnance loads will be considered live loaded for the sortie.

Military Operations Area (MOA)—Special use airspace allocated to the military to separate/segregate certain military activities from IFR traffic, and to identify the location of these military activities to CFR traffic. MFR traffic is not restricted from transiting MOAs.

Military Training Route (MTR) —A low-level, high-speed training route used by the U.S. Department of Defense to conduct low altitude navigation and tactical training, in instrument and visual weather conditions, below an altitude of 10,000 feet AMSL and at airspeeds more than 250 knots calibrated airspeed (KCAS). Routes are established as IRs or VRs.

Ordnance—Explosives, chemicals, pyrotechnics, and similar stores (e.g., bombs, guns and ammunition, flares, smoke, or napalm).

Penetrator—Dense projectile component of ammunition round designed to pierce armor.

Practice Bombs [training ordnance]—Practice bombs may be full scale or miniature. Some practice bombs contain a small explosive charge or pyrotechnic that marks the point of impact with a small cloud of smoke or flash. For example, BDU-33 practice bombs contain a MK 4 spotting charge, and MK 82 practice bombs may contain 6.25 pounds of composition C-4 high explosive.

Restricted Area—Area where the flight of an aircraft, while not wholly prohibited, is subject to restriction. When not activated by the using agency, the controlling air traffic control facility may authorize IFR or VFR operations in the area. If joint use is authorized, the name of the air traffic control controlling facility is annotated on the map.

Safe Ordnance—Ordnance launched or jettisoned without the fuze being activated and will not explode on impact.

SAFE-RANGE Program Methodology—A systematic procedure for applying training weapon safety footprints to perform a quantitative risk assessment of aircraft ordnance deliveries.

Sortie—A term to describe a single training flight performed by one aircraft from takeoff through landing.

Target Area—The area on a range complex that immediately surrounds the target or designated mean point of impact. The target area demarcation should normally be no less than 1,000 feet from the center of the target or designated mean point of impact.

Training Ordnance—Munitions such as the AGM-65 Maverick missile, the 2.75-inch folding fin propellant-driven rocket, MK-106 and BDU-33 bombs, and 7.62-mm, 30-mm, 20-mm, and .50-caliber ammunition (or equivalents). See Appendix C for description of ordnance.

Weapon Safety Footprint Area—A closed contour that defines the land area containing 99.99 percent (at a 95 percent confidence level) of initial impacts and ricochets, resulting from the release of a specified weapon during air-to-ground weapon delivery events.

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APPENDIX B

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Table B-1. Aircraft In Nevada Test And Training Range Military Operations Areas

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
F-15C Eagle	Aircraft Handling Characteristics	5,000 ft AGL to 30,000 ft AMSL	0 KCAS to mach 1.0	None	Maneuverability exercises
F-15C Eagle	Basic Fighter Maneuvers	10,000 feet AGL to 30,000 feet AMSL	0 KCAS to mach 1.0	1 AIM-9M, chaff/flares	Maneuverability exercises
F-15C Eagle	Air Combat Maneuvers	10,000 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.1	1 AIM-9M, chaff/flares	Aircraft intercept against various adversary formations and tactics
F-15C Eagle	Step Down Training	300 feet AGL to 20,000 feet AMSL	0 KCAS to mach 1.0	1 AIM-9M, chaff/flares	Demonstrate proficiency in low altitude offensive and defensive tasks
F-15C Eagle	Tactical Intercepts	300 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	Perform 2 and 4-ship intercept mission against various formations and tactics
F-15C Eagle	Night	10,000 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	4 versus 4 intercepts in an area defense mode
F-15C Eagle	Dissimilar Air Combat Tactics	300 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	Perform point defense scenarios and employ ordnance
F-15C Eagle	Mission Employment	300 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	Plan a composite strike force with 6-ship plus unknown number of friendly aircraft, adversaries, and bombers with electronic countermeasures (ECM)
F-15E Strike Eagle	Advanced Handling Characteristics	5,000 feet AGL to 30,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9	Maneuverability exercises
F-15E Strike Eagle	Basic Fighter Maneuvers	5,000 feet AGL to 30,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9M, chaff/flares	Maneuverability exercises
F-15E Strike Eagle	Tactical Intercepts	500 feet AGL to 40,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9M, chaff/flares	Perform 1, 2, and 4-ship low altitude intercepts against various formations and tactics

Table B-1. Aircraft In Nevada Test And Training Range Military Operations Areas (Continued)

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
F-15E Strike Eagle	Air Combat Maneuvering/Air Combat Tactics	500 feet AGL to 40,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9M, chaff/flares	3-ship and 1/2/4/6 adversaries
F-15E Strike Eagle	Mission Employment	300 feet AGL to 30,000 feet AMSL	350 KCAS to mach 1.0	2 GBU-10(I), 2 GBU-12(I), 12 MK-82 AIR(I) 12 MK-82LD(I), captive AIM-9, chaff/flares	Tactical ingress of a coordinated strike package, reaction to airborne and surface threats, delivery of inert ordnance, and tactical egress.
F-16 Falcon	Advanced Handling Characteristics	5000 feet AGL to 30,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9	Airborne systems check, G-awareness exercise, gun tracking exercise, local area orientation, and low approach at Indian Springs AFAF
F-16 Falcon	Basic Fighter Maneuvers	5000 feet AGL to 30,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9, flares	Gun/missile exercises, 1 versus 1 maneuvering
F-16 Falcon	Tactical Intercepts/Air Combat Maneuvering	500 feet AGL to 40,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9, chaff/flares	Single/multiple ship intercepts against low altitude aircraft
F-16 Falcon	Air Combat Tactics	500 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.3	Captive AIM-9, chaff/flares	Defend a specified point from four to six adversaries
A/OA-10 Thunderbolt II	Dissimilar Air Combat Tactics/Defensive Low Altitude Air-to-Air Training	300 feet AGL to 25,000 feet AMSL	120 to 450 KCAS	Chaff/flares, 1 captive AIM-9M	2-ship, 4 adversaries. Demonstrate and instruct mutual support and defensive maneuvers.
A/OA-10 Thunderbolt II	Mission Employment	300 feet AGL to 30,000 feet AMSL	300 to 350 KCAS	6 BDU-33, 1 TGM-65D/G, chaff/flares, 1 captive AIM-9M	2/3/4-ship, 2 dissimilar escorts, 2 adversaries. Employment of AGM-65, gun, free-fall ordnance, and LUU/2A/B flares and/or night vision goggles in a complex night composite force scenario against fixed and mobile targets
F-16C Falcon CTS/AT Adversary Tactics	Local Area Orientation	10,000 AGL to 50,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9	Local area familiarization and procedures orientation. G-awareness exercise, air-to-air intercepts, low approach at Indian Springs AFAF

Table B-1. Aircraft In Nevada Test And Training Range Military Operations Areas (Continued)

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
F-16C Falcon CTS/AT Adversary Tactics	Single Air Combat	10,000 AGL to 50,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9, chaff/flares	Introduce Former Soviet Union (FSU) formations, basic offensive and defensive maneuvers, and gun exercises
F-16C Falcon CTS/AT Adversary Tactics	Element Air Combat	10,000 AGL to 50,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9, chaff/flares	Employ FSU element offensive maneuvers against single bandit
F-16C Falcon CTS/AT Adversary Tactics	Low Altitude Step Down Training	500 AGL to 30,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9, chaff/flares	2-ship, 2 adversaries. Demonstrate low altitude maneuvers, pursuit, and weapons employment
F-16C Falcon CTS/AT Adversary Tactics	Element Combat Tactics	10,000 AGL to 50,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9, chaff/flares	2/4-ship, 2/4 adversaries. Practice basic Mig-29 FULCRUM formations and tactics
HH-60G Pave Hawk Helicopter	Basic Helicopter Maneuvers	Surface to 1000 AGL	0 to 140 KCAS	Clean	Helicopter maneuvers and 2-ship maneuvers
HH-60G Pave Hawk Helicopter	Defensive Maneuvering Air	Surface to 1000 AGL	0 to 140 KCAS	chaff, 2 M-60 with 7.62-mm blanks	2-ship, up to two helicopter aggressors and 2 fixed wing aggressors. Defensive and offensive maneuvers
HH-60G Pave Hawk Helicopter	Low-Level Navigation Training	Surface to 200 AGL	0 to 140 KCAS	2 M-60 with 1,500 7.62 mm blanks	1-3 ship operation
B-52 Statofortress	Red/Green Flag, Mission Employment/ Strike Phase	300 AGL to 39,000 AMSL	340 to 420 KTAS	Simulated bombs and missiles	Transition to Series 60/70 ranges

Table B-2. Aircraft Operating In Nevada Test And Training Range 60 Series Ranges

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
F-15C Eagle	Air Combat Maneuvers	10,000 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.1	1 AIM-9M, chaff/flares	Aircraft intercept against various adversary formations and tactics
F-15C Eagle	Step Down Training	300 feet AGL to 20,000 feet AMSL	0 KCAS to mach 1.0	1 AIM-9M, chaff/flares	Demonstrate proficiency in low altitude offensive and defensive tasks
F-15E Strike Eagle	Surface Attack	75 feet AGL to 25,000 feet AMSL	350-600 KCAS	200 20-mm target practice (TP), 1 BDU-38, 4 MK-106, BDU-33, TGM-65, TGBU-15, TAGM-130, captive AIM-9, chaff/flares	Airborne system checks, day and night low altitude navigation, 2-ship day/night formation training. High and low altitude free-fall weapons delivery, laser guided delivery, & simulated nuclear weapon delivery.
F-15E Strike Eagle	Weapons, day/night	75 feet AGL to 25,000 feet AMSL	350-600 KCAS	12 live CBU-52/58/71, 12 live MK-20, 12 live MK-82 (air), 12 live MK-82 LD, 1 GBU-15(I), 1 GBU-24(I), 1 AGM-65D/G, 2 TGM-64D/G, 2 live GBU-10, 2 live MK-84 AIR, 2 MK-84 LD, 12 live CBU-87, captive AIM-9, chaff/flares	Tactical ingress, reactions to airborne and surface threats, delivery of live or inert ordnance on tactical targets, and tactical egress
F-16 Falcon	Advanced Handling Characteristics	5000 feet AGL to 30,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9	Airborne systems check, G-awareness exercise, gun tracking exercise, local area orientation, and low approach at Indian Springs AFAF
F-16 Falcon	Surface Attack	100 feet AGL to 30,000 feet AMSL	350 to 550 KCAS	4-6 BDU-33, 4 MK-106, 250 20-mm TP	Low altitude step-down training with ordnance deliveries
F-16 Falcon	Surface Attack Tactics	300 feet AGL to 30,000 feet AMSL	350 to 550 KCAS	12 BDU-33, 1CATM-88, 6 MK-82 AIR Inert, 2 GBU-12(I), captive AIM-9, chaff/flares	Two/four ship low altitude ingress, low altitude adversary threat reactions, single ship surface to air threat reactions, four-ship attacks against enemy air defense targets, attacks employing LGB ordnance and LANTIRN, escape and egress maneuvers

Table B-2. Aircraft Operating In Nevada Test And Training Range 60 Series Ranges (Continued)

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
F-16 Falcon	Close Air Support	500 feet AGL to 30,000 feet AMSL	350 to 550 KCAS	1 TGM-65A/B, 1 TGM 65D/G, 1 AGM-65D/G (live), 2 GBU-12 (inert), chaff/flares	Night low-level (500 AGL) using LANTIRN, one and two ship maverick attacks (300 AGL), coordinated attacks, live AGM-65D/G and tactical egress
F-16 Falcon	Night	500 feet AGL to 30,000 feet AMSL	350 to 550 KCAS	2 TGM-65D/G, 2 GBU-12 (live), chaff/flares	LANTIRN TFR checks, 2/4 ship low and medium altitude ingress, preplanned night attacks with inert and live ordnance and tactical egress.
A/OA-10 Thunderbolt II	Advanced Handling Characteristics	5000 feet AGL to 25,000 feet AMSL	120 to 350 KCAS	Clean	Local area orientation, low altitude navigation, maneuvering and formation, vertical recovery, stall series, and performance exercises.
A/OA-10 Thunderbolt II	Basic Fighter Maneuvers	5000 feet AGL to 25,000 feet AMSL	120 to 350 KCAS	1 captive AIM-9M, flares	Perform BFM and practice low altitude flying
A/OA-10 Thunderbolt II	Surface Attack	100 feet AGL to 25,000 feet AMSL	200 to 400 KCAS	18 BDU-33s, 4 2.75-inch TP rocket, 30-mm TP or combat mix, 1 TGM-65A/B or live AGM-65A/B and 1 TGM-65D/G or live AGM-65D/G, 1 GBU-12, 2 CBU-52/58, 2 CBU-87, 2 MK-20, 6 MK-82LDGP(live), 7 white phosphorous rocket (WP RX), chaff	Perform weapons deliveries. Demonstrate 2-ship holding options, attack formations, mutual support considerations, and delivery options in a high threat environment
A/OA-10 Thunderbolt II	Weapons Employment	100 feet AGL to 25,000 feet AMSL	250 to 350 KCAS	12 MK-82LDGP(live), 8 MK-82HDGP(live), 14 2.75-inch rockets, 3 MK84(live), or 2 MK84(live) with 1 TGM-65A/B and 1 TGM-65D/G, 500 rounds 30-mm TP, flares/chaff	2/4-ship with high threat scenario. Demonstrate holding options, threat tactics, use ordnance. Employ low drag tactical options and analyze A-10 heavyweight handling characteristics.
A/OA-10 Thunderbolt II	Combat Search and Rescue	100 feet AGL to 20,000 feet AMSL	200 to 400 KCAS	6 BDU-33, 2 TGM-65 A/B/C/D, 400 rounds 30-mm TP, 14 2.75-inch WP RX, flares	4-ship demonstrate SAR in a tactical alert scenario including threat suppression and weapon employment.

Table B-2. Aircraft Operating In Nevada Test And Training Range 60 Series Ranges (Continued)

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
A/OA-10 Thunderbolt II	Night	2,000 feet AGL to 20,000 feet AMSL	200 to 400 KCAS	9 BDU-33, 1 GBU-12, 2 MK 84LDGP(live), 4 2.75-inch WP RX, 300 rounds 30-mm TP, 2 TGM-65D/G (live AGM-65 may be substituted), flares	2-ship, demonstrate basic night weapons deliveries, various flare deliveries, laser and Pave Penney pod options, low intensity CAS, Air Interdictions, low threat tactics using illumination flares and MK84 bombs in a night tactical CAS scenario.
A/OA-10 Thunderbolt II	Dissimilar Air Combat Tactics/Defensive Low Altitude Air-to-Air Training	300 feet AGL to 25,000 feet AMSL	120 to 450 KCAS	Chaff/flares, 1 captive AIM-9M	2-ship, 4 adversaries. Demonstrate and instruct mutual support and defensive maneuvers.
A/OA-10 Thunderbolt II	Mission Employment	300 feet AGL to 30,000 feet AMSL	300 to 350 KCAS	6 BDU-33, 1 TGM-65D/G, chaff/flares, 1 captive AIM-9M	2/3/4-ship, 2 dissimilar escorts, 2 adversaries; employment of AGM-65, gun, free-fall ordnance, and LUU/2A/B flares and/or night vision goggles in a complex night composite force scenario against fixed and mobile targets
F-16C Falcon CTS/AT Adversary Tactics	Local Area Orientation	10,000 AGL to 50,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9	Local area familiarization and procedures orientation. G-awareness exercise, air-to-air intercepts, low approach at Indian Springs AFAF
F-16C Falcon CTS/AT Adversary Tactics	Single Air Combat	10,000 AGL to 50,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9, chaff/flares	Introduce FSU formations, basic offensive and defensive maneuvers, and gun exercises
F-16C Falcon CTS/AT Adversary Tactics	Element Air Combat	10,000 AGL to 50,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9, chaff/flares	Employ FSU element offensive maneuvers against single bandit
F-16C Falcon CTS/AT Adversary Tactics	Low Altitude Step Down Training	500 AGL to 30,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9, chaff/flares	2-ship, 2 adversaries. Demonstrate low altitude maneuvers, pursuit, and weapons employment
F-16C Falcon CTS/AT Adversary Tactics	Element Combat Tactics	10,000 AGL to 50,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9, chaff/flares	2/4-ship, 2/4 adversaries. Practice basic Mig-29 FULCRUM formations and tactics

Table B-2. Aircraft Operating In Nevada Test And Training Range 60 Series Ranges (Continued)

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
F-16C/D Falcon Thunderbirds	USAF Demonstration Squadron	250 AGL to 18,000 AMSL	110 KCAS to 0.94 mach	Smoke ejectors	Single and six-ship formations flying at Indian Spring AFAF within R-65
HH-60G Pave Hawk Helicopter	Basic Helicopter Maneuvers	Surface to 1,000 AGL	0 to 140 KCAS	Clean	Helicopter maneuvers and 2-ship maneuvers
HH-60G Pave Hawk Helicopter	Defensive Maneuvering Air	Surface to 1,000 AGL	0 to 140 KCAS	Chaff, 2 M-60 with 7.62-mm blanks	2-ship, up to two helicopter aggressors and 2 fixed wing aggressors. Defensive and offensive maneuvers
HH-60G Pave Hawk Helicopter	Combat Search and Rescue Task Force Scenario	Surface to 1,000 AGL	0 to 140 KCAS	2 M-60 with 800 7.62-mm blanks, chaff	2-ship, HC-130, escort aircraft, survivor, and ground aggressors; instruct SAR in a tactical alert, preplanned scenario; two sorties conducted at night
B-52 Statofortress	Red/Green Flag, Mission Employment/ Strike Phase	300 AGL to 39,000 AMSL	340 to 420 KTAS	Simulated bombs and missiles.	Transition to Series 60/70 ranges
Predator UAV	Flight Training	1500 AGL to 60,000 AMSL	65 to 300+ knots	None	Flight pattern work in R-63, R-64, and R-65 and use of airspace to climb UAV into positive control area above 18,000 AMSL

Table B-3. Aircraft Operating In Nevada Test And Training Range 70 Series Ranges

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
F-15C Eagle	Step Down Training	300 feet AGL to 20,000 feet AMSL	0 KCAS to mach 1.0	1 AIM-9M, chaff/flares	Demonstrate proficiency in low altitude offensive and defensive tasks
F-15C Eagle	Tactical Intercepts	300 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	Perform 2 and 4-ship intercept mission against various formations and tactics
F-15C Eagle	Night	10,000 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	4 versus 4 intercepts in an area defense mode
F-15C Eagle	Dissimilar Air Combat Tactics	300 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	Perform point defense scenarios and employ ordnance
F-15C Eagle	Mission Employment	300 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	Plan a composite strike force with 6-ship plus unknown number of friendly aircraft, adversaries, and bombers with electronic countermeasures (ECM)
F-15E Strike Eagle	Tactical Intercepts	500 feet AGL to 40,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9M, chaff/flares	Perform 1, 2, and 4-ship low altitude intercepts against various formations and tactics
F-15E Strike Eagle	Surface Attack	75 feet AGL to 25,000 feet AMSL	350-600 KCAS	200 20-mm TP, 1 BDU-38, 4 MK-106, BDU-33, TGM-65, TGBU-15, TAGM-130, Captive AIM-9, chaff/flares	Airborne system checks, day and night low altitude navigation, 2-ship day/night formation training. High and low altitude free-fall weapons delivery, laser guided delivery, & simulated nuclear weapon delivery.
F-15E Strike Eagle	Air Combat Maneuvering/Air Combat Tactics	500 feet AGL to 40,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9M, chaff/flares	3-ship and 1/2/4/6 adversaries
F-15E Strike Eagle	Surface Attack Tactics, day/night	75 feet AGL to 25,000 AMSL	350-600 KCAS	12 BDU-33, 12 BDU-50, 2 MK-84LD(I), 2 GBU-10(I), captive AIM-9, chaff/flares	2/4-ship, up to 4 adversaries, tactical ingress at low/medium altitude, surface and airborne threat reactions, attack on tactical targets, weapons delivery escape maneuvers.

Table B-3. Aircraft Operating In Nevada Test And Training Range 70 Series Ranges (Continued)

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
F-15E Strike Eagle	Weapons, day/night	75 feet AGL to 25,000 feet AMSL	350-600 KCAS	12 live CBU-52/58/71, 12 live MK-20, 12 live MK-82 air, 12 live MK-82 LD, 1 GBU-15(I), 1 GBU-24(I), 1 AGM-65D/G, 2 TGM-64D/G, 2 live GBU-10, 2 live MK-84 AIR, 2 MK-84 LD, 12 live CBU-87, captive AIM-9, chaff/flares	Tactical ingress, reactions to airborne and surface threats, delivery of live or inert ordnance on tactical targets, and tactical egress
F-15E Strike Eagle	Mission Employment	300 feet AGL to 30,000 feet AMSL	350 KCAS to mach 1.0	2 GBU-10(I), 2 GBU-12(I), 12 MK-82 AIR(I) 12 MK-82LD(I), captive AIM-9, chaff/flares	Tactical ingress of a coordinated strike package, reaction to airborne and surface threats, delivery of inert ordnance, and tactical egress.
F-16 Falcon	Surface Attack	100 feet AGL to 30,000 feet AMSL	350 to 550 KCAS	4-6 BDU-33, 4 MK-106, 250 20-mm TP	Step-down training with ordnance deliveries
F-16 Falcon	Surface Attack Tactics	300 feet AGL to 30,000 feet AMSL	350 to 550 KCAS	12 BDU-33, 1CATM-88, 6 MK-82 AIR Inert, 2 GBU-12(I), captive AIM-9, chaff/flares	Two/four ship low altitude ingress, low altitude adversary threat reactions, single ship surface to air threat reactions, four-ship attacks against enemy air defense targets, attacks employing LGB ordnance and LANTIRN, escape and egress maneuvers.
F-16 Falcon	Weapons	300 feet AGL to 50,000 feet AMSL	350 KCAS to mach 1.2	2 TGM-65D/G, 2 GBU-12 (live), 4 MK-20, 4 CBU-52/58, 2 CBU-87 or CBU-58, 6MK-82 LDGP, 2 MK-84, captive AIM-9, chaff/flares	4 to 8 ships, up to 8 adversaries; medium or low altitude ingress; preplanned attacks with inert or live weapons; tactical egress
F-16 Falcon	Night	500 feet AGL to 30,000 feet AMSL	350 to 550 KCAS	2 TGM-65D/G, 2 GBU-12 (live), chaff/flares	LANTIRN TFR checks, 2/4 ship low and medium altitude ingress, preplanned night attacks with inert and live ordnance and tactical egress.
F-16 Falcon	Mission Employment	500 feet AGL to 30,000 feet AMSL	350 KCAS to mach 1.2	2 TGM-65D/G, chaff/flares	4-ships, 4-bombers, 4 adversaries; night composite force employment or defend a specified area from adversary air threat; tactical ingress at 5000 or 500 AGL

Table B-3. Aircraft Operating In Nevada Test And Training Range 70 Series Ranges (Continued)

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
A/OA-10 Thunderbolt II	Surface Attack	100 feet AGL to 25,000 feet AMSL	200 to 400 KCAS	18 BDU-33, 4 2.75-inch TP rocket, 30-mm TP or combat mix, 1 TGM-65A/B or live AGM-65A/B and 1 TGM-65D/G or live AGM-65D/G, 1 GBU-12, 2 CBU-52/58, 2 CBU-87, 2 MK-20, 6 MK-82LDGP(live), 7 WP RX, flares/chaff	Perform weapons deliveries. Demonstrate 2-ship holding options, attack formations, mutual support considerations, and delivery options in a high threat environment
A/OA-10 Thunderbolt II	Weapons Employment	100 feet AGL to 25,000 feet AMSL	200 to 400 KCAS	12 MK 82LDGP (live), 14 2.75-inch rockets, 8 MK82 HDGP (live), 14 HE 2.75-inch rockets, 3 MK 84(live) or 2 MK84 (live) with 1 TGM-65A/B and 1 TGM-65D/G(live AGM-65s may be substituted), 500 rounds 30-mm TP, flares/chaff	2/4-ship with high threat scenario. Demonstrate holding options, threat tactics, use ordnance. Employ low drag tactical options and analyze A-10 heavyweight handling characteristics.
A/OA-10 Thunderbolt II	Combat Search and Rescue	100 feet AGL to 20,000 feet AMSL	200 to 400 KCAS	6 BDU-33, 2 TGM-65 A/B/C/D, 400 rounds 30-mm TP, 14 2.75-inch WP RX, flares	4-ship demonstrate SAR in a tactical alert scenario including threat suppression and weapon employment.
A/OA-10 Thunderbolt II	Mission Employment	300 feet AGL to 30,000 feet AMSL	300 to 350 KCAS	6 BDU-33, 1 TGM-65D/G, chaff/flares, 1 captive AIM-9M	2/3/4-ship, 2 dissimilar escorts, 2 adversaries; employment of AGM-65, gun, free-fall ordnance, and LUU/2A/B flares and/or night vision goggles in a complex night composite force scenario against fixed and mobile targets
F-16C Falcon CTS/AT Adversary Tactics	Local Area Orientation	10,000 AGL to 50,000 AMSL	200 KCAS to mach 1.2	Captive AIM-9	Local area familiarization and procedures orientation. G-awareness exercise, air-to-air intercepts, low approach at Indian Springs AFAF
HH-60G Pave Hawk Helicopter	Defensive Maneuvering Ground	Surface to 1,000 AGL	0 to 140 KCAS	Chaff	2-ship, demonstrate ability to evade electronic threats day and night, defensive maneuvers against ground based threats

Table B-3. Aircraft Operating In Nevada Test And Training Range 70 Series Ranges (Continued)

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
HH-60G Pave Hawk Helicopter	Mission Employment	Surface to 1,000 AGL	0 to 140 KCAS	Chaff, 2 M-60 with 1500 7.62-mm live	2-ship operation, HC-130, escort aircraft, survivor, fixed wing or helicopter aggressor, ground aggressors; instruct in a preplanned scenario against a hostile force
HH-60G Pave Hawk Helicopter	Electronic Combat	Surface to 1,000 AGL	0 to 140 KCAS	Chaff, 2 M-60 with 1500 7.62-mm live	2-ship may conduct repelling operations
B-52 Statofortress	Red/Green Flag, Mission Employment/ Strike Phase	300 AGL to 39,000 AMSL	340 to 420 KTAS	Simulated bombs and missiles.	Transition to Series 60/70 ranges

Table B-4. Aircraft Operating In Nevada Test And Training Range Alamo Ranges

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
F-15C Eagle	Air Combat Maneuvers	10,000 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.1	1 AIM-9M, chaff/flares	Aircraft intercept against various adversary formations and tactics
F-15C Eagle	Step Down Training	300 feet AGL to 20,000 feet AMSL	0 KCAS to mach 1.0	1 AIM-9M, chaff/flares	Demonstrate proficiency in low altitude offensive and defensive tasks
A/OA-10 Thunderbolt II	Advanced Handling Characteristics	5,000 feet AGL to 25,000 feet AMSL	120 to 350 KCAS	Clean	Local area orientation, low altitude navigation, maneuvering and formation, vertical recovery, stall series, and performance exercises
A/OA-10 Thunderbolt II	Basic Fighter Maneuvers	5,000 feet AGL to 25,000 feet AMSL	120 to 350 KCAS	1 captive AIM-9M, flares	Perform BFM and practice low altitude flying
HH-60G Pave Hawk Helicopter	Combat Search and Rescue Task Force Scenario	Surface to 1,000 AGL	0 to 140 KCAS	2 M-60 with 800 7.62-mm blanks, chaff	2-ship, HC-130, escort aircraft, survivor, and ground aggressors; instruct SAR in a tactical alert, preplanned scenario; two sorties conducted at night

Table B-5. Aircraft Operating In Nevada Test And Training Electonic Combat Ranges

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
F-15C Eagle	Tactical Intercepts	300 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	Perform 2 and 4-ship intercept mission against various formations and tactics
F-15C Eagle	Night	10,000 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	4 versus 4 intercepts in an area defense mode
F-15C Eagle	Mission Employment	300 feet AGL to 50,000 feet AMSL	0 KCAS to mach 1.5	1 AIM-9M, chaff/flares	Plan a composite strike force with 6-ship plus unknown number of friendly aircraft, adversaries, and bombers with electronic countermeasures (ECM)
F-15E Strike Eagle	Air Combat Maneuvering/Air Combat Tactics	500 feet AGL to 40,000 feet AMSL	0 KCAS to mach 1.0	Captive AIM-9M, chaff/flares	3-ship and 1/2/4/6 adversaries
F-15E Strike Eagle	Surface Attack Tactics, day/night	75 feet AGL to 25,000 AMSL	350-600 KCAS	12 BDU-33, 12 BDU-50, 2 MK-84LD(I), 2 GBU-10(I), captive AIM-9, chaff/flares	2/4-ship, up to 4 adversaries, tactical ingress at low/medium altitude, surface and airborne threat reactions, attack on tactical targets, weapons delivery escape maneuvers
F-15E Strike Eagle	Mission Employment	300 feet AGL to 30,000 feet AMSL	350 KCAS to mach 1.0	2 GBU-10(I), 2 GBU-12(I), 12 MK-82 AIR(I) 12 MK-83LD(I), captive AIM-9, chaff/flares	Tactical ingress of a coordinated strike package, reaction to airborne and surface threats, delivery of inert ordnance, and tactical egress
F-16 Falcon	Surface Attack	100 feet AGL to 30,000 feet AMSL	350 to 550 KCAS	4-6 BDU-33, 4 MK-106, 250 20-mm TP	Low altitude step-down training with ordnance deliveries
F-16 Falcon	Surface Attack Tactics	300 feet AGL to 30,000 feet AMSL	350 to 550 KCAS	12 BDU-33, 1CATM-88, 6 MK-82 AIR Inert, 2 GBU-12(I), captive AIM-9, chaff/flares	Two/four ship low altitude ingress, low altitude adversary threat reactions, single ship surface to air threat reactions, four-ship attacks against enemy air defense targets, attacks employing LGB ordnance and LANTIRN, escape and egress maneuvers
F-16 Falcon	Mission Employment	500 feet AGL to 30,000 feet AMSL	350 KCAS to mach 1.2	2 TGM-65D/G, chaff/flares	4-ships, 4-bombers, 4 adversaries; night composite force employment or defend a specified area from adversary air threat; tactical ingress at 5000 or 500 AGL

Table B-5. Aircraft Operating In Nevada Test And Training Electonic Combat Ranges (Continued)

Aircraft	Mission	Altitude	Airspeed	Weapon Configurations	Tasks
A/OA-10 Thunderbolt II	Surface Attack	100 feet AGL to 25,000 feet AMSL	200 to 400 KCAS	18 BDU-33s, 4 2.75-inch TP rocket, 30-mm TP or combat mix, 1 TGM-65A/B or live AGM-65A/B and 1 TGM-65D/G or live AGM-65D/G, 1 GBU-12, 2 CBU-52/58, 2 CBU-87, 2 MK-20, 6 MK-82LDGP (live), 7 WP RX, chaff	Perform weapons deliveries. Demonstrate 2-ship holding options, attack formations, mutual support considerations, and delivery options in a high threat environment
A/OA-10 Thunderbolt II	Weapons Employment	100 feet AGL to 25,000 feet AMSL	200 to 400 KCAS	12 MK 82LDGP (live), 8 MK82 HDGP (live), 14 HE 2.75-inch rockets, 3 MK-84 (live) or 2 MK84 (live) with 1 TGM-65A/B and 1 TGM-65D/G (live AGM-65s may be substituted), 500 rounds 30-mm TP, flares/chaff	2/4-ship with high threat scenario. Demonstrate holding options, threat tactics, use ordnance; employ low drag tactical options and analyze A-10 heavyweight handling characteristics
A/OA-10 Thunderbolt II	Combat Search and Rescue	100 feet AGL to 20,000 feet AMSL	200 to 400 KCAS	6 BDU-33, 2 TGM-65 A/B/C/D, 400 rounds 30-mm TP, 14 2.75-inch WP RX, flares	4-ship demonstrate SAR in a tactical alert scenario including threat suppression and weapon employment
A/OA-10 Thunderbolt II	Mission Employment	300 feet AGL to 30,000 feet AMSL	300 to 350 KCAS	6 BDU-33, 1 TGM-65D/G, chaff/flares, and 1 captive AIM-9M.	2/3/4-ship, 2 dissimilar escorts, 2 adversaries; employment of AGM-65, gun, free-fall ordnance, and LUU/2A/B flares and/or night vision goggles in a complex night composite force scenario against fixed and mobile targets
HH-60G Pave Hawk Helicopter	Mission Employment	Surface to 1000 AGL	0 to 140 KCAS	Chaff, 2 M-60 with 1500 7.62-mm live	2-ship operation, HC-130, escort aircraft, survivor, fixed wing or helicopter aggressor, ground aggressors. Instruct in a preplanned scenario against a hostile force
HH-60G Pave Hawk Helicopter	Electronic Combat	Surface to 1000 AGL	0 to 140 KCAS	Chaff, 2 M-60 with 1500 7.62-mm live	2-ship may conduct repelling operations
B-52 Statofortress	Red/Green Flag, Mission Employment/ Strike Phase	300 AGL to 39,000 AMSL	340 to 420 KCAS	Simulated bombs and missiles.	Transition to Series 60/70 ranges

Source: USAF 1999a, Volume 2, Appendix A.3.

APPENDIX C
ORDNANCE USED BY NTTR AND R-2508 COMPLEX

APPENDIX C

ORDNANCE USED BY NTTR AND R-2508 COMPLEX

Name/Designation	Type	Reference
	Air-to-Ground Missiles and Rockets	
AGM-65	Maverick. For use against tanks and hardened targets. Propulsion: Solid propellant rocket motor. Aircraft Options: A-10, F-15E, F-16.	Jackson 2001, p. 820
AGM-84	Harpoon. Anti-ship. Propulsion: Turbojet sustainer engine. Aircraft Option: A-10, F-16, B-52.	Jackson 2001, p. 819
AGM-86	Air Launched Cruise Missile [ALCM]. Used to increase effectiveness of B-52 bombers. Propulsion: Turbofan engine. Aircraft Option: B52H.	USAF 2001d
AGM-88	High-Speed Anti-Radiation Missile [HARM]. Used to destroy radar-equipped air defense systems. Propulsion: Dual thrust rocket motor. Aircraft Option: F-16C-D.	Jackson 2001, p. 819
AGM-114	Hellfire. Laser guided, subsonic missile used to destroy tanks, structures, bunkers, and helicopters. It can also be used as an air-to-air weapon against helicopters or slow-moving fixed-wing aircraft. Propulsion: solid propellant rocket.	Jackson 2001, p. 819
AGM-129	Advanced cruise missile. Used to evade air and ground defenses to strike heavily defended, hardened targets. Propulsion: F112-WR-100 Turbofan. Aircraft Option: B-52H.	Jackson 2001, p. 817
AGM-130	Powered standoff weapon. Used against high-value fixed targets. Propulsion: Solid propellant rocket motor. Aircraft Option: F-15E.	Jackson 2001, p. 817
AGM-142	HAVE NAP. Used against high-value fixed targets. Propulsion: Solid propellant rocket motor. Aircraft Option: B-52H.	Jackson 2001, p. 820
AGM-154	Joint Standoff Weapon (JSOW). Used against light-armored/armored vehicle columns, surface-to-air targets, and personnel targets. Propulsion: None (glide weapon). Aircraft Option: F-16, B-1B, B2A, F-15E, B-52H, JSF and Navy F/A-18.	Jackson 2001, p. 818
AGM-158	Joint Air-to-Surface Standoff Missile [JASSM]. Used against hard/medium-hardened, soft, and area type targets. Propulsion: J402 Teledyne engine. Aircraft Option: F-16, F-15, B-2, Navy F/A-18.	Jackson 2001, p. 819
TAGM-130	Captive training version of AGM-130.	N/A
TGM-64D/G	Captive training version of AGM-64 D/G.	N/A
TGM-65D/G	Captive training version of AGM-65 Maverick.	N/A
TOW Missile	Tube Launched, Optically Tracked, Wire-Guided (TOW) is an anti-armor missile. After launch, the cross hairs stay on the target. A computer in the launcher corrects any deviation from the aim point on the target and sends corrections to the missile via wires that deploy in flight. The system is composed of a reusable launcher, a missile guidance set and sight system. It can be mounted on a tripod. This system is mounted on the Army's AH-1S Cobra Attack Helicopter.	Jackson 2001, p. 822

Name/Designation	Type	Reference
Air-to-Air Missiles		
AIM-7	Sparrow. Radar guided missile. Propulsion: Rocket motor. Aircraft Option: F-4, F-15, F-16, ADF.	Jackson 2001, p. 822
AIM-9	Sidewinder. Heat-seeking missile. Propulsion: Solid propellant rocket motor. Aircraft Option: F-4G, F-15A-E, F-16A-D, F-111D-F.	Jackson 2001, p. 821
AIM-120	Advanced Medium Range Air-to-Air Missile [AMRAAM]. (Scorpion, Slammer). Radar-guided missile. Propulsion: Boost/sustain. Aircraft Option: F-15, F-16, F-18, F-4F, Harrier, JAS 37 Viggen, JAS 39 Gripen	Jackson 2001, p. 818
ATAS	Stinger. Missile system provides protection against air-to-air threats. The Stinger has a super-cooled infrared seeker.	Jackson 2001, p. 822
General Purpose Bombs		
CBU	Cluster Bomb. Anti-Personnel/Anti-Material. Combines dispensers, fuzes, & submunitions into a single weapon with a specialized or general purpose mission. Aircraft Options: A-10A, F-4G, F-16A-D, F-111D-F, B-52H, F-117A, F-15A-E.	USAF 2001d
CBU-97	Cluster Bomb. Sensor Fuzed Weapon. Combines 10 submunitions with 4 skeet type warheads in a single dispenser. For armor and soft skinned targets. Aircraft Options: A-10, F-16A-D, B-52, F-117A, F-15E, B-1, B-2.	USAF 2001d
CBU-103-105	Wind Corrected Munitions Dispenser: compensates for launch transients, winds aloft, surface winds, & adverse weather. Propulsion: None. Aircraft Options: B-1B, B-52, F-15, F-16, F-117.	USAF 2001d
GBU-10 Series	Guided Bomb Unit. 2,000-pound unpowered, laser-guided weapon. Aircraft Options: A-10A, F-4G, F-15E, F-16A-D, F-111D-F, F-117A, B-52H.	USAF 2001d
GBU-12 Series	Guided Bomb Unit. 500-pound unpowered, laser-guided weapon. Aircraft Options: A-10A, F-4G, F-15E, F-16A-D, F-117A, B-52.	USAF 2001d
GBU-15 Series	Guided Glide Bomb Unit. 2,000-pound unpowered, television or infrared guided standoff weapon. Aircraft Options: F-15E, F-111F, F-4.	USAF 2001d
GBU-24	Guided Bomb Unit. 2,000-pound unpowered, low-level laser guided weapon. Aircraft Options: F-15E.	USAF 2001d
GBU-27	Guided Bomb Unit. 2,000-pound unpowered, hard target laser guided weapon. Aircraft Options: F-117.	USAF 2001d
GBU-28	Guided Bomb Unit. 5,000-pound unpowered, hard target laser guided weapon. Aircraft Options: F-15E.	USAF 2001d
GBU-31 & 32	Guided Bomb Unit. Joint Direct Attack Munition. GPS/inertial navigation system smart tailkit that fits on general purpose unguided bombs. Aircraft Options: B-1B, B-2, B-52H, F-15E, F-16C-D, F-14D, F/A-18C/D, S-3, F-22, AV-8B.	USAF 2001d
TGBU-15	Training version of GBU-15 series bombs.	N/A
BDU-33, -38, -48	Practice bomb. Contains a small charge, which briefly emits a bright white smoke cloud when the weapon impacts the ground so range officials can score its accuracy. Aircraft Options: F-4, F-15, F-16, F-111, B-52H.	USAF 2001d
MK-20	Rockeye II. Anti-tank Cluster w/shaped charge warheads. Aircraft Options: F-4G, F-16A-D, A-10A, F-111D-F, F-15A-E, B-52H, F-117A.	USAF 2001d

Name/Designation	Type	Reference
MK-82 series	Unguided 500-pound bomb, free-fall, general purpose bomb. Aircraft Options: A-10A, B-1B, B-52H, F-4G, F015A-E, F-16A-D, F-111D-F, F-117A.	USAF 2001d
MK-83 series	Unguided 1,000-pound bomb, free-fall, general purpose bomb. Aircraft Options: A-10A, F-4G, F-15E, F-16A-D, F-111D-F.	USAF 2001d
MK-84 series	Unguided 2,000-pound bomb, free-fall, general purpose bomb. Aircraft Options: A-10A, B-52H, F-117A, F-4G, F-15A-E, F-16A-D, F-111D-F.	USAF 2001d
MK-106	2.27 kilogram practice bomb used for training purposes. The MK-106 is used to simulate the MK-82 in high drag configuration. Aircraft Options: F-4, F-15, F-16, F-111.	USAF 2001d
MK-66 series	Unguided 2.75-inch and 5.0-inch rockets used for target practice, sometimes containing white phosphorous.	USAF 2001d

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APPENDIX D

INDIAN SPRINGS FLIGHT ACTIVITY

APPENDIX D

INDIAN SPRINGS FLIGHT ACTIVITY

Year	A-6	A-7	AV-8	A-10	C-5	C-9	C-12	C-130	C-141
1990	7	10	32	12	2		11	44	14
1991	1		42	11	9	3	10	16	3
1992			10	11	19	8	13	36	52
1993	2			11	1	2	3	26	7
1994	1		2	13		21	6	35	4
1995			302	11	1		1	37	4
Total	11	10	388	69	32	34	44	194	84

Year	F-4	F-14	F-15	F-16	F-18	F-111	KC-10	KC-135	Light A/C
1990	2	8	11	69	15	1			37
1991	1		24	29	1		6		24
1992		2	13	58	33	5		3	27
1993	11	5	14	38	6	5		4	16
1994	12	7	8	53	10	6		12	22
1995	16	4	12	62	4	10		4	24
Total	42	26	82	309	69	27	6	23	150

Year	T-37	T-38	T-45	Tornado	HELO	U-21	Other	Totals
1990	72	1			237	9	35	629
1991	80	5			115	4	15	399
1992	75	26			241	7	31	670
1993		1		2	78		19	251
1994	2	1		2	105	6	14	342
1995	2	3	3	28	392		43	963
Total	231	37	3	32	1168	26	157	3254

Source: *Renewal of the Nellis Air Force Range Land Withdrawal: Legislative Environmental Impact Statement,* (USAF 1999a, Appendix A.1, Table A.1-2, p. A.1-15).

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APPENDIX E

TONOPAH TEST RANGE ACTIVITIES

APPENDIX E

TONOPAH TEST RANGE ACTIVITIES

Year	Aircraft Sorties	Aircraft Inflight Emergencies
1986	9,250	96
1987	9,250	96
1988	9,250	96
1989	9,250	96
1990	9,250	96
1991	9,250	96
1992	9,250	96
1993	2,450	9
1994	2,391	9
1995	2,386	7

Source: *Renewal of the Nellis Air Force Range Land Withdrawal: Legislative Environmental Impact Statement* (USAF 1999a, Appendix A.1, Table A.1-3, p. A.1-16).

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APPENDIX F

CIVILIAN, MILITARY, AND DOE AIRPORT OPERATIONS

APPENDIX F

CIVILIAN, MILITARY, AND DOE AIRPORT OPERATIONS

Table F-1. Recent and Projected Airport Operations Compared to Maximum Criteria

Airport	Approximate Distance, D, to North Portal (miles) (a)	2001 Operations (b)	2010 Operations (c)	2040 Operations (c)	Max Criterion Operations (d)
Civilian					
Alamo	77	0	0	0	5,929,000
Amargosa	38	0	0	0	1,444,000
Beatty	21	1,005	1,600	6,700	441,000
Calvada Meadows	46	0	0	0	2,116,000
Furnace Creek	37	10,200	16,000	68,000	1,369,000
Goldfield	75	300	470	2,000	5,625,000
Henderson	94	98,500	150,000	660,000	8,836,000
Heritage	86	0	0	0	7,396,000
Hidden Hills	66	200	310	1,300	4,356,000
Imvite	28	0	0	0	784,000
Jackass Aeropark	15	604	940	4,000	225,000
Jean	97	20,000	31,000	130,000	9,409,000
Lida Junction	61	10	16	67	3,721,000
McCarran Int'l	89	476,511	740,000	3,200,000	7,921,000
North Las Vegas	82	275,386	430,000	1,800,000	6,724,000
Shoshone	61	700	1,100	4,700	3,721,000
Sky Ranch	86	2,000	3,100	13,000	7,396,000
Stovepipe Wells	44	1,000	1,600	6,700	1,936,000
Tonopah	91	12,727	20,000	85,000	8,281,000
Trona	87	7,000	11,000	47,000	7,569,000
Valley View	47	0	0	0	2,209,000
VOC Tech	92	0	0	0	8,464,000
Military					
Nellis AFB	90	62,421	97,000	420,000	8,100,000
Indian Springs	45	4,000	6,200	27,000	2,025,000
Tonopa Test Range	66	200	310	1,300	4,356,000
DOE					
Desert Rock	27	330	510	2,200	729,000
Pahute Mesa	18	80	120	540	324,000
Yucca Airstrip	20	0	0	0	484,000

a. Approximate distances to North Portal were determined from NIMA 2001 and NACO 2002b.
b. 2001 operations were determined from information contained in GCR (2002g) (civilian), Langendorf 2002 (DOE operations), and Takenaka 2002 (Nellis operations).
c. Projections to 2010 and 2040 assume five percent per year growth rate (Assumption 4.1). For example (2001 operations) × $(1.05)^9$ for 2010 projection and (2001 operations) × $(1.05)^{39}$ for 2040 projection. Results are rounded to 2 significant figures.
d. $D^2 \times 1000$.

Table F-2. Crash Probability Parametric Analysis Using Sandia Model

x	$\rho(x)$	N	P_N	A	P_{IF}
1	1.64E-01	70,000	4.0E-10	0.1	4.6E-07
2	3.34E-02	70,000	4.0E-10	0.1	9.4E-08
3	6.84E-03	70,000	4.0E-10	0.1	1.9E-08
4	1.40E-03	70,000	4.0E-10	0.1	3.9E-09
5	2.86E-04	70,000	4.0E-10	0.1	8.0E-10
10	1.02E-07	70,000	4.0E-10	0.1	2.9E-13
15	3.65E-11	70,000	4.0E-10	0.1	1.0E-16
20	1.31E-14	70,000	4.0E-10	0.1	3.7E-20
25	4.67E-18	70,000	4.0E-10	0.1	1.3E-23

From Smith (1983) p. I-2 and I-3:

$$P_{IF} = N \times P_N \times \rho(x) \times A$$

and

$$\rho(x) = c \times e^{\frac{-|x|}{\Theta}}$$

where

P_{IF} = Probability of an inflight (IF) aircraft crash into selected structures per year
N = Number of inflight operations per year along airway (conservatively high-volume number selected as a constant for this parametric analysis)
P_N = Probability per statute mile of aircraft crash per inflight operation (value from NRC 1987, Section 3.5.1.6.III.2)
$\rho(x)$ = Crash probability density per statute mile
x = Perpendicular distance from the centerline of airway to surface facility, miles (various distances selected for this parametric analysis)
A = Representative effective crash area in square statute miles of selected structures (constant chosen for use in this parametric analysis)
c = Inflight crash density constant for air carrier (Smith 1983, p. I-5) = 0.8
Θ = Inflight crash density constant for air carrier (Smith 1983, p. I-5) = 0.63

For example, at 1 mile from a facility:

$\rho = 0.8 \times \exp(-1/0.63) = 1.64E\text{-}01$

and

P_{IF} = 1.64E-01 x 70,000 x 4.00E-10 x 0.1 = 4.6E-07

APPENDIX G

SCREENING OF AIRCRAFT HAZARDS FROM AIRSPACE ACTIVITIES ON THE NTTR AND R-2508 RANGE

APPENIDX G

SCREENING OF AIRCRAFT HAZARDS FROM AIRSPACE ACTIVITIES ON THE NTTR AND R-2508 RANGE

Airspace Activities on the NTTR and R-2508 Range

The objective of this Appendix is to make a determination that certain aircraft hazards resulting from airspace activities on the NTTR and the R-2508 Range Complex are not credible with regard to impacts on the MGR surface facilities. This determination is based on a qualitative evaluation of credible abnormal flights in the ranges. The evaluation will show that beyond a certain distance from the North Portal, aircraft experiencing an abnormal flight cannot credibly impact facilities at the North Portal. Because of this evaluation, these hazards will be screened from further analysis of aircraft hazards at the MGR.

Range Characteristics

Detailed descriptions of these ranges and their missions are provided in Section 5. Specific characteristics important to quantitative screening are discussed in Section 6.

Both the NTTR and the R-2508 Range Complex occupy large land areas involving millions of acres and extend over 100 miles in length and width. The distances from each range to the North Portal at Yucca Mountain site is generally over 30 miles although small portions of the range may be closer. These ranges are divided into sub-ranges and aircraft activities that generally occur in the center of these sub-ranges resulting in operations that are well over 30 miles away.

Aircraft missions in these ranges include flight training, air-to-air combat training, and air-to-ground training involving single aircraft to large-force deployment with many types of aircraft. Pilots are required to operate under strict procedures developed for each particular range in order to minimize the hazards to range ground personnel as well as people and facilities located outside the range boundaries.

Normal versus Abnormal Flights

A specific mission to be performed will generally involve a normal flight based on an established flight plan that defines how to ingress the range, conduct the test and training exercise, and egress the range. On occasion, however, these flights may not be normal because of an unplanned event such as equipment malfunction or pilot error. Not all abnormal flights result in an airplane crash. A system or the pilot may not be functioning within operating range and the mission could be aborted with the aircraft returning to its home base or a nearby landing field. Conditions leading to abnormal flights with crash potential involve either a disabled aircraft resulting in pilot ejection or a failure of the pilot to maintain control of the aircraft. The conditions include the following:

- engine failure
- control system failure
- structural damage

- pilot loss-of-consciousness
- pilot error.

Anticipated Consequences of Abnormal Flights with Crash Potential

Engine Failure—Engine failure in a two-engine aircraft is not considered an abnormal flight with a crash potential because these aircraft have the capacity to return to base using a single engine. Engine failure in a helicopter will result in a crash very near to the point of failure since this aircraft has no glide capability.

Engine failure of a single-engine aircraft could place the pilot in immediate danger or could allow pilot actions to mitigate this event. An engine fire could result in an immediate pilot ejection. It is expected that this would result in an in-flight explosion of the aircraft or a nearby crash of the aircraft depending on its altitude, speed, and direction. In both cases, the aircraft would not travel long distances (i.e., several miles) before it is destroyed.

During an engine flameout, depending on the aircraft altitude, the pilot would either immediately eject or could "zoom" the aircraft (i.e., climb by trading airspeed for altitude). This provides the pilot with additional time to jettison all stores, such as weapons and fuel tanks, attempt to restart the engine, and maneuver the aircraft to the best location on the range for ejection and rescue. Each aircraft has a specific glide capability. The glide capability for the aircraft was determined in *MGR Aircraft Crash Frequency Analysis* (CRWMS M&O 1999, p. 26). The maximum glide distance is equal to the maximum lift/drag ratio $(L/D)_{max}$ times the altitude above ground level. An $(L/D)_{max}$ of 8.58 was selected for the small attack and fighter aircraft used in the NTTR.

Ejection altitude can vary depending on the situation. The pilot must eject at a minimum altitude of 2,000 feet AGL in a controlled situation or about 6,000 feet AGL in an uncontrolled situation (NRC 2002, Answer 39, pp. 15-16). It is expected that in a controlled situation at high altitudes, the pilot would eject between 10,000 and 15,000 feet AMSL (approximately 5,000 to 10,000 feet AGL assuming a ground elevation of 5,000 feet) after unsuccessful restart.

The aircraft could potentially glide a maximum of about 16 miles (8.58 × 10,000 feet/ 5,280 feet/mile) under ideal conditions. In an uncontrolled situation, the aircraft does not have glide potential and would crash close to where the event occurred. Engine failures below 2,000 feet AGL would result in crashes within about three miles of where the event occurred (8.58 × 2,000 feet/5,280 feet/mile).

From Appendix B, high-altitude missions are flown between 10,000 feet AGL and 50,000 feet AMSL. A disabling event at high altitudes would result in either immediate descent of the aircraft with pilot ejection or a controlled descent, providing time for pilot action prior to ejection. During that time, the pilot can attempt to control the aircraft and/or locate a preferred ejection point, before reaching the 10,000 feet AGL maximum preferred altitude for ejection. Under ideal conditions, for an attack/fighter aircraft to glide 30 miles would require an altitude of 18,000 feet AGL (30 miles × 5,280 feet/mile / 8.58). This is 8,000 feet higher than the maximum preferred ejection altitude.

Control System Failure—Failure of a hydraulic or electrical control system that results in an abnormal flight with crash potential can put the aircraft in an uncontrollable situation. Depending on the extent of the system failure, the pilot may be able to position the aircraft for a safe ejection. However, it is expected that the aircraft would crash not far from where the event occurred since it is potentially uncontrollable and has no glide capability.

Structural Damage—Structural damage that results in an abnormal flight with crash potential can put the aircraft in an uncontrollable situation. Depending on the extent of the damage, the pilot may be able to position the aircraft for a safe ejection. However, it is expected that the aircraft would crash not far from where the event occurred since it is potentially uncontrollable and has no glide capability.

Pilot Loss-of-Consciousness—Gravity-induced loss of consciousness (GLOC) occurs when a pilot becomes unconscious because of the "G" or gravity forces imposed on the pilot. Pilots are required to perform G-awareness warm up turns while enroute to the range that exposes them to approximately four Gs. During range exercises pilots may experience higher G loads. GLOC is a temporary condition that typically lasts 20-30 seconds. An aircraft going the speed of sound in level flight would travel about five miles during the GLOC. Since GLOC is induced through rapid changes in direction, it is unlikely that it would travel five miles. The crash potential during GLOC depends on the altitude and direction of the aircraft. If the aircraft is at a high altitude and not in a vertical descent, the pilot will regain control and a crash is averted. If the aircraft is at low altitude or in a vertical descent, the crash will occur within a few miles of the GLOC.

Pilot Error—Pilot errors resulting in a crash are mid-air collisions with major aircraft structural damage or collisions with the ground during low level maneuvering. In both events the crash will occur close to the point of the initiating event.

Impacts on MGR Surface Facilities – Summary—The conditions leading to abnormal flights with crash potential described in the previous paragraphs result in an uncontrolled aircraft located in areas that are generally over 30 miles from the North Portal at Yucca Mountain. It has been shown in the previous paragraphs that time and altitude are the key variables in determining how far an uncontrolled aircraft can travel.

It is not considered credible for an aircraft disabled 30 miles away to impact MGR surface facilities. Recent aircraft crash studies performed for other existing or proposed nuclear facilities further corroborate this conclusion, as described in the following section.

Corroborative Studies

NTS Aircraft Crash Frequency Analysis—Lawrence Livermore National Laboratory (Kimura et al. 2002) calculated the crash frequency for the Device Assembly Facility (DAF) located on the NTS. That calculation did not consider aircraft events beyond 20 miles from DAF (Kimura et al. 2002, p. 4) and did not address aircraft above 18,000 AMSL because the crash hit risk beyond these parameters were considered to be minor contributors to the overall aircraft crash frequency.

Private Fuel Storage Facility Safety Analysis Report—The Private Fuel Storage Facility (PFSF) is a spent nuclear fuel storage facility that has been proposed for an area near the USAF Utah Test and Training Range. The safety analysis report for the facility has been reviewed by the Nuclear Regulatory Commission and the State of Utah. The position taken in the PFSF safety analysis report regarding the North Area of the Utah Test and Training Range, located approximately 30 miles away from the PFSF site, is that "it is not conceivable that a crashing aircraft 30 miles away would impact the site" (PFS 2000, p. 29). The safety analysis report provides a basis for a 10-mile limit beyond which aircraft flying in the South Area of the Utah Test and Training Range poses no credible crash hazard to the PFSF (PFS 2000, pp. 37d to 38a).

The safety analysis report states that a crashing aircraft capable of reaching the PFSF from more than ten miles away would be under pilot control for the following reasons.

- PFSF assumed a seven nautical mile per 5,000-foot altitude glide ratio to calculate that an F-16 requires an altitude of 6,200 feet AGL to glide ten miles. Note: The PFSF assumption is approximately the same as used in this Appendix (i.e., seven nautical miles/5,000 feet × 5,280 feet/mile × 1.1516 mile/nautical mile = 8.51). As a worst case, PFSF assumed the aircraft was at a slow airspeed (i.e., in the 170-200 knot range), and it would take 1.5 minutes of glide time before reaching the recommended ejection altitude of 2,000 feet AGL. Therefore, the shortest time that a pilot can take evasive action of 1.5 minutes is ample time for less than a 5-degree turn required to avoid the PFSF site.

- The only situations where the aircraft would not respond to pilot inputs are structural problems or a deep stall. In both of these situations, the plane would crash close to where the problem occurred.

- GLOC only lasts 20 to 30 seconds, so the pilot would regain control or the crash would occur close to where loss of consciousness occurred.

- Collisions with the ground during low-level air-to-air or air-to-ground training due to pilot error would occur at the point of the error or misjudgment.

The bases for these conclusions have been accepted by the Nuclear Regulatory Commission and are not issues brought out by the State of Utah in the hearings with the Atomic Safety and Licensing Board.

PACKAGE DIVIDER