

# Development of Pershing II

by MAJ Robert L. Shearer

The recent approval by the North Atlantic Treaty Organization (NATO) to deploy the Pershing II missile system in Europe caught the attention of a large and diverse group. As most artillerymen recognize, there was a serious effort by the Soviets to negatively influence the deployment decision. The resulting political tension caused what must be considered a media blitz for a highly sophisticated weapon system which traditionally carries a low level of public interest.





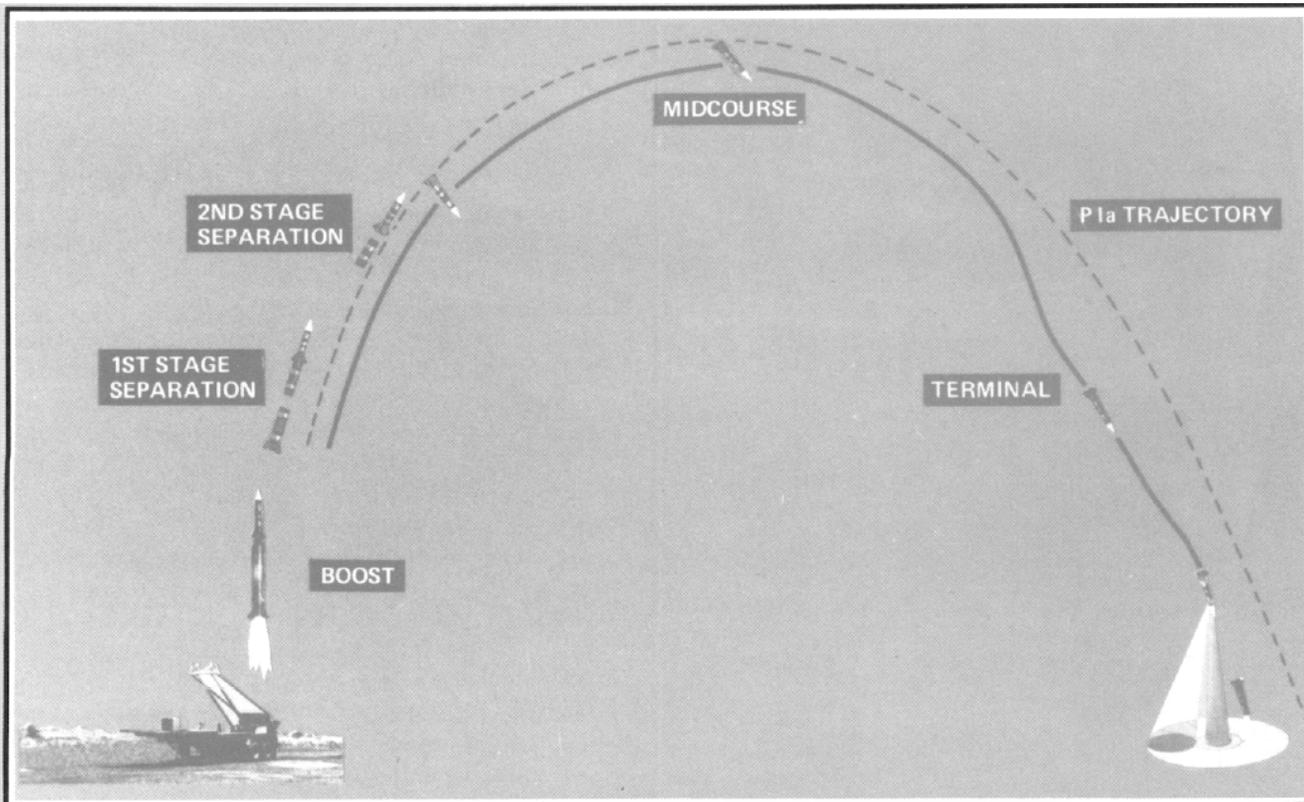
Although the Pershing II weapon system has been under development since the early 1970s, there has been little international interest in the system except for perhaps one important characteristic—its extended range.

The Pershing system has been deployed by the US in Europe since 1963 as the Army's contribution to the Theater Nuclear Force. Replacing the Redstone missile, it was developed and deployed as the field army nuclear component to complement the shorter range Honest John and Sergeant systems in support of the division and corps. It is smaller than the Redstone, is highly mobile, and uses a solid propellant. With its 400-nautical mile range, new interservice agreements were required with the Air Force since Pershing operates in the fringes of a region which previously was restricted to aircraft and strategic missile systems.

Two significant actions occurred at the time Pershing was deployed to Europe. First, theater forces were reorganized, replacing the field army with the theater army. A second significant action was tactical recognition that the Pershing missile system could offer a cost-effective alternative to aircraft which had previously provided quick reaction coverage of targets. This coverage (called the Quick Reaction Alert (QRA)) acted as a deterrent against surprise nuclear or overwhelming conventional attack of the alliance by Warsaw Pact forces; as such, Pershing gave some new and unique capabilities to the Supreme Allied Commander, Europe (SACEUR). For example, as a ballistic missile which could launch in a time frame comparable to aircraft (but have a much shorter time of flight), it could be used against time-sensitive targets and not conflict with the aircraft which would be arriving later. Additionally, the initial missile strike would increase aircraft survivability by reducing capabilities of enemy air defense systems.

Although this missile system provided an essential part of the European theater nuclear force, its ground support equipment, required for cross-country mobility, needed improvement for the QRA role. A subsequent decision to develop new ground support equipment while retaining the existing missile became the model for improving other existing weapons. Thus Pershing Ia, in the field today, plays a key part of the theater deterrent force as its posture on QRA sites provides a highly visible capability to respond to aggression.

The need, however, for improved systems in the theater nuclear force has continued to develop to support the national policy of flexible response to any level of aggression. Weapons currently deployed, to include the Pershing Ia, used relatively large yields to compensate for delivery errors and accomplish required damage levels. Since technology was available to provide the accuracy required, development of Pershing II was initiated.



P1a-P11 trajectory comparison.

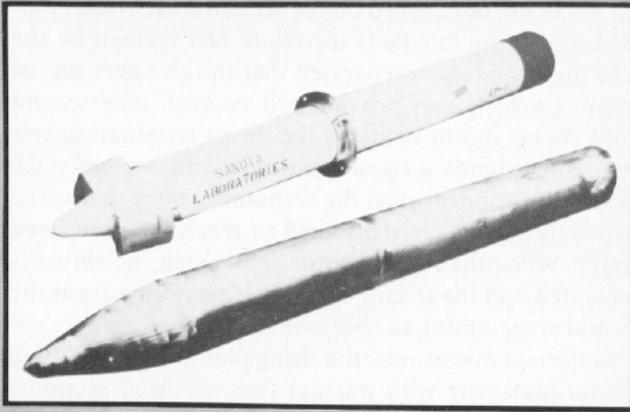
The required accuracy to exploit improved ability to accurately locate targets and high effectiveness with smaller yields was accomplished by a terminal guidance system. The advanced development phase during 1974 through 1978 validated the feasibility of using terminal guidance on a missile system. Although this was the first free-world terminally guided ballistic missile, the validation was accomplished with a minimum of public attention, culminating with the firing of five Pershing II missiles with the Pershing II re-entry vehicle installed.

The guidance system for Pershing II is similar to that of the current Pershing Ia system during most of the missile flight. Both are inertially guided throughout the boost phase and both have two solid propellant rocket motors. Differences occur however with the separation of the re-entry vehicles from the last booster section. For example, in Pershing Ia the separated re-entry vehicle follows a ballistic trajectory to the target without further guidance since the guidance package remains on board the booster motor. In Pershing II, the guidance package remains with the re-entry vehicle and provides inertial guidance capability through the entire trajectory to impact. The re-entry vehicle has thrusters to provide attitude control outside the atmosphere and air vanes for control once the re-entry vehicle returns to the atmosphere. It is during the final stages of the trajectory that

the greatest difference between Pershing Ia and Pershing II becomes obvious.

The radar in the nose of the re-entry vehicle is engaged during the final portion of flight and maps the terrain in the region of the target area. The computer converts the radar image to a digital representation of the target area and then compares this "live scene" to a previously stored reference. This reference is prepared before flight by a computer from a digital representation of the entire land mass of the region. The computer in the missile can identify the target on the reference, compare the trajectory it is actually flying (determined from the live radar return), compute the adjustments necessary to hit the target, and apply these corrections through air vanes on the re-entry vehicle. This *search, compare, correct* routine is repeated several times during the final phases of the trajectory. This guidance scheme is one of the most accurate available since it guides to a live radar picture of the actual target area.

In addition to its accuracy, the Pershing II re-entry vehicle can control its final maneuvers. This capability is essential for demonstrating the feasibility of delivering one of the two warheads being developed by Department of Energy concurrently with the Department of Defense's development of the missile system. This new



Earth penetrator before and after actual firing test.

of the missile system. This new warhead penetrates deep beneath the surface of the earth before detonating and provides a capability to destroy very hard and underground targets without relying on the large surface or airburst weapons which would otherwise be required. Pershing II is currently the only free-world system which is capable of delivering this type warhead.

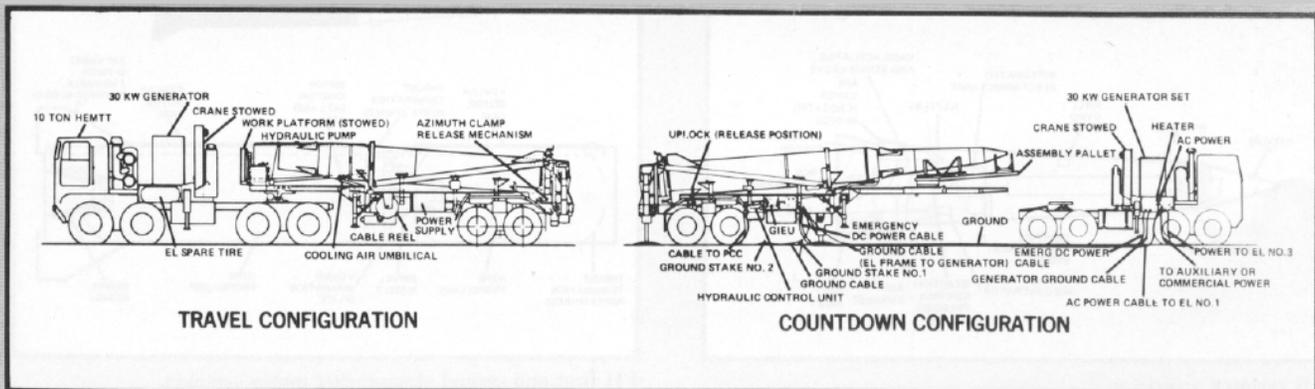
In late 1978, the Army completed test flights on the reentry vehicle, which demonstrated the feasibility of attaining the accuracy required for the system, and was then ready to proceed into full scale engineering development as a part of the theater nuclear force modernization program. At that time the Pershing II maximum range was still 400 nautical miles and would probably have retained its relative anonymity had it not been for two new long-range Soviet weapon systems. These Soviet weapons systems, the TU-26 backfire bomber and the SS-20 intermediate range ballistic missile, had the capability to strike NATO forces from bases within the Soviet borders. In response then to the need to upgrade the NATO long range theater forces, the Army agreed to upgrade the Pershing II to the Department of Defense

range requirement of something in excess of 400 nautical miles.

With the Pershing II guidance scheme, it was possible to accomplish this range adjustment and at the same time provide the same accuracy regardless of range. The Army team went into high gear to provide an integrated weapon system which would not only provide the range and accuracy required but would also reduce the amount of equipment in the Pershing units, simplify the operational requirements, and provide the battlefield endurance required of a system which must survive the initial conflict and still be capable of providing nuclear fires when required.

The decision in December 1978, by the Department of Defense, to enter full scale engineering development of a Pershing II missile system with a range in excess of 400 nautical miles sparked the beginning of the increased public interest in Pershing. The system now in development is designed around the basic elements of the Pershing organization, erector-launcher, and firing platoon. The erector-launcher used for Pershing II is the same launcher that was fielded in 1969 and is used today for Pershing Ia. For Pershing II, however, the launcher will be modified to accept the new Pershing II missile and a new 10-ton tractor/support vehicle. There are three launchers in each firing platoon and each will be capable of operating independently should the need arise. A separate vehicle is required per platoon in the Pershing Ia missile system to transport a fire data computer and system countdown power source. Missile assembly and repair requires still another platoon level vehicle, the 5-ton wrecker. With Pershing II, these vehicles are not needed since the 10-ton tractor which pulls the semitrailer erector-launcher will also carry a 30-kilowatt generator and a material handling crane.

The Army standard diesel engine generator mounted on the tractor provides the required electrical power for the erector-launcher and the missile for both countdowns and standby power. The material handling crane provides the lift for assembly and maintenance replacement



Pershing erector-launcher modified for PII.

of missile sections. Having the crane on the tractor also eliminates the requirement for the separate small davit on the Pershing Ia erector-launcher. The requirement for conditioned and high pressure air to conduct countdowns has been totally eliminated so we won't need the complex Pershing power station. Thus the three Pershing II self-contained erector-launchers require fewer personnel and less equipment and improves survivability on the battlefield.

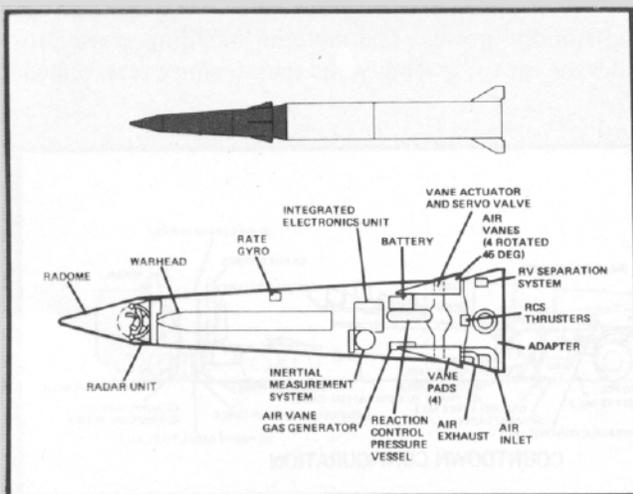
The new missile for the long range Pershing II consists of the same re-entry vehicle previously described, with only minor changes to accommodate the increased range capability, resulting in an increased time of flight, which means that electrical and pneumatic devices must function for a longer period of time.

The two new rocket motor sections use a propellant similar to the one used in the Patriot air defense system to provide the greater thrust required to achieve the increased range. The Pershing II motor sections have the same diameter and nearly the same length as their Pershing Ia counterparts; however, due to the increased weight of the new propellant, they weigh significantly more than Pershing Ia motors. To keep the total weight as low as possible, the motor cases are constructed of Kevlar, a lightweight material which is even stronger than fiberglass or steel of equal weight. Kevlar is also used for the structural walls of the missile motor sections with skirts attached at the front and rear to keep the outside dimensions smooth. The rocket motor nozzles, which are designed to provide thrust, are attached to the aft skirts and are part of the control system which also helps reduce weight. The direction of the thrust can be changed to provide up and down (pitch) and left to right (yaw) control. To guide the missile along the desired trajectory, air vanes on the first stage rocket motor provide the necessary roll control and stability in the early part of flight.

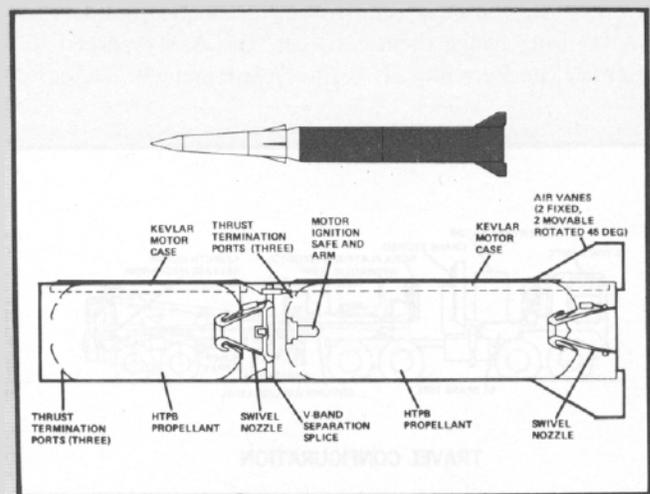
Air vanes are not needed on the second stage rocket motor because the missile is travelling fast enough by the time the first stage is separated that the air vanes on the re-entry vehicle can provide roll control. The second stage rocket motor contains the thrust termination system, which sends a signal that blows the second stage rocket motor open when the computer senses that sufficient velocity has been attained to reach the prescribed target. When the rocket motor splits open, no thrust is generated and the re-entry vehicle is separated from the second stage motor to continue its flight.

In normal operations, the firing platoon has the three erector-launchers with missiles (less warhead sections) assembled at all times. The warhead section is mated only when required by the tactical situation, such as actual combat, periods of increased tension, or a Quick Reaction Alert status during peacetime.

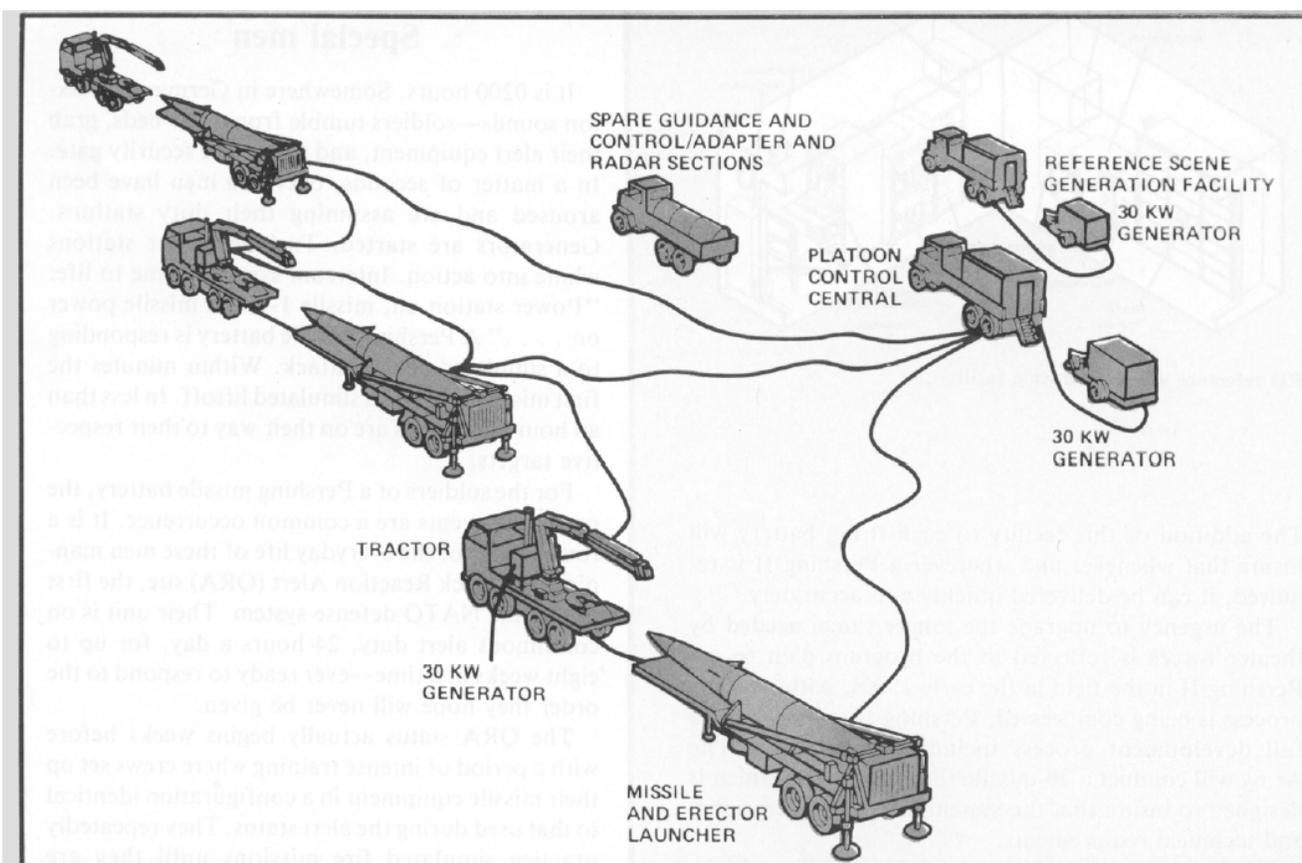
Although the erector-launchers are capable of independent operations, the usual tactical operation will be by platoon. A new piece of equipment for the Pershing II platoon—the platoon control center (PCC)—will provide the technical and operational control for platoon level operations. The PCC is based on an Army standard S-280 shelter which is designed to mount on a 2½-ton vehicle. In the Pershing II configuration, the PCC will include communications gear to receive nuclear and tactical command and control messages, control panels for technical control of countdowns, and launch control units to control the actual firing of the platoon missiles. The PCC will also contain additional operational and control equipment which will enable the platoon commander to accomplish all the required actions such as insuring that missiles are not launched until properly ordered. The PCC will be manned by three personnel—the platoon commander or officer-in-charge, the PCC operator, and the operations assistant.



PII re-entry vehicle.



PII first and second stage rocket motor sections.

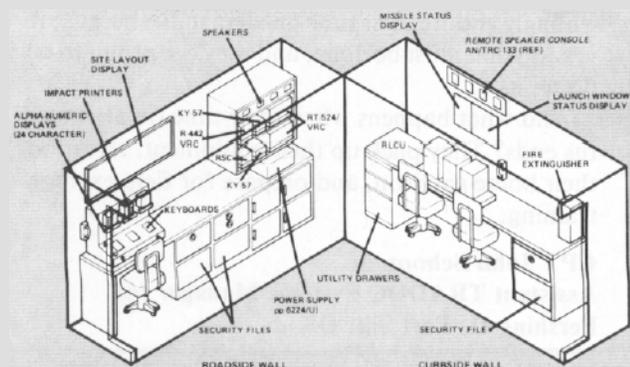


**PII forward area hardware.**

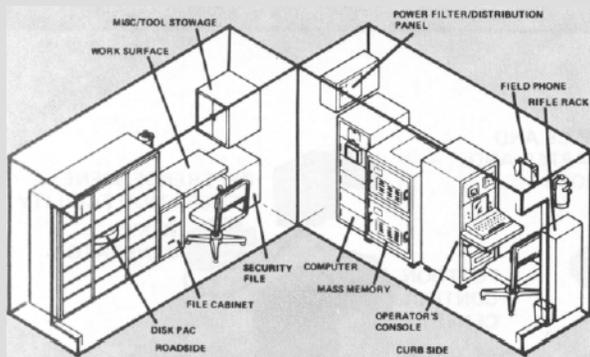
A fairly sophisticated computer, along with a supporting computer on the erector launcher, controls the missile flight and terminal guidance with scene matching and also controls most of the preflight operations. This computer system permits independent launcher operations and requires only one cable between the launcher and PCC which allows the platoon commander to control platoon operations from the PCC. With Pershing II, platoon reaction time is reduced in that all missiles can be counted down simultaneously rather than having to

count each missile in sequence as in the Pershing Ia system. The Pershing II platoon package is designed to provide battlefield survivability and at the same time provide great operational flexibility.

The only new equipment required outside the platoon for Pershing II is a new maintenance and repair van in the support unit designed to be compatible with the new equipment in the platoon. However, one additional item—the field computer system—is being developed to support Pershing II in the field. The field computer system will make the digitized reference scenes which must be inserted into the missile computer before flight to provide the radar scene matching process previously described. This facility, called the field reference scene generation facility, will supplement the fixed reference generation facility and provide the capability within the Pershing II units to fire on any target within range in a matter of minutes. This facility will not be a part of the platoon equipment, but will be collocated with one of the three platoons in the Pershing II firing battery. Reference scenes for preplanned targets will be generated in advance, but the field computer will provide the capability to update target lists, change targets, or fire on any target which may be developed during the course of the battle.



**PII platoon control center.**



**PII reference scene generation facility.**

The addition of this facility to each firing battery will insure that whenever and wherever a Pershing II is required, it can be delivered quickly and accurately.

The urgency to upgrade the longer range needed by theater forces is reflected in the program plan to get Pershing II in the field in the early 1980s. Although the process is being compressed, Pershing II will undergo a full development process including flight tests. The Army will conduct a 28-missile flight test series which is designed to insure that the system meets all operational and technical requirements.

The Army executed a contract for \$360 million with its prime contractor, Martin Marietta Aerospace, in 1979 for the engineering development of the Pershing II system. Procurement costs are projected to be more than double that, perhaps as much as one billion dollars; but, with the savings in personnel and equipment and the improved operational capabilities and survivability benefits, Pershing II will actually cost less in the long run when you consider the advantages it brings to the theater forces. Some advantages are:

- Sufficient range to cover the theater commanders area of interest.
- Drastically improved accuracy.
- Warhead yields small enough to significantly reduce civilian casualties while attaining military objectives.
- Earth penetrator warhead.
- Improved force reaction time.
- Savings in people and equipment.

These advantages also go a long way toward explaining why the Pershing II missile system has gained national and international interest. 

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## Special men

It is 0200 hours. Somewhere in Germany a claxton sounds—soldiers tumble from their beds, grab their alert equipment, and run to the security gate. In a matter of seconds, over 100 men have been aroused and are assuming their duty stations. Generators are started. Turbine power stations whine into action. Intercom systems come to life: "Power station on, missile 1-1 . . . missile power on . . ." A Pershing missile battery is responding to a simulated enemy attack. Within minutes the first missile achieves a simulated liftoff. In less than an hour all missiles are on their way to their respective targets.

For the soldiers of a Pershing missile battery, the preceding events are a common occurrence. It is a routine part of the everyday life of these men manning the Quick Reaction Alert (QRA) site, the first line of the NATO defense system. Their unit is on continuous alert duty, 24 hours a day, for up to eight weeks at a time—ever ready to respond to the order they hope will never be given.

The QRA status actually begins weeks before with a period of intense training where crews set up their missile equipment in a configuration identical to that used during the alert status. They repeatedly practice simulated fire missions until they are trained and cross-trained to flawlessly perform every minute detail of missile launch procedures. Simultaneously their equipment is tested, inspected, adjusted, and polished until it is as near as possible to that ultimate state called perfection. Only then are they tested by expert personnel from Headquarters, 56th Field Artillery Brigade, to insure that their equipment and training proficiency meet the stringent standards demanded of their critical mission.

These are proud men, who work diligently at their daily tasks, because they know the importance of their duty and gain satisfaction in the knowledge that they are directly influencing world peace. They willingly endure their time on alert status because it is a job that must be done, and they are proud to be doing it.

And what happens when their time on alert status ends? They pack up their equipment, return to their home garrison, and prepare for field exercise training.

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