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Report to the Chairman, Committee on
Government Operations, House of
Representatives

December 1988

SOLID ROCKET MOTORS

Loss of Oxidizer Production Necessitates Emergency Allocation Procedures



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National Security and
International Affairs Division

B-231319

December 16, 1988

The Honorable Jack Brooks
Chairman, Committee on
Government Operations
House of Representatives

Dear Mr. Chairman:

This report responds to your May 24, 1988, letter concerning a fire and subsequent explosion that destroyed an ammonium perchlorate (AP) plant owned by the Pacific Engineering and Production Company of Nevada (PEPCON). You asked several specific questions concerning the loss of this AP production capability. In particular, since both the National Aeronautics and Space Administration (NASA) and the Department of Defense depend on AP as a critical ingredient in solid rocket motor propellant, you were concerned about the production shortfall that might occur and the impact the shortfall could have on the Nation's space program. You also wanted to know whether the cause of the fire and explosion was related to quality and safety problems at the plant and who would be responsible for replacing this capability.

Results in Brief

The AP Advisory Group, chaired by the Deputy Assistant Secretary of the Air Force, was established to help resolve potential problems created by the loss of the AP plant. It believes that there should be an adequate supply of AP through May 1989. If the PEPCON plant is not back in operation in 1989, the advisory group estimates that there could be a shortfall of up to 14 million pounds. However, even if this shortfall materializes, the advisory group expects no adverse affect on major user programs during this period. It has allocated a sufficient supply of AP for shuttle flights through April 1990. In addition, the advisory group intends to try to allocate AP to ensure continuity in the Department of Defense's schedule for its expendable launch vehicles, which are used to launch satellites into orbit.

Several agencies,¹ including the Nevada Division of Occupational Safety and Health, have investigated the cause of the fire and explosion. Although the results of the investigations have not been officially released, PEPCON has been cited for various safety violations and fined a

¹Other agencies involved in the investigation include the Federal Occupational Safety and Health Administration and the Clark County (Nevada) Fire Department.

total of \$36,455. In addition, Kerr-McGee, Inc.—the only other U.S. producer of AP—was also cited and fined for safety violations, and, as a result, it ceased operations until corrective actions were taken. Kerr-McGee restarted its operation in June 1988 and is currently operating at full capacity.

Current plans to reestablish the AP production capability include rebuilding the PEPCON facility and building a new Kerr-McGee facility at a remote site outside of Henderson, Nevada. Until these plans are approved and financing is arranged, it is not clear what the replacement cost will be or what exactly the government's liability will be. Details on these issues and answers to your specific questions are discussed in appendix I.

Objectives, Scope, and Methodology

To answer your specific questions, we interviewed appropriate officials and examined pertinent records at the Army Missile Command and the Marshall Space Flight Center in Huntsville, Alabama; the Air Force Space Division in El Segundo, California; and the Ballistic Missile Office at Norton Air Force Base, California. We interviewed officials at PEPCON and Kerr-McGee to discuss plans to rebuild and expand their facilities. We also interviewed officials at the Clark County Fire Department, the Nevada Division of Occupational Safety and Health, and the Federal Occupational Safety and Health Administration to discuss safety investigations performed by these agencies.

We conducted our work from July through November 1988 in accordance with generally accepted government auditing standards. As requested, we did not obtain official agency comments on this report. However, we discussed the results of our work with NASA and Department of Defense officials and considered their comments as we prepared the report.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days after its issue date. At that time we will send copies to the Secretary of Defense; the Administrator, National Aeronautics and Space Administration; appropriate congressional committees; and other interested parties upon request.

GAO staff members who made major contributions to this report are listed in appendix II.

Sincerely yours,

Harry R. Finley

Harry R. Finley
Senior Associate Director

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Abbreviations

AP	ammonium perchlorate
EMLRS	European Multiple Launch Rocket System
NASA	National Aeronautics and Space Administration
PEPCON	Pacific Engineering and Production Company of Nevada

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Concerns About the Partial Loss of Oxidizer Production Capability for Solid Rocket Motors

Background

On May 4, 1988, a fire and subsequent explosion destroyed the Pacific Engineering and Production Company (PEPCON) ammonium perchlorate (AP) manufacturing plant in Henderson, Nevada. Before this mishap, PEPCON and Kerr-McGee provided approximately 90 percent of the free world's supply of AP.

PEPCON and Kerr-McGee had the combined capability of producing about 76 million pounds of AP annually (40 million by PEPCON and 36 million by Kerr-McGee). At the time of the fire and explosion, these companies were producing at about 68 percent of capacity, or 52 million pounds annually.

Both facilities were built in Henderson, Nevada, because of the availability of inexpensive hydroelectrical power from nearby Hoover Dam. The dry desert climate also allows for easier handling and storage of this moisture-absorbing product.

Importance of AP to National Security

AP is the oxidizing agent for the propellant used in space shuttles, expendable launch vehicles, and virtually every solid-fueled tactical and strategic missile in the U.S. inventory. In addition, several foreign countries, including France and West Germany, use AP and purchase some of their supply from the United States. Table I.1 shows those Air Force, Army, Navy, and NASA rockets and missiles that use AP.

Table I.1: Major Rockets and Missiles That Use AP

Air Force	Army	Navy	NASA
Peacekeeper	Multiple Launch	Trident D-5	Shuttle solid
Minuteman	Rocket System	Tomahawk Cruise	rocket motors
Maverick	Chapparral	Missile	
Advanced Medium Range	Army Tactical	Sparrow	
Air-to-Air Missile	Missile System	Harpoon	
Titan ^a	Hawk	Sidewinder	
Delta II ^a	Patriot	Phoenix	
Inertial Upper Stage	Stinger	Harm	
		Standard Missile	

^aThese are types of expendable launch vehicles.

The amount of AP required in a given motor type varies by the type of solid rocket or missile propellant. For example, approximately 70 percent of the weight of the space shuttle solid rocket motor propellant consists of AP. Each set of shuttle motors uses about 1.7 million pounds of AP; thus, the space shuttle is the largest user of AP.

**Answers to Specific
Questions Asked by
the Chairman**

The Chairman of the House Committee on Government Operations asked the following questions concerning the fire and explosion that destroyed PEPCON.

Will there be a shortfall of AP?

Shortly after the PEPCON plant was destroyed, the Under Secretary of Defense for Acquisition designated the Air Force as the lead service to work with the National Aeronautics and Space Administration (NASA) to assess the impact of the mishap, manage existing AP supplies, and oversee the actions necessary to restore the U.S. capacity to produce AP. To assist in the overall effort, an AP Advisory Group was formed, consisting of senior representatives from each service, NASA, and the Office of the Secretary of Defense. Its purpose is to address the restoration of the U.S. capacity to produce AP and establish overall priorities and a method for allocating the existing AP supply.

According to the advisory group, there will be an adequate supply of AP through May 1989. The advisory group projected that Kerr-McGee, the only other U.S. producer of AP, would produce 20 million pounds during June through December 1988. With this amount and an existing inventory of 24 million pounds, a total of 44 million pounds will be available. Of the 44 million pounds, the advisory group allocated 28.5 million pounds to users based on existing purchase orders and shipping documents provided by the rocket motor manufacturers. Table I.2 shows user requests and AP amounts allocated.

Table I.2: Requests for and Allocation of AP for 1988

Millions of pounds			
	User requests	Adjustments	Amount allocated
Air Force	11.0	- 2.8	8.2
Army	9.3	- 3.6	5.7
Navy	3.7	- 0.6	3.1
NASA	8.5	0.0	8.5
Other ^a	6.3	- 3.3	3.0
Total	38.8	-10.3	28.5

^aThis includes commercial, European Multiple Launch Rocket System (EMLRS), and other exports.

Although most users received less AP than they requested, the advisory group said there will be no adverse affect on major programs. Since only 28.5 million pounds were allocated in 1988, the advisory group estimates that 15.5 million pounds will be available for 1989. In addition, 40

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million pounds of AP will be produced by Kerr-McGee, for a total 1989 estimated allocation of 55.5 million pounds.

According to the advisory group, meeting future demand depends on when the PEPCON plant will be back in operation. Table I.3 shows expected demand for AP from 1989 through 1994.

Table I.3: Estimated Demand for AP Through 1994

Millions of pounds						
	1989	1990	1991	1992	1993	1994
Air Force	14.0	16.1	12.9	10.0	10.0	10.0
Army	16.5	11.7	9.1	9.1	9.4	10.3
Navy	4.2	5.4	5.1	5.1	5.1	5.1
NASA	17.6	22.1	24.2	28.0	31.3	29.7
Commercial	3.7	5.2	.4	1.0	.6	.6
EMLRS	4.4	5.3	5.3	7.0	5.3	5.3
Other exports	2.0	2.0	2.0	2.0	2.0	2.0
Total	62.4	67.8	59.0	62.2	63.7	63.0

The advisory group estimates that if PEPCON is back in operation by May 1989, as planned, it could produce as much as 15 million pounds before the end of 1989. If this happens, the advisory group projects that both PEPCON and Kerr-McGee will produce an adequate supply of AP and no major programs will be adversely affected. However, if PEPCON is not in operation at all in 1989, a shortfall as high as 14 million pounds could exist. As indicated above, the total AP available for 1989, not including AP produced by PEPCON, should be 55.5 million pounds. However, 7 million pounds must be withheld for a required working inventory,² leaving 48.5 million pounds available for user allocation, which is 13.9 million less than 1989 demand.

What is being done or will be done to close the gap between supply and demand for this very critical product, and will the government foot the bill?

The current plan, according to the advisory group, calls for the government to assist PEPCON in rebuilding a new plant near Cedar City, Utah, with an annual production capability of 30 million pounds, which may

²A basic working inventory of unblended AP is required to satisfy any of the user's contingency needs. Thus, AP on hand can be immediately refined to meet specific program needs.

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eventually be expanded to 40 million pounds.³ Additionally, the government will assist Kerr-McGee in building a new facility with an annual production capability of 40 million pounds, which may be expanded to 60 million pounds. This facility would be located at a site remote from Henderson, Nevada.

If this plan is successfully implemented, the United States would eventually have the capability to produce 100 million pounds of AP annually—40 million by PEPCON and 60 million by Kerr-McGee.

According to the advisory group, PEPCON and Kerr-McGee are expected to obtain their own financing for rebuilding lost production capability. The advisory group indicated that, as an incentive, the government will allow PEPCON and Kerr-McGee to recover their respective capital investment by allowing accelerated amortization charges to be added to the base price of the product. PEPCON's amortization charge will be based on a minimum of 20 million pounds of AP delivered annually. Kerr-McGee is expected to have a similar agreement. Even though exact details of the financial arrangements are considered business sensitive in both cases, it is expected that capital investments could be fully amortized in 7 years. Any amount not recovered by the end of the 7th year would be fully payable by the government. Until these plans are approved and financing is arranged, it is not clear what the replacement cost will be or what exactly the government's liability will be.

What will be the impact of the shortfall on the Shuttle, Peacekeeper, Trident, Titan, Patriot, and other tactical missile programs?

The advisory group advised us that a sufficient supply of AP has been allocated for shuttle flights through April 1990. In addition, it intends to try to allocate AP to ensure continuity in the Department of Defense's schedule for its expendable launch vehicles, which are used to launch satellites into orbit. Although some other programs, such as the Army's Multiple Launch Rocket System Program, may not receive its full AP request, the advisory group expects no critical impairment to program effectiveness if full AP production capability is established by late 1989.

³The primary cause of the delay in rebuilding the PEPCON facility has been PEPCON's difficulty to obtain funds from interested banks because the banks want government guarantees for their loans. The advisory group said that the government has not and will not guarantee PEPCON loans.

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How will priorities be decided? Will programs like Patriot, which also support Foreign Military Sales, take precedence over programs like Space Shuttle?

The advisory group stated that allocation decisions are made based on (1) AP demand data, as requested by each agency or service, (2) the potential impact on national security, and (3) the economic impact on the agency or service. As indicated earlier in this report, the AP Advisory Group was established to make these decisions, along with input and review from the Departments of Transportation and State, which are also involved with AP. According to the advisory group, no Foreign Military Sales programs are expected to take precedence over the space shuttle in receiving AP allocations.

Does the impact on programs like the Shuttle have other implications? For example, will the likely slowdown in planned Shuttle launch rates have rippling effects throughout the program and in satellite programs?

According to the advisory group, the space shuttle has been allocated enough AP for its launches through April 1990. Other expendable launch vehicles, i.e., Titan and Delta, have also been allocated sufficient AP for 1988, and the advisory group intends to try to continue these allocations for 1989 and beyond. Other than the shuttle launch decisions, complete allocations for 1989 have not been determined; however, even if PEPCON does not produce AP in 1989, as expected, the advisory group believes there will be no adverse affect on major user programs during this period.

Was the PEPCON explosion and fire related to quality and safety problems?

The final report on the cause of the fire and explosion has not been issued. However, Clark County Fire Department officials stated that the origin of the fire was from a welder's spark in a batch dryer building. The fire caused multiple explosions that eventually destroyed the complex, resulting in two fatalities. In addition, 3 employees suffered lung damage and broken eardrums, and about 70 employees suffered minor injuries.

The Nevada Division of Occupational Safety and Health conducted a safety and health hazard inspection after the explosion and criticized PEPCON for exposing employees to

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- increased likelihood of fire and/or explosion, resulting from inadequate safety controls with faulty or no maintenance procedures;
- potentially hazardous levels of toxic chemicals due to lack of confined space entry procedures, such as entry without training or protective equipment;
- serious hazards such as being struck, crushed, burned, or asphyxiated, resulting from a lack of effective emergency evacuation and response procedures; and
- polyester resin and other hazardous vapors, which caused workers to become physically ill after being denied access to respirators.

Additionally, PEPCON was cited for (1) improper storage of AP, which created a hazard for the likelihood of a fire and explosion, (2) its policy of allowing and requiring employees to fight fires without the proper training, and (3) locking the exit gate. As a result of these violations, the Nevada Division of Occupational Safety and Health levied fines against PEPCON amounting to \$36,455.

The Nevada Division of Occupational Safety and Health also inspected and criticized Kerr-McGee for violations similar to those that PEPCON was cited for, and it fined Kerr-McGee \$5,250. In response, Kerr-McGee voluntarily stopped production so it could review its internal safety. A blue ribbon panel established by the Governor of Nevada recommended that Kerr-McGee not restart production until (1) an outside safety inspection team had inspected the plant and made recommendations for improvement and (2) it had taken adequate corrective actions based on the team's findings. Kerr-McGee and the Governor's blue ribbon panel renegotiated the safety improvements and separated them into short- and long-term improvements. Kerr-McGee met these requirements and reopened the plant in June 1988.

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