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# **Appendix E**

## **Weapon Systems**



# APPENDIX E

## WEAPON SYSTEMS

**Table E-1. Typical Missile Exercise Weapons Used at Pacific Missile Range Facility**

TYPE	CHARACTERISTICS				
	Weight	Length	Diameter	Range	Propulsion
<b>Surface-to-Air Missiles</b>					
<u>Short Range</u>					
Stinger (FIM-92A)	10.0 kg (22 lb)	1.5 m (5 ft)	70 mm (2.8 in)	4.8 km (3.4 nm)	Solid fuel
Sea Sparrow (RIM-7)	204 kg (450 lb)	3.7 m (12 ft)	203-2 mm (8 in)	14.8 km (10.6 nm)	Solid fuel
Rolling Airframe (RIM-116)	73.5 kg (162 lb)	2.8 m (9 ft 3 in)	127 mm (5 in)	7 km (5.0 nm)	Solid fuel
<u>Medium Range</u>					
Standard SM-1 MR (RIM-66B)	499 kg (1,100 lb)	4.5 m (14 ft 8 in)	342.9 mm (13.5 in)	46.3 km (33 nm)	Solid fuel
Standard SM-2 (RIM-66C)	612 kg (1,350 lb)	4.4 m (14 ft 7 in)	342.9 mm (13.5 in)	74.1 km (53 nm)	Solid fuel
<u>Long Range</u>					
Standard SM-2 ER (RIM-67A/B and 67-C/D)	1,325 kg (2,920 lb)	8.2 m (27 ft)	342.9 mm (13.5 in)	166.7 km (90 nm)	Solid fuel
Standard SM-2 AER (RIM-67B)	1,452 kg (3,200 lb)	6.7 m (22 ft)	342.9 mm (13.5 in)	150 km (107.1 nm)	Solid fuel
<b>Air-to-Air Missiles</b>					
<u>Short Range</u>					
Sidewinder (AIM-9)	84.4 kg (186 lb)	2.9 m (9 ft 6 in)	127 mm (5 in)	18.5 km (10 nm)	Solid fuel
<u>Medium Range</u>					
Sparrow (AIM-7)	231 kg (510 lb)	3.6 m (11 ft 10 in)	203.2 mm (8 in)	55.6 km (30 nm)	Solid fuel
<u>Long Range</u>					
Phoenix (AIM-54)	447 kg (985 lb)	4 m (13 ft)	381 mm (15 in)	203.9 km (110 nm)	Solid fuel
<b>Air-to-Surface Missiles</b>					
<u>Short Range</u>					
Skipper II (AGM-123)	582 kg (1,283 lb)	4.3 m (14 ft)	355.6 mm (14 in)	9.6 km (5.2 nm)	Solid fuel

## Notes:

ft	feet	lb	pounds
in	inches	m	meters
kg	kilograms	mm	millimeters
km	kilometers	nm	nautical miles

**Table E-1. Typical Missile Exercise Weapons Used at Pacific Missile Range Facility (Continued)**

TYPE	CHARACTERISTICS				
	Weight	Length	Diameter	Range	Propulsion
<b>Air-to-Surface Missiles (Concluded)</b>					
<u>Medium Range</u>					
HARM (AGM-88)	366.1 kg (807 lb)	4.2 m (13 ft 9 in)	254 mm (10 in)	18.5 km (10 nm)	Solid fuel
Shrike (AGM-45)	177 kg (390 lb)	3 m (10 ft)	203.2 mm (8 in)	18.5 km (10 nm)	Solid fuel
Sidearm (AGM-122)	90.7 kg (200 lb)	3 m (10 ft)	127 mm (5 in)	17.8 km (9.6 nm)	Solid fuel
<u>Long Range</u>					
Harpoon (AGM-84/ RGM-84/UGM-84)*	797 kg (1,757 lb)	5.2 m (17 ft 2-in)	342.9 mm (13.5 in)	278 km (150 nm)	Solid fuel
<b>Surface-to-Surface Missiles (Cruise)</b>					
Harpoon (AGM-84/ RGM-84/UGM-84)*	797 kg (1,757 lb)	5.2 m (17 ft 2-in)	342.9 mm (13.5 in)	278 km (150 nm)	Solid fuel

Source: U.S. Department of the Navy, 1998a

Notes:

\*Characteristics vary according to variant. Those for RGM-84F are shown.

ft	feet	lb	pounds
in	inches	m	meters
kg	kilograms	mm	millimeters
km	kilometers	nm	nautical miles

**Table E-2. Typical Aerial Target Drones and Missiles Used at Pacific Missile Range Facility**

TYPE	CHARACTERISTICS			
	Length	Speed (Maximum)	Operational Altitude (Maximum)	Time on Station (Maximum)
<b>Subsonic</b>				
BQM-34S	7 m (23 ft)	Mach 0.9	15,240 m (50,000 ft)	60 minutes
BQM-74C	4 m (13 ft)	430 knots	10,668 m (35,000 ft)	75 minutes
<b>Supersonic</b>				
MQM-8G (ER)	7.6 m (25 ft)	Mach 2.7	1,524 m (5,000 ft)	N/A
AQM-37C	4.1 m (13.6 ft)	Mach 4.0	30,480 m (100,000 ft)	N/A

Source: U.S. Department of the Navy, 1998a

Notes:

ft	feet
m	meters
N/A	Not Applicable

**Table E-3. Typical Existing Target Systems Used at Pacific Missile Range Facility**

Type	Category	Name	Propellant Type
Ballistic Missile			
	Small	AQM-37C	Liquid
		Black Brant V	Solid
		Hawk	Solid
		Recruit	Solid
		Malemute	Solid
		HERMES	Solid
		Lance	Liquid
		Standard	Solid
		Tomahawk (Rocket)	Liquid/Solid
		Honest John (Booster)	Solid
		Nike (Booster)	Solid
		PATRIOT as a Target (PAAT)	Solid
		Apache	Solid
		Cajun	Solid
		Genie (14" diameter)	Solid
	Medium	Terrier	Solid
		Talos	Solid
		Castor	Solid
		STRYPI	Solid
		Antares (Stack)	Solid
		Aries	Solid
		Spartan	Solid
		Talos	Solid
		SR-19 (Air Drop)	Solid
		STORM	Solid
		MA-31	Liquid
		Liquid Fuel Target System	Liquid
	Large	Strategic Target System	Solid
		Hera	Solid
		Terrier	Solid
	Supersonic	AQM-37C	Liquid
		Vandal	Liquid/Solid

**Table E-3. Typical Existing Target Systems Used at Pacific Missile Range Facility  
(Continued)**

Type	Category	Name	Propellant Type
Aircraft			
	Subsonic	QF-4	Liquid
		AF-16	Liquid
Balloon			
		Balloon	N/A
Towed			
	Aerial	TDU-34A	N/A
Subsurface			
		MK-30 Mod 1	Liquid
		EMATT	Liquid
		SPAT-1 (Self Prop Acoustic Target)	Liquid
		MK-17 (Stationary Target for MK-46)	N/A
Surface			
		QST 35	Liquid
		HULK (TBD)	N/A
		ISTT (Improved Surface Towed Target)	N/A
Cruise Missiles			
	Subsonic	BQM-34S	Liquid
		BQM-74/CHUKAR	Liquid
		AQM-34	Liquid
		MQM-107	Liquid
		Harpoon	Liquid
		Liquid Fuel Target System	Liquid
		Tactical Air Launched Decoy (TALD ADM-141A)	Liquid
		ITALD (Improved version ADM-141C)	Liquid
	Supersonic	Vandal	Liquid/Solid
		MA-31	Liquid
		Terrier	Solid
		GQM-163A (Coyote)	Solid
		Liquid Fuel Target System	Liquid

Source: U.S. Department of the Navy, 1988a

Notes: N/A Not Applicable

**Table E-4. Typical Existing Weapon Systems Used at Pacific Missile Range Facility**

Type	Category	Name	Propellant Type (Liquid/Solid)
<b>Missiles</b>			
	Ship	ASROC	Liquid/Solid
	Ship	Harpoon (RTM-84)	Liquid
	Ship	MK-46 VLA	Liquid/Solid
	Ship	SM-2 BLK II	Solid
	Ship	SM-2 BLK III	Solid
	Ship	SM-2 BLK IV	Solid
	Ship	Sparrow (A1M7)	Solid
	Surf/Ship/Sub	Harpoon (R/UGM-84)	Liquid/Solid
	Air	AGM-45 (SHRIKE)	Solid
	Air	Harpoon (AGM-84)	Liquid
	Air	Phoenix	Solid
	Air	Sidewinder	Solid
	Air	Sparrow	Solid
	Air/Surf/Sub	Tomahawk	Liquid/Solid
	Land	Hawk	Solid
	Land	MEADS	Solid
	Land	PATRIOT	Solid
	Land	THAAD	Solid
	Land/Ship	Stinger	Solid
<b>Guns</b>			
	Ship	Naval Guns	N/A
	Ship	Phalanx/Vulcan	N/A
	Air	Aircraft Mounted Guns	N/A
	Land	Howitzer	N/A
<b>Weather Rocket</b>			
	Land	PWN-11D	Solid
	Land	PWN-12A	Solid
<b>Torpedoes</b>			
	Sub	MK-48 ADCAP	Liquid
	Sub	MK-48	Liquid
	Air/Ship	MK-44 (PLLT)	Battery
	Air/Ship	MK-30	Battery
	Air/Ship	MK-50	Liquid
	Air/Ship	MK-54	Liquid
	Air/Ship	Type 80 (Japanese)	Liquid
	Air/Surf	MK-46	Liquid

Source: U.S. Department of the Navy, 1998a

Note: N/A Not Applicable

**Table E-4. Typical Existing Weapon Systems Used at Pacific Missile Range Facility (Continued)**

Type	Category	Name	Propellant Type (Liquid/Solid)
Sub Launched Mines			
	Sub	MK-67-2 Sub Launched Mobile Mine (SLMM)	Battery
Air Deployed Mines			
	Air	MK-25	N/A
	Air	MK-36	N/A
	Air	MK-36 DST	N/A
	Air	MK-52	N/A
	Air	MK-76	N/A
Bombs			
	Air	BDU-45	N/A
	Air	MK-82	N/A

Source: adapted from U.S. Department of the Navy, 1998a

Note: N/A Not Applicable

**Table E-5. Typical Electronic Warfare Assets Used at Pacific Missile Range Facility**

TYPE	CHARACTERISTICS		
	Frequency Bands	Power Output (Maximum)	Location Used
<b>Air and Seaborne Electronic Warfare Assets</b>			
<u>Airborne Simulator Systems</u>			
APS-504(V)5	8.9925 to 9.375 GHz	8 kW	Pacific Missile Range Facility (PMRF) RC-12F Aircraft
MK-67	907.2 kg (2,000 lb)	4.00 m (13 ft 5 in)	533 mm (21 in)
<u>Expendable Radar Transmitter Sets</u>			
AN/DPT-1(V)	7.8 to 9.6, 14.0 to 15.2 GHz	80 kW	BQM-334S Targets
AN/DPT-2(V)	9.375 GHz	20 kW	BQM-74C Targets
<u>Airborne Electronic Countermeasures Systems</u>			
Traveling Wave Tube Countermeasures System	425 to 445 MHz, 902 to 928 MHz, 2 to 4 GHz	100 W	PMRF RC-12F Aircraft
ALT-41	425 to 445 MHz	100 W	PMRF RC-12F Aircraft
ALT-42	902 to 928 MHz	100 W	PMRF RC-12F Aircraft
DLQ-3	2 to 4 GHz	100 W	PMRF RC-12F Aircraft
ULQ-21	8 to 10.5 GHz	100 W	PMRF RC-12F Aircraft



**Table E-5. Typical Electronic Warfare Assets Used at Pacific Missile Range Facility  
(Continued)**

TYPE	CHARACTERISTICS		
	Frequency Bands	Power Output (Maximum)	Location Used
<u>Seaborne Simulator Systems</u>			
AN/DPT-1(V)	7.8 to 9.6, 14.0 to 15.2 GHz	80 kW	Range Boats
AN/DPT-2(V)	7.8 to 9.6, 14.0 to 15.2 GHz	150 kW	Range Boats
<b>Land-Based Electronic Warfare Assets</b>			
<u>Simulator Systems - Fixed</u>			
AN/DPT-1(V)	7.8 to 9.6, 14.0 to 15.2 GHz	70 kW	Makaha Ridge, Kauai
ENSYN	2 to 4, 7 to 11 GHz	1 kW	Makaha Ridge, Kauai
I/J-TES	7.8 to 9.6, 14.0 to 15.2 GHz	70 kW	Makaha Ridge, Kauai
AN/DPT-1(V)	7.8 to 9.6, 14.0 to 15.2 GHz	70 kW	Mauna Kapu, Oahu
<u>Simulator Systems - Mobile</u>			
AN/DPT-1(V)	2.9 to 3.1, 7.8 to 9.6, 14.0 to 15.2 GHz	70 kW	Barking Sands, Kauai
AN/UPT-2A(V)	2.9 to 3.1, 7.8 to 9.6, 14.0 to 15.2 GHz	150 kW	Barking Sands, Kauai
AN/D/DPT-1(V)	7.8 to 9.6, 14.0 to 15.2 GHz	70 kW	Perch Site, Niihau
AN/UPT-2A(V)	2 to 4, 8 to 18 GHz	150 kW	Perch Site, Niihau
ENSYN	2 to 4, 8 to 18 GHz	1 kW	Naval Air Station (NAS) Barbers Point, Oahu
AN/DPT-1(V)	2.9 to 3.1, 7.8 to 9.6, 14.0 to 15.2 GHz	70 kW	NAS Barbers Point, Oahu
<u>Electronic Countermeasures Systems - Fixed</u>			
ALT-41	425 to 445 MHz	100 W	Makaha Ridge, Kauai
ALT-42	902 to 928 MHz	100 W	Makaha Ridge, Kauai
ULQ-26	2 to 4 GHz	100 W	Makaha Ridge, Kauai
ULQ-21	8.0 to 10.5-GHz	100 W	Makaha Ridge, Kauai
<u>Electronic Countermeasures Systems - Mobile</u>			
DLQ-3	425 to 445 MHz 14.0 to 15.2 GHz	100 W	Range Boats, Remote Sites
ULQ-26	425 to 445 MHz 14.0 to 15.2 GHz	100 W	Range Boats, Remote Sites
ULQ-21	425 to 445 MHz 14.0 to 15.2 GHz	100 W	Range Boats, Remote Sites
ALT-41/42	425 to 445 MHz 14.0 to 15.2 GHz	100 W	Range Boats, Remote Sites

Source: adapted from U.S. Department of the Navy, 1998a

Notes:

ft feet                    in inches                    kW kilowatts                    m meters                    mm millimeters  
GHz gigahertz                    kg kilograms                    lb pounds                    MHz megahertz                    W watts

**Table E-6. Existing Pacific Missile Range Facility Radars, Locations, and Characteristics**

Emitter	Comments	Location	Power Peak (kW)	Scan Rate	Frequency (MHz)		Pulse Width (μS)	PRF (PPS)	Ant. Gain (dBi)	Ant. Elev. (m)	Remarks
					Low	High					
AN/MPS-25	Monopulse Tracking (2 each)	Main Base	1,000	--	5,400	5,900	0.25, 0.5, 1	160, 640	46	18	AZ=0 to 360 degrees. Elevation=-5 to +185 degrees
AN/SPS-10	Surveillance	Main Base	250	15 rpm	5,450	5,825	0.5, 1.3	640	30	22	
AN/UPX-27	AN/SPS-10 IFF Interrogator	Main Base	1	15 rpm	1,030	1,030	0.8	640	23	22	Uses AN/SPS-10 antenna
AN/FPS-106	Weather Radar	Main Base	500		5,450	5,650	0.5	320	35	20	
AN/WRF-100	DOE Radar Facility	Main Base	250	--	9,375	9,375	1	640	32	10	
THAAD Radar	X-Band Tracking	Main Base			8,000	12,000				22	
AN/MPS-25	Monopulse Tracking (2 each)	Makaha Ridge	1,000	--	5,400	5,900	0.25, 0.5, 1	160, 640	46	500	AZ=0 to 360 degrees. Elevation=-5 to +185 degrees
AN/FPQ-10	Monopulse Tracking (2 each)	Makaha Ridge	1,000	--	5,400	5,900	0.25, 0.5, 1	160, 640	43	473	AZ=0 to 360 degrees. Elevation=-5 to +90 degrees
AN/SPS-48E	Track-While-Scan Surveillance	Makaha Ridge	2,400	15 rpm	2,908	3,110	27	Various	39.1	462	
AN/UPX-27	AN/SPS-48E IFF Interrogator	Makaha Ridge	1	15 rpm	1,030	1,030	0.8	Various	19	462	
AN/APS-134	Surface Surveillance	Makaha Ridge	500	15 rpm	9,500	10,000	0.5	500	42	457	Linear frequency chirp each pulse
AN/FPS-16	Monopulse Tracking	Kokee	1,000	--	5,400	5,900	0.25, 0.5, 1	160, 640	43	1,155	AZ=0 to 360 degrees. Elevation=-5 to +185 degrees
AN/FPQ-10	Monopulse Tracking	Kokee	1,000	--	5,400	5,900	0.25, 0.5, 1	160, 640	43	1,150	AZ=0 to 360 degrees. Elevation=-5 to +90 degrees
USB	Unified S-Band System	Kokee	20	--	2,090	2,120	CW	CW	44	1,110	
AN/FPS-117	Surveillance	Kokee	24.75	5 rpm	1,215	1,400	51.2, 409.6	241	38.6	1,310	
OX-60/FPS-117	AN/FPS-117 IFF Interrogator	Kokee	2	5 rpm	1,030	1,030	Various	241	21	1,310	
AN/APS-134	Surveillance	Niihau	500	15 rpm	9,500	10,000	0.5	500	42	375	
R73-6	Raytheon Pathfinder (3 each)	Weapons Recovery Boat and Torpedo Weapons Recovery	10	24 rpm	9,410	9,410	0.08, 0.4, 0.8, 1.2	2,000, 1,500, 750, 500	16	8	
APS-134	Surveillance	HIANG Kokee	500	15 rpm	9,500	10,000	0.5	500	42	375	

Source: U.S. Department of the Navy, 1998a

**Table E-7. Representative Proposed Target Systems**

Type	Name	Propellant Type
Ballistic Missile		
	Orion 50S XLG	Solid
	Orion 50 XL	Solid
	Super STRYPI	Solid

**Table E-8. Target Launch Pad—Rail and Stool Requirements**

Item/Facility Type	Requirements 0 to 1,200 kilometers (0 to 647.9 nautical miles)
Dimensions of Launch Pads/Construction Materials Assumed	12.2 meters x 15.2 meters + 15.2 meters (40 x 50 feet + 50 feet) for environmental shelter = 12.2 meters x 30.5 meters (40 x 100 feet) = 371.6 square meters (4,000 square feet). Concrete pad with outer gravel or coral area.
Cleared Area/No Vegetation Zone Surrounding Launch Pad	15.2 to 30.5 meters (50 to 100 feet)
Explosive Safety Quantity-Distance (ESQDs) by Category Type (Intraline [IL], Public Transportation Route [PTR], Inhabited Building [IB])	85.3 meters (280 feet) IL 228.6 meters (750 feet) PTR 381 meters (1,250 feet) IB ESQD
Ground Hazard Area (GHA) Radius	For most unguided systems, GHA = 609.6 meters (2,000 feet) For guided systems, GHA = 1,828.8 to 3,048 meters (6,000 to 10,000 feet)
Electromagnetic Radiation Constraints to Personnel, Fuels, or Ordnance	Consider HERO (ordnance electronic triggering mechanisms potentially set off due to electromagnetic radiation).
Launch Pad Fencing/Security Needs	Should have access control to the hazardous operations/launching area. The target payload may be classified.
Utilities to Launch Pad/Type Needed	Will bring some portable electrical generator capability (campaign). Will require a power distribution system, fuel storage, and containment area to avoid soil contamination.
Road Access to Launch Pad/Hazardous Transportation Route/ % Grade	Prefer gravel road of less than 6 percent grade. Prefer to stay off public highways.
Environmental Shelter/Pad/Dimensions	Depends on the type of missile system and site environmental constraints (some missiles are temperature, humidity, and salt spray dependent). At Kauai Test Facility, only tarps are used in some cases. Some booster rockets must be maintained between 15.5 to 26.7 degrees Celsius (60 to 80 degrees Fahrenheit). Also stool launch items will require wind protection.
Soil Conditions Desired	Stable soil, cleared gravel or paved area around the launcher.
Minimum Distance to Shoreline If Any	None. Consider waves, salt spray.

Source: U.S. Department of the Navy, 1998a

**Table E-9. Target Support/Preparation and Launch Control Facilities Requirements**

Item/Facility Type	Requirements
Missile Assembly—Need missile assembly building on Island or Build-up at Another Location (Specify if Known), Ship by Aircraft or Barge to Island, or Other Logistics Based on Distance, Weight, Airfield, etc.	No new missile assembly building needed. Build up at Pacific Missile Range Facility (PMRF). Transport by aircraft or barge to island. May have an environmental shelter (stool) and/or clamshell (rail) at the launch site. Possible Environmental Control addition to Rocket Motor Staging Area at Kauai Test Facility—may want to add air conditioning.
Vertical Target Missile Service Tower Needed, Dimensions	None required.
Launch Control Van or Building	Mobile Launch Control Van [could be a van brought in by air or barge or a trailer like Kokole Point at PMRF with a berm (if a rail), or a van in a hardened van shelter (if a stool)].
Launch Pad Equipment Building	Equipment building [8 x 8 feet] next to pad.
Missile Storage Facility	May need missile storage if the number of launches per year justifies the cost.
Warehousing	Would use existing warehousing if available. If not, keep supplies on a barge or fly in/out. May use military vans or enclosed semi trailers.
Road Access Dimensions/Minimum Radii	12 feet wide road minimum, 50 feet turning radius to launch pad, 8 feet minimum to launch control.
Min. Distance to Shoreline If Any	None. Wave action? Salt spray?
Utilities to Facilities/Type Needed	Electricity.
Security/Fencing/Clear Zone Needed/Dimensions	Not required unless there is a need to provide security protection or to mitigate for bird control (site specific—Tern). Dimensions undefined.
Electromagnetic Radiation Constraints to Personnel, Fuels, or Ordnance	Consider HERO (ordnance electronic triggering mechanisms potentially set off as a result of electromagnetic radiation).
View of Launch Pad Needed from Control Van/Building	Desired.

Source: U.S. Department of the Navy, 1998a

**Table E-10. Representative Defensive Missile Systems**

Type	Category	Name	Propellant Type (Liquid/Solid)
Missiles			
	Ship	SM-2 BLK IVA	Solid
	Ship	SM-3	Solid
	Ship	SM-6	Solid
	Air	AMRAAM	Solid
	Land	MEADS	Solid
	Land	PATRIOT (PAC-2)	Solid
	Land	PAC-3	Solid
	Land	THAAD	Solid

Source: U.S. Department of the Navy, 1998a

**Table E-11. Land-based Interceptor Launch Site (Mobile) Requirements**

Item/Facility Type	Requirements 0 to 1,200 kilometers (0 to 647.9 nautical miles)
Desired Operational Launch Orientation/Flight Path	Need target range of between 350 and 1,000 kilometers (217.5 and 621.4 miles)
Dimensions of Launch Pads/Construction Materials Assumed	Need a hardstand area (prefer gravel or coral) and relatively level ground. Need an area of approximately 42.1 x 20.1 meters = 846 square meters (138 x 66 feet = 9,108 square feet). The launchers are to be sited within the 120 degree angle of the radar signal (60 degrees either side of the boresight). The launchers are to be located between 130.1 meters (427 feet) and 10 kilometers (6.2 miles) from the radar set. Several launchers may be sited within this area.
Cleared Area/No Vegetation Zone Surrounding Launch Pad	None. Consider security/visibility.
Explosive Safety Quantity-Distance (ESQD) by Category Type (Intraline [IL], Public Transportation Route [PTR], Inhabited Building [IB])	381 meters (1,250 feet) for IB ESQD, 85.3 meters (280 feet) IL, 228.6 meters (750 feet) PTR Note—Should plan for 381 meters (1,250 feet)—Dual mode Area Interceptors.
Ground Hazard Area (GHA) Radius	1,829-meter (6,000-foot) radius
Electromagnetic Radiation Constraints to Personnel, Fuels, or Ordnance	120.1 meters (394 feet) in front of the radar - 60 degrees both sides of boresight (refer to PAC-3 environmental document).
Launch Pad Fencing/ Security Needs/Dimensions	Security guards required.
Utilities to Launch Pad/Type Needed	Utilities are required for aerospace ground equipment and test instrumentation.
Road Access to Launch Pad/Percent Grade	Require road access through rough terrain, gravel preferred. Turning radius of 15.2 meters (50 feet). System designed to be mobile.
Soil Conditions Desired	Stable soil. Gravel surface desirable. Don't want equipment to sink.
Environmental Shelter/Pad/Dimensions	Re-enforced structures for Command and Control trailers.
Minimum Distance to Shoreline If Any	None. Consider wave action, salt spray.

Source: U.S. Department of the Navy, 1998a

**Table E-12. Telemetry, Optics, and Radar Instrumentation Requirements**

Item/Facility Type	Requirements
Instrumentation Devices/Facilities Required—Targets	<p>Targets—Short- and medium-range multi-participant target and interceptor tracking and telemetry reception, additional range safety monitoring, and additional data products needed.</p> <p>Makaha Ridge: Radars (COSIP), optics, lasers, electronic warfare, telemetry (receivers, recorders, antennas) and internal power plant upgrades</p> <p>Kokee Parcel A: Radar (x band), Communications (CEC [tower], voice, data [telephone poles])</p> <p>Parcel C: Telemetry antenna (phase array or dish), building (40x60)</p> <p>Parcel D: Radar (COSIP), telemetry antenna</p>
Instrumentation Device(s)/Facilities Required - Interceptors	Area Interceptors—Assumes that Range assets are fixed or trailer mounted (portable).
Number of Interceptor Personnel Working/How Long	Radar site requires 15 people working 2 to 3 weeks.
Mobile Instrumentation Alternative	May consider mobile instrumentation at some sites if no or inadequate on-ground facilities exist. Example is the Wallops Flight Facility (NASA) system. Requires C-141 accessibility for airborne assets. On-ground assets require concrete pad for mobile radar pedestal, line of sight, adequate safety clear zone, and generator use. May also consider military P-3 aircraft use.

Source: U.S. Department of the Navy, 1998a

**Table E-13. Communications, Command, and Control Requirements**

Item/Facility Type	Requirements
Number of Interceptor Personnel Working/How Long	Battle management, communications, command, and control, and intelligence—15 people for 2 to 3 weeks.
Command and Control Enhancements—Targets/ Interceptors	<p>Command and control needed; enhanced range safety monitoring needed; and FTS enhancement needed.</p> <p>Possible use of Building 105—Control Center at PMRF.</p> <p>Expand fiber optics.</p> <p>Expand office space.</p> <p>Add transmitters and receivers, other communication equipment.</p> <p>Could be mobile in aircraft.</p>

Source: U.S. Department of the Navy, 1998a

**Table E-14. Support Infrastructure Requirements**

Item/Facility Type	Requirements
Electric Power/Portable Generator/Backup	For Interceptors—Need power under Test mode, no power under Tactical mode. Self contained. For Targets—Power needed, either local power or a generator.
Sanitation/Septic/Waste Treatment	For Interceptors—Total sanitation need is for 47 personnel for 2 to 3 weeks/launch. For Targets—Total sanitation need is for 6 to 10 personnel for 1 to 2 weeks/launch.
Solar Power	None for Interceptors. Targets—No need defined.
Natural Gas/Propane	None for Interceptors. Targets—No need defined.
Potable Water/Fire Flow/Storage	Interceptors and Targets—Drinking water for personnel, minor fire control.
Solid Waste Disposal/Transfer	Interceptors and Targets—Temporary on site storage and/or transport away.
Hazardous Materials Temporary Storage Transfer—Liquid and Storage	Interceptors and Targets—Temporary storage.
Storage/Warehousing/ Logistics Support and Services—Campaign Only	Interceptors and Targets—Use existing space, if available.
On-Island Road Access/Vehicle Storage, Maintenance, and Parking—Campaign Only	Interceptors and Targets—Semi-trailer road access to assets required. Campaign—No storage.
Off-Island Transportation (Air, Barge, Other)	Interceptors and Targets—Air transport (C-130, C-141, and C-5/C-17) and landing craft or ship. Aircraft use desirable.
Fire Station/Pumper/Training/Equipment/ Emergency Medical Team	As defined by PMRF Safety.
Security Forces/Training	Interceptors and Targets—Security guards will be required during launches. No permanent support.
Recreation Facilities/Services	Interceptor and Targets—No need defined.
Fuel Storage	Interceptor and Targets—Electric generator and vehicle fuel storage.
Transient Quarters/Berthing Quarters-Barges	Interceptor and Targets—Need defined. Self-contained onshore camp concept or ship/barge quarters. See personnel numbers. Depends on frequency/location.
Permanent Housing (Base UEPH/Family Housing or Private Rental Housing)	Interceptor and Targets—No need defined.
Administrative Services/Office Space/ Campaign Trailer	Interceptor and Targets—Possible use of Building 105 at PMRF or SNL/KTF complex. Possible use of campaign trailer(s).
Medical Facility and Services	Interceptors and Targets—No special facilities required. Typical services assumed.
Mess Hall/Laundry Facility and Services	Interceptors and Targets—Self-contained onshore camp concept or ship/barge facilities.
Communications Facility and Services	Interceptors and Targets—No need defined.
Liquid Propellant Storage (Hypergolic)	Interceptor—May require temporary storage. Targets—Need defined for targets.

**Table E-14. Support Infrastructure Requirements (Continued)**

Item/Facility Type	Requirements
Small Explosives/Igniter/Squib Storage/Setbacks	Interceptor—No need defined. Targets—May require squib storage.
Heavy Equipment/Crane	Interceptor—No need defined. Targets—May require crane.
Lightering Boat and Marine Crew Services/Stevedoring	Interceptor and Targets—Need defined.
Berthing/Moorage/Dock and Ramp	Interceptor and Targets—Need defined if no adequate airfield.
Helipad	Interceptor and Targets—Need helipad support capability for emergency medical evacuation and supplies delivery, or airfield capability.
Aircraft Runway (C-130, C-141, C-5, C-17 or Other)/Airfield operations and maintenance/Hotpad/Aircraft Parking and Maintenance	C-130, C-141, and C-5/C-17.

Source: U.S. Department of the Navy, 1998a

**Table E-15. Representative Missile Propellant and Exhaust Components**

Missile	Propellant Class	Major Propellant Components	Major Exhaust Components
Weapon Systems			
MEADS	Solid	Aluminum, HTPB	Aluminum Oxide, Carbon Dioxide, Carbon Monoxide, Hydrogen, Hydrogen Chloride, Nitrogen, Water
PAC-2	Solid	Aluminum, Ammonium Perchlorate, Iron Oxide, Polymer Binder	Aluminum Oxide, Carbon Dioxide, Carbon Monoxide, Hydrogen, Hydrogen Chloride, Nitrogen, Water
PAC-3	Solid	Aluminum, HTPB	Aluminum Oxide, Carbon Dioxide, Carbon Monoxide, Hydrogen, Hydrogen Chloride, Nitrogen, Water
Standard Missile	Solid	Aluminum, Ammonium Perchlorate, HMX	Aluminum Chloride, Aluminum Oxide, Ammonia, Carbon Dioxide, Carbon Monoxide, Ferric Chloride, Ferric Oxide, Hydrogen, Hydrogen Chloride, Nitric Oxide, Nitrogen, Water
THAAD	Solid	Aluminum, Ammonium Perchlorate, Binder	Aluminum Oxide, Carbon Dioxide, Carbon Monoxide, Hydrogen, Hydrogen Chloride, Nitrogen, Water
Target System			
HERA	Solid	Aluminum, Ammonium Perchlorate, CTPB, HMX, Nitrocellulose-Nitroglycerine	Aluminum Oxide, Carbon Dioxide, Carbon Monoxide, Hydrogen, Hydrogen Chloride, Nitrogen, Water
LANCE	Liquid	IRFNA (Hydrogen Fluoride, Nitric Acid, Nitrogen Dioxide), UDMH, Water	Carbon Dioxide, Carbon Monoxide, Nitrogen, Oxygen, Water
STRYPI	Solid	Aluminum, Ammonium Perchlorate, CTPB, Nitrocellulose-Nitroglycerine, Polysulfide Elastomer	Aluminum Oxide, Carbon Dioxide, Carbon Monoxide, Chlorine, Hydrogen, Hydrogen Chloride, Hydrogen Sulfide, Nitrogen, Sulfur Dioxide, Water

Source: U.S. Department of the Navy, 1998a

Notes:

CTPB = Carboxyl-terminated Polybutadiene

HMX = Cyclotetramethylenetetranitramine

IRFNA = Inhibited Red Fuming Nitric Acid

HTPB = Hydroxyl-terminated Polybutadiene

UDMH = Unsymmetrical Dimethyl Hydrazine