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Supplementary Documentation for an Environmental Impact Statement Regarding the Pantex Plant

Description of Facilities and Estimation of Resource Requirements

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SUPPLEMENTARY DOCUMENTATION FOR AN ENVIRONMENTAL IMPACT STATEMENT REGARDING THE PANTEX PLANT:

DESCRIPTION OF FACILITIES AND ESTIMATION OF RESOURCE REQUIREMENTS

by

N. M. Schnurr

ABSTRACT

This report documents work performed in support of the preparation of an Environmental Impact Statement (EIS) regarding the Department of Energy's Pantex Plant near Amarillo, Texas. The specific areas that are discussed in this report include a detailed description of each alternative covered by the EIS and the cost, labor, and construction material requirements for each alternative. The rationale used in the selection of alternatives is discussed. The procedures used to estimate costs, labor, and construction material requirements are outlined, and detailed breakdowns of those quantities are included.

I. INTRODUCTION

This report documents work performed in support of the preparation of an Environmental Impact Statement (EIS) regarding the Department of Energy's Pantex Plant near Amarillo, Texas. That EIS addresses continuing nuclear weapons operations at Pantex and the construction of additional facilities to house those operations. The EIS was prepared in accordance with current regulations under the National Environmental Policy Act. Regulations of the Council on Environmental Quality (40 CFR 1500) require agencies to prepare concise EISs with less than 300 pages for complex projects. This report was prepared by Los Alamos National Laboratory to document details of work performed and supplementary information considered during preparation of the Draft EIS.

An important task in the preparation of the EIS was the selection of a range of alternatives that the Department of Energy could implement as means to fulfill its obligations for nuclear weapons operations mandated by presidential direction and congressional authorization and appropriation. The effects of those alternatives on the natural environment and existing socioeconomic conditions were to be compared.

Included here are detailed descriptions of the various alternatives, the rationale that led to their selection, and the resources that a particular alternative would require. These include financial resources, labor, and construction materials. The procedures used to estimate costs, labor, and construction material requirements for each alternative are discussed, and detailed breakdowns of those quantities are included.

II. SELECTION OF ALTERNATIVES

An EIS requirement is rigorous exploration and objective evaluation of all reasonable alternatives. The most obvious alternative is continued operation at sites now being used (or those previously used) for nuclear weapons assembly. These include the Pantex Plant near Amarillo, Texas, and the Iowa Army Ammunition Plant (IAAP) at Burlington, Iowa.

Location at a new site should also be considered. Los Alamos Technical Associates (LATA) has recently completed a study (LATA 1981) to identify and evaluate potential sites for a DOE nuclear weapons assembly facility. LATA used a large number of selection criteria including those related to environmental impacts, public safety, socioeconomic impacts, and energy conservation. These criteria were used in evaluating 32 sites that have been designated as suitable for a nuclear weapons assembly plant. The site receiving the highest rating was the Hanford Reservation near Richland, Washington. It is, therefore, chosen as an alternative for the Pantex EIS. LATA's list of candidate sites also includes the Pantex Plant and the IAAP with Pantex being rated second highest overall.

The Pantex alternative includes five options. The first three options provide successively greater levels of operational safety. Option 1 (P-1) assumes construction of new facilities to meet future workload increases. The new construction would meet current criteria for protective features. Option 2 (P-2) assumes completion of option 1 and additional new construction to replace many existing structures so that the entire plant would meet the current criteria. Option 3 (P-3) assumes construction of an all-new plant that would meet even more stringent goals for protective features.

Option 4 (P-4) assumes continuing operation in the existing facilities and that no new construction is started after the end of 1982. It is defined as the "No Action" alternative for the purpose of the EIS. Option 5 (P-5) encompasses several mitigation measures to reduce specific environmental impacts that could be implemented in conjunction with one of the first four options.

The IAAP alternative includes two options. Option 1 (B-1) assumes the reutilization of that portion of the plant operated until 1975 for nuclear weapons assembly. These existing facilities would be used to accommodate about 25% of future workload. The existing Pantex Plant facilities and those under construction by the end of 1982 (same as P-4) would be utilized to accommodate about 75% of future workload.

Option 2 (B-2) assumes construction and operation of an all-new nuclear weapons facility at the IAAP. The Pantex Plant would be closed.

The Hanford alternative (H-1) assumes construction and operation of an all-new plant on the Department of Energy's Hanford Reservation. The Pantex Plant would be closed.

The fourth basic alternative (T-1) is termination of nuclear weapons operations by the DOE at the Pantex Plant. This alternative is not within the DOE's jurisdiction but is evaluated for comparative purposes. Evaluation of this alternative covers only the environmental impact of termination of operations at the Pantex Plant and does not include other aspects of United States nuclear weapon policies. The termination of operation at the Pantex Plant is also part of the all-new plant options B-2 and H-1.

III. SUMMARY OF RESULTS

Predicted capital investments and the maximum work force requirements for all options are given in Table I. Estimates of quantities of construction materials required are listed in Table II. Detailed descriptions of each option and discussions of the methods used to estimate resource requirements comprise the remainder of this report.

IV. METHODS OF ESTIMATING COST

The accuracy of the cost estimates given in this report varies depending on the characteristics of the facilities, sources of information, and estimating

TABLE I

COSTS AND LABOR REQUIREMENTS

	Pantex*		Burlington		Hanford	
Alternative	Cost ($ Millions)	Maximum Work Force	Cost ($ Millions)	Maximum Work Force	Cost ($ Millions)	Maximum Work Force
P-1	198	459	--	--	--	--
P-2	664	1000	--	--	--	--
P-3	1239	1600	--	--	--	--
P-4	53	217	--	--	--	--
B-1	53	217	163	305	--	--
B-2	73**	217	1415	1800	--	--
H-1	73**	217	--	--	1479	1800
T-1	73**	217	--	--	--	--

*Option P-5 (mitigation measures) is not included because a variety of possible actions could be selected.
**This figure may vary depending on when a decision to terminate operations at Pantex is made.

TABLE II

CONSTRUCTION MATERIAL REQUIREMENTS

Alternative	Pantex* Steel Thousand (tonnes)	Pantex* Concrete Thousand (m^3)	Burlington Steel Thousand (tonnes)	Burlington Concrete Thousand (m^3)	Hanford Steel Thousand (tonnes)	Hanford Concrete Thousand (m^3)
P-1	21	56	--	--	--	--
P-2	48	187	--	--	--	--
P-3	106	347	--	--	--	--
P-4	15	41	--	--	--	--
B-1	15	41	11	37	--	--
B-2	15**	41**	91	306	--	--
H-1	15**	41**	--	--	91	306
T-1	15**	41**	--	--	--	--

*Option P-5 (mitigation measures) is not included because a variety of possible actions could be selected.
**This figure may vary depending on when a decision to terminate operations at Pantex is made.

method used. The methods used in the cost analysis and their estimated accuracies are discussed in this section.

A. New Buildings

Eleven different facilities are either presently (mid 1982) under construction or scheduled to be constructed in the near future. These facilities are listed in Table III. Those now under construction are line items in the federal budget. Detailed design has been completed and contracts have been signed for construction of these facilities. The construction costs listed in Table III should be considered exact as of June 1982 barring failure of the construction companies to fulfill their contracts. Items for which contracts have not been signed have cost estimates based on Title 1 or Title 2 designs. Their costs may ultimately change by as much as 25% depending on changes in the design and changes in material and labor costs.

Cost estimates for major new facilities for alternatives P-2, P-3, B-2, and H-1 have been taken from the continuing DOE long-range planning efforts (LRPE). Estimates of material and equipment costs have been developed from detailed takeoffs of civil, structural, and architectural components of each new or modified building included in the siting schemes and from construction cost quotations for similar type structures received in 1981 as part of the USDOE Production and Assembly Facilities Project, Contract No. DE-AC04-81AL16069 (Task I). Civil, structural, and architectural costs are the dominant component of all cost estimates and represent approximately two-thirds of total installed cost. Estimates of mechanical and electrical materials and equipment costs were

TABLE III

LINE ITEM FACILITIES FOR THE PANTEX PLANT

No.	Facility	Construction Period	Cost ($ Millions)
1	Production and Assembly Facilities	9/81-7/83	23.0
2	Weapons Assembly Facility	9/83-9/85	41.0
3	Weapons Assembly Facilities	9/83-9/85	24.5
4	Weapon Assembly Facilities, Stockpile Modernization (82-AL-30)	9/83-9/85	28.3
5	Remote Hole Drilling Facility and Aging Facility (79-7-P)	12/82-3/84	5.6
6	High Explosives Development Machining Facility (78-17-E)	7/82-3/84	10.6
7	Universal Pilot Plant (79-7-0)	9/82-3/84	12.6
8	Alternate Energy Source Project	5/84-12/87	46.6
9	Main Substation	8/83-4/85	3.3
10	Explosives Staging Facility	3/82-11/82	0.7
11	Interim Test-Fire Facility	1/82-7/82	0.7
			196.9

also derived from the 1981 construction quotations. The total cost estimate includes a 12% contingency and 15% allowance for owner's costs, including engineering and construction support activities. Total cost estimates are assumed to be accurate to 25%.

The estimates from the LRPE were based on wage rate scales for Amarillo, Texas, and apply only to that locality. The costs of construction of identical facilities at other locations were estimated using city adjustment indexes taken from Berger 1981. The results are a factor of 1.15 for Hanford, Washington, and 1.10 for Burlington, Iowa.

The cost estimate with the greatest uncertainty is the new facilities estimate for the Army, option B-2. They now use approximately half of the buildings previously used for nuclear weapons operations, and several of those are only partly utilized. The total work force is approximately 150. When the AEC Burlington Plant was in full operation, 1080 were employed in the same facilities. The LRPE estimates for an all-new production and assembly facility, adjusted for a work force of approximately 10% of that for which those facilities were designed, suggest a construction cost of slightly more than $100 million.* The facilities used by the Army will not require full containment

*All costs listed in this report are in July 1981 dollars.

because nuclear materials are not present and should, therefore, be less expensive. The estimated cost is $100 million.

Other areas within the IAAP are now unused, and the possibility exists of refurbishing those facilities for use by the Army. This may require no more than $10 million. The $100 million that is used in the cost estimate for option B-2 should be regarded as a "worst case."

B. Decontamination and Demolition

An estimate of the cost of decontaminating and demolishing the Pantex Plant was prepared by R. E. Miller, Los Alamos, Group ENG-8. Unit costs of labor, materials, and equipment for demolition were obtained from Berger 1980. Decontamination costs were assumed to be 10% of the demolition cost. The general cleanup costs were assumed to be 20% of the decontamination costs. Typical construction markup rates were used. The total cost to decontaminate and demolish the Pantex Plant was estimated to be $20 million. This estimate is assumed to be accurate to 25%.

C. Miscellaneous Items

Costs of items listed in this section are somewhat less accurate because, in many cases, a detailed design is not available. For example, the cost of paved roads needed at Hanford for option H-1 could not be determined without knowing the exact length of road and without a careful study of the topography and geological characteristics of the site. The cost of security systems for options H-1 and B-2 could only be estimated based on preliminary designs. The approach used for these and other items listed in this section was to perform a preliminary design and to obtain unit cost estimates based on costs of similar recently constructed facilities. A list of specific items and their estimated unit cost is given in Table IV. These data are estimated to be accurate to about 50%.

The initial costs and purchase dates of many specific items of production equipment used at the Burlington AEC Plant are available (MHSM 1972). These data were converted to July 1981 dollars using a 10% escalation rate and are assumed accurate to 25%.

V. METHODS OF ESTIMATING WORK FORCE

The cost analysis performed for the LRPE includes detailed estimates of the total number of man-hours of labor. Those results indicate labor requirements of 0.012 man-hours of labor per dollar of construction cost. That number was used to estimate labor requirements for the new construction included in each alternative.

The size of the labor force depends on the construction schedule. The dates for the beginning and end of construction for the line items are given in

TABLE IV

COST ESTIMATES FOR MISCELLANEOUS ITEMS

Item	Estimated Cost ($)
Electrical and water distribution system and sewerage treatment plant	42 million
Test-fire facility	0.7 million each
Computer facility	3.0 million
Security equipment	
Detection equipment	162/ft of fence
Fence	20/ft
Equipment at portals	0.5 million
Towers	0.1 million each
Hardened guard stations	0.1 million each
Vehicles and support equipment	3.0 million
Secondary paved road	0.7 million/mile
Refurbishing old buildings at Burlington	$10/ft^2$
Moving Army from Burlington	10 million
Magazines	0.45 million each

NOTE: Estimates are for Amarillo, Texas, unless otherwise noted. Construction costs for Burlington and Hanford are obtained by using site factors of 1.10 and 1.15, respectively.

Table III. For projects of less than 3 years duration, the work force is relatively constant. The size of the work force for each line item was, therefore, determined by multiplying the construction cost by 0.012 man-hours/$ and dividing by 146.7 hours of work/month to determine the total number of man-months. That number was then divided by the duration of the project in months to determine the size of the work force.

The results of this analysis are shown graphically in Fig. 1. This graph is used to determine the size of the work force dedicated to the construction of line items for those options that include one or more line items.

Construction schedules for those options that require large amounts of new construction (P-2, P-3, B-2, and H-1) have not been developed. The total construction period has, however, been estimated by DOE personnel to be 5 years for option P-2 and 7-1/2 years for P-3, B-2, and H-1. It has been shown (Rapp 1974) that the labor force for a large construction project having a duration of 5 to 8 years reaches a peak 30 to 50% higher than the average work force for the

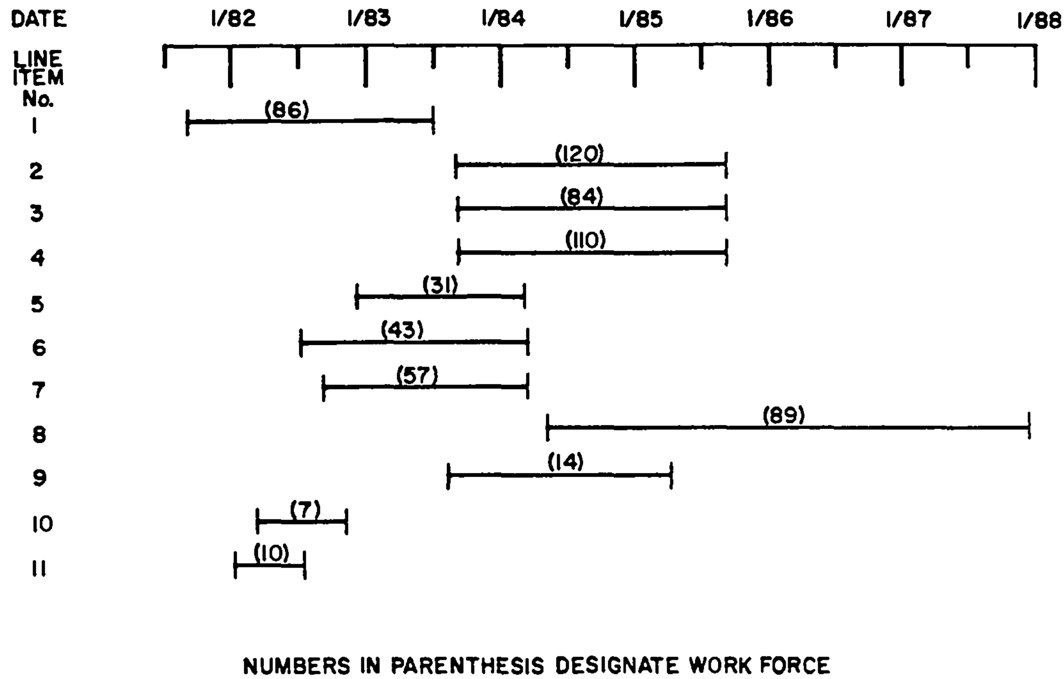

Fig. 1. Work force for line items.

entire period. The peak occurs near the midpoint of construction. The maximum work force for these cases is calculated from

$$\text{Maximum work force} = 1.5 \times (\text{cost of construction}) \times (0.012 \text{ man-hours/\$})/$$

$$(1760 \text{ man-hours/year})/(\text{construction period in years}) \quad .$$

VI. ESTIMATION OF CONSTRUCTION MATERIAL REQUIREMENTS

Quantities of steel and concrete required for each line item are listed in Table V.

Concrete and structural steel requirements are given in the LRPE for each prototype structure. Those data were summed for the LRPE alternatives corresponding to options P-2 and P-3. The results are 131 000 m^3 of concrete and 27 000 tonnes of steel for options P-2 and 306 000 m^3 of concrete and 91 000 tonnes of steel for option P-3. These figures are for the new construction used to replace facilities that do not meet the applicable design criteria and do not include the line items that are a part of these alternatives.

TABLE V

CONSTRUCTION MATERIAL REQUIREMENTS FOR LINE ITEMS

Line Item No.	Concrete (m^3)	Steel (tonnes)
1	6 154	912
2	2 592	386
3	594	299
4	10 925	4 875
5	11 351	5 570
6	10 187	2 543
7	13 442	5 997
8*	--	--
9	154	23
10	141	7
11	155	41
Totals	55 695	20 653

*This line item is in the preliminary design stages.

VII. PANTEX ALTERNATIVES

A. New Construction; P-1

The first Pantex alternative is to continue operations in existing facilities and to construct 11 specific line-item projects to meet future workload requirements. The approximate construction period and cost for each project are given in Table III. The work force analysis was discussed in Sec. V and shown in Fig. 1. A description of the size and function of each facility follows.

1. Production and Assembly Facility, Task I. This project includes an assembly/disassembly complex consisting of two assembly cells and a service magazine, seven assembly bays, one radiography bay, and seven high-explosive service magazines.

The new assembly cells will have nearly the same design as the existing "Gravel Gertie" assembly cells. Each will contain a cylindrical assembly room with suspended gravel roof. The blast doors will be of an improved design that will withstand the full high-explosives load limit. These facilities will meet all but possibly one of the protective design requirements of the current criteria. The possible exception is the degree to which the release of radioactive material following an accident would be limited. A field test program is now under way to quantitatively determine the filtering capability of the gravel roof should an explosion occur. The associated high-explosive service magazine will be a metal-arch, earth-covered structure.

The seven new assembly bays will have heavily laced reinforced (interwoven heavy steel reinforcing bars) concrete walls and earth-covered slab roofs. The roofs are similar to those in the existing earth-covered bays. Included with this facility will be tooling and tester storage areas, offices, restrooms, a mechanical room, and connecting ramps. All of these new bay facilities will meet the current criteria for new construction.

The radiography bay will house the existing 8-MeV linac (linear accelerator) used to generate intense x rays for radiography of weapons and weapon components. The radiological room will have reinforced concrete construction with an earth overburden. The control and film process room will also have reinforced concrete construction but will lack the earth cover.

The high-explosives service magazines consist of seven new multiplate metal-arch, earth-covered noncombustible structures for the staging of in-process high-explosives components.

2. Weapons Assembly Facility, FY 82. This project includes an assembly/disassembly complex consisting of one new assembly cell, seven assembly bays, a radiography bay, and associated support facilities.

The assembly cell will be either a new design, heavily laced reinforced concrete structure or a new design Gravel Gertie structure. It would have blast doors and fast-acting blast valves to contain the physical effects of an accidental detonation, protecting workers in adjacent areas and preventing propagation. The blast valves would provide the capability for nearly eliminating potential release of radioactive material from an accidental detonation. It would have the same type of blast doors but would depend on the energy absorbing and filtering capability of a suspended gravel roof to provide the protection to workers in adjacent areas and to limit the release of radioactive material from an accidental detonation. Detailed quantitative information on the filtering capabilities of the gravel roof will be provided by actual field tests to be conducted in late 1982 at the Nevada Test Site. If these tests prove the adequacy of the filtering, the Gravel Gertie concept would be preferred because of easier construction. Whichever concept is selected will meet all the criteria for new construction regarding protective design features.

The assembly bay complex includes a linac radiography bay, seven assembly bays, and necessary personnel support areas and corridors. The bays will be essentially the same as the existing earth-covered bays described. This basic design concept proved adequate in tests performed by the US Army Corps of Engineers at their Vicksburg facility in 1982.

3. Weapons Assembly Facilities. This project consists of one assembly cell and four assembly bays. Construction is planned to be complete in 1985.

The assembly cell will be one of the two concepts described under Project No. 2. The complex will include an assembly room tool staging area, nuclear material staging area, mechanical room, corridor, equipment entrance and personnel entrance, an entrance corridor, a tester storage area, a valve room, a monitoring equipment storage room, and a decontamination area.

The assembly bay facility will consist of four assembly bays. Each will be similar to the existing earth-covered bays. Each will have separate equipment and personnel entrance corridors, inert parts staging areas, a mechanical room, two fan buildings, and a connecting ramp.

4. Weapon Assembly Facilities, Stockpile Modernization. This project consists of one assembly cell, nine assembly bays, and related support and service areas. Construction is expected to be completed in 1985.

The assembly cell will be one of the two concepts described under Project No. 2. The facility will include a staging area, one inert tooling and tester staging area, a unit equipment room, a service vestibule, and a personnel passage.

Each assembly bay will be similar to the existing earth-covered bays. The facility includes inert parts staging, service vestibules, and personnel passages. The support facilities for each bay include fan buildings and materials staging areas. All nine bays will be supported by a central mechanical equipment building.

5. Remote Hole Drilling Facility and Aging Facility. The proposed explosives drilling facility will contain one drilling bay (with reinforced concrete walls and roof and blast resistant doors), a control room, and an equipment room. It will contain 279 m^2 of net area of which 146 m^2 is ramp. This facility is required to provide a capability for remotely drilling large high-explosive components. The aging facility will provide controlled temperature and humidity conditions for testing the properties of high explosives over time.

6. High Explosives Development Machining Facility. The proposed high-explosives development machining facility consists of five machining bays with separate control rooms, an in-process staging bay, a precision measurements bay, a waste treatment bay for high-explosives contaminated water, a mechanical room, two storage areas, office space with a vault, and restrooms. This facility will

replace the high-explosive development machining and gauging facility that was partially destroyed by an accidental explosion in March 1977. This building will have 1951 m^2 of floor space and is approximately 20% larger than the previous building. The additional space houses one additional machining bay and the equipment necessary to perform remote machining operations (the machine operator is not physically present during the machining operation) in all five machining bays. The facility will meet the current criteria applicable to new construction protective design features.

7. Universal Pilot Plant. This high-explosives pilot plant will contain three work bays and the required support areas totaling 1486 net usable square meters. This project will replace an old existing facility. A major reason for the project is to enhance worker safety. This high-explosives pilot plant will be used for synthesis of high explosives and development of new high-explosive manufacturing processes.

8. Alternate Energy Source Project. This project is a power plant producing hot water for heating and cooling.

One option would be a cogeneration plant burning low-sulfur coal and would generate some electricity in addition to producing hot water for heating. This option would comply with federal policy to reduce and eliminate use of natural gas in federal facilities. The electricity produced would supply part of the plant requirements.

Coal storage and handling facilities would include a new rail line, a railroad coal car unloading facility, a coal pile (360 by 270 by 5 ft high), conveyors to plant, a dry ash handling facility, and an ash settling area (300 by 100 ft) adjacent to the coal storage area. This plant would reduce water use by about 20 million gallons a year compared with the existing steam generation facility or about a 5 to 6% reduction in overall plant use. The new plant would be designed to meet the applicable Environmental Protection Agency (EPA) and Texas Air Control Board standards. Baghouse filters would clean flue gas before discharge.

DOE is also considering an Alternate Energy Source Plant that would use a fuel other than coal. A natural-gas-fired or oil-fired plant is expected to be less costly to construct and easier to operate.

9. Main Substation. This project is a new power substation including switchgear, a transformer, a capacitor bank, utility metering, distribution equipment, and power lines for connection to local utility and existing plant distribution systems.

10. Explosives Staging Facility. This project is a new storage facility for small explosives components. The facility will consist of an explosives

storage area, a small work station, and a connecting corridor and will have 308 m^2 of floor area.

11. Interim Test-Fire Facility. This project is a high-explosive test-fire facility. It would contain emissions generated by test shots involving depleted uranium and beryllium. The facility will consist of a control bunker, a test-fire containment chamber, and an effluent filtering system. The proposed facility is required to assure that Pantex will meet Texas State air quality standards and to preclude the introduction of beryllium into the environment from Pantex activities.

The test chamber will be a cylindrical steel tank designed to contain test-fire detonation blast effects, heat, and pressures. It is designed to contain residual gases until they can be slowly released through filters. The filtering system will be 99.9% effective High Efficiency Particulate Air (HEPA) filters.

The facility is being designed to contain only the test shots with beryllium and relatively small amounts of high explosives.

B. Total Plant Upgrade; P-2

The second Pantex alternative is based on the restriction that all facilities that contain high explosives or nuclear materials meet the current design criteria. The 11 specific line item projects listed in Table I meet those criteria and would be included under this alternative. Several existing facilities do not meet the current criteria, however, and would have to be replaced or used for lower hazard class operations.

A blast damage analysis was performed for all buildings in zones 11 and 12 used for the production or storage of high explosives to determine whether they would meet the current criteria and could continue to be used for their present class of operation and present explosive capacity. If not, the buildings were evaluated for their reuse potential for a revised class of operation and/or revised charge capacity or for continued use only as a nonexplosives operating structure. The results of that analysis indicated that buildings having 7014 m^2 of floor area should be downgraded from high explosives to inert operations, and facilities having 41 145 m^2 should be decontaminated and demolished.

Conceptual designs have been developed for prototype structures that would meet process requirements and provide the degree of protection required. The designs covered a wide range of charge weights and structural dimensions. Nine prototype structures were designed to cover the range of vented and containment structures necessary for the various hazard and operations requirements.

Combinations of these prototype structures were used in the various alternative development schemes. New construction totals 106 222 m^2. Continued availability of various existing support facilities is assumed. These include magazines in zone 4, the main substation, firing sites, warehouses, sewage treatment plant, water supply system, vehicle maintenance facility, and burning grounds.

The total cost of option P-2 is estimated to be $664 million. This includes $198 million for line items and related demolition. The cost of new construction to replace existing facilities that do not meet the current criteria is $466 million.

The maximum work force during construction of the line items is 459 in August 1983. The additional new construction would be completed in 5 years starting (nominally) in 1987. The peak work force for that phase is estimated at 1000 in 1989. Construction material requirements are 48 000 tonnes of steel and 187 000 m^3 of concrete.

C. Total Plant Replacement; P-3

The third Pantex alternative requires all facilities to meet the enhanced goals for protective features. The LRPE developed nine alternative development schemes that satisfy this requirement. Because there are very few buildings in zones 11 and 12 that meet the more stringent design criteria, all-new construction is recommended for the production and assembly areas. Alternative No. 1 is selected as the basis for the third Pantex alternative.

The new construction that replaces zones 11 and 12 is a complex that is divided into development, fabrication, production support, assembly, and administrative/technical areas. The total floor area of new construction is 182 047 m^2. The production and assembly areas consist of assembly bays and cells (prototype structures discussed above) arranged to minimize transport distances and maximize production efficiency and safety.

In addition, line items 1, 5, 6, 7, 8, 10, and 11 are included. These line items (with the exception of the alternate energy source project) are now under construction and are needed to meet current production schedules. Existing support facilities including magazines in zone 4, the main substation, firing sites, warehouses, sewerage treatment plant, water supply system, vehicle maintenance facility, and burning grounds are retained under this option.

The total cost of option P-3 is estimated at $1239 million. This includes $100 million for the line items and $1139 million for the major new construction.

The major new construction would be completed in approximately 7-1/2 years beginning in 1987. The work force is expected to reach a peak of 1600 in 1991. Construction material requirements are 106 000 tonnes of steel and 347 000 m^3 of concrete.

D. Existing Facilities Only (No Action); P-4

Under this option, the only changes to the existing (mid 1982) Pantex Plant would be the completion of line items 1, 5, 6, 7, 10, and 11, which are already under construction. The cost would be $53.2 million. The maximum predicted work force is 217 by the end of 1982. Material requirements are 15 000 tonnes of steel and 41 000 m^3 of concrete.

E. Mitigating Measures; P-5

Several concepts for possible mitigating measures to limit environmental effects have been investigated. These could be used with one or more of the other options. These measures are divided into those that could reduce the probability or consequences of potential accidents and those that could reduce the impact on the environment of routine operations.

Mitigating measures for potential accidents include the following.

- Reduce the probability of an aircraft crash by obtaining a prohibited airspace in the vicinity of the Pantex Plant, moving the VORTAC radio navigation device to a different location, and modifying the standard approach patterns for the Amarillo Airport.

- Replace World War II nuclear weapons operations structures.

- Develop firefighting procedures that could limit the length and temperature of a fire in a Safe Secure Trailer transport vehicle.

- Upgrade the existing assembly cells at Pantex.

- Acquire additional land around the Pantex Plant or the IAAP to form a buffer zone.

Mitigation measures for normal operation are the following.

- Install an automated energy management system to reduce energy consumption at Pantex.

- Add a new test-fire facility that would contain all emissions from test shots.

- Develop a power plant that would have a smaller environmental impact than the coal-fired cogeneration plant being considered.

An accurate estimate of resources required by each measure cannot be obtained until each measure is investigated in more detail. However, none is expected to significantly affect cost, work force, or construction material requirements except the new power plant. A new coal-fired cogeneration plant has been included in most alternatives, and changing to a different fuel source should not result in a large change in resources required.

VIII. IOWA ARMY AMMUNITIONS PLANT (IAAP) ALTERNATIVES

A. Partial Relocation of Workload; B-1

The AEC operated the Burlington AEC Plant from 1947 to 1965. The mission of that plant included fabrication of chemical explosives and nuclear weapon assembly functions. This involved new production, modification, retrofit, surveillance, retirement, and other related weapon stockpile functions, along with development support and other weapon program reimbursable work as directed by the AEC.

The Burlington AEC Plant was located within the Army-owned IAAP 10 miles west of Burlington, Iowa. An exclusive use agreement with the Army involved some 728 hectares located within the 7687-hectare IAAP that included Group 1, line 1, Yard C, the firing site, an explosives disposal area, and three warehouses. In 1975, the Burlington AEC Plant was closed and the facilities were returned to the Army.

The first IAAP option assumes that the Burlington Plant would be reopened, and nuclear weapons operations would be divided approximately 75% at Pantex and 25% at the IAAP. Facilities at both locations would be upgraded to meet the current design criteria. Line items 1, 5, 6, 7, 8, 10, and 11 would be added at Pantex. Some operations would be moved to different facilities so that the current criteria would be met.

Reopening the Burlington Plant would require reclaiming the Group 1 area (line 1) for use as the high-explosives production and weapons assembly area and Yard C for storage and staging. The high-explosives burning ground, maintenance facilities, steam plant, and firing sites would be shared with the Army. Six new assembly bays would be needed in the line 1 area. Blast doors would be added to seven assembly cells, four of which would be used as bays. A sewage treatment plant and computer facility would be constructed, and new security systems would be installed around the perimeters of line 1 and Yard C. Additional production equipment would be purchased. Some facilities in the line 1 area are presently being used by the Army and could be used with little modification. Other facilities would require significant refurbishing.

The cost at Pantex for option B-1 is $53 million. The maximum work force (determined from Fig. 1) is approximately 217 in September 1983. The construction material requirements include 15 000 tonnes of steel and 41 000 m^3 of concrete.

TABLE VI

ESTIMATE OF COSTS OF REOPENING THE BURLINGTON PLANT

Item		Cost ($ Millions)
Six new assembly bags		5.1
Add blast doors to three assembly cells		1.0
Add blast doors to four cells for use as bays		0.3
Equipment		25.4
Security		6.6
Vehicles and support		3.0
Computer facility and equipment		3.0
Sewerage treatment plant		5.0
Move Army		10.0
Cleanup and refurbish		
Assembly cells	0.1	
Assembly bays	0.2	
High explosives production	2.8	
Administration	0.3	3.4
Construct new facilities for the Army		100.0
Total		162.8

Estimated costs to reopen the Burlington Plant are given in Table VI. The total is approximately $163 million. The maximum work force is estimated to be 305. This includes 100 for construction and refurbishing in the line 1 area and 205 for construction of new facilities for the Army (based on a 5-year construction period). Construction material requirements are estimated at 11 000 tonnes of steel and 37 000 m^3 of concrete, most of which would be used for new facilities for the Army.

B. All New Plant (Complete Relocation of Workload); B-2

A second Burlington option is complete relocation of operations at the IAAP. This will require the construction of new production and assembly facilities that meet the enhanced design criteria. These facilities would be identical to the new production and assembly complex of option P-3. A plot of land east of the firing site could be used for this complex.

Some facilities now existing at the IAAP such as magazines and the firing site could be recovered from the Army. New facilities, however, would have the advantages of improved operational efficiency and safety and smaller environmental impacts. The added cost was estimated to be small enough to justify new magazines, test firing site, and burning ground. They are included in this option.

TABLE VII

COST ESTIMATES FOR OPTION B-2

Item	Cost ($ Millions)
Production and assembly complex	1252.9
Magazines (64 required)	31.8
Electrical and water distribution systems and sewerage treatment plant	41.8
20 miles of paved road	16.4
Main substation	4.4
Test-fire facility	3.1
Vehicle maintenance and garage facility	7.7
Coal-fired cogeneration plant	50.3
Security system	6.6
Total	1415.0

The total cost of option B-2 at the IAAP is estimated at $1415 million. A cost breakdown is given in Table VII. The peak work force is estimated at 1800 in 1991. The construction material requirements are 91 000 tonnes of steel and 306 000 m^3 of concrete.

The costs at Pantex for option B-2 include $53.2 million for line items 1, 5, 6, 7, 10, and 11 now under construction and $20 million for decontaminating and demolishing the plant. The maximum work force would be approximately 217 in early 1983. Concrete and steel requirements are 41 000 m^3 and 15 000 tonnes, respectively.

IX. HANFORD ALTERNATIVE

The Hanford alternative entails closing the Pantex Plant and building an entirely new plant on the Hanford Reservation (H-1). The new construction is assumed to meet the enhanced design criteria and would be nearly identical to that of option B-2.

The new construction is assumed to meet the enhanced design criteria and would be nearly identical to that of option B-2.

The total cost of option H-1 at Hanford is estimated at $1479 million. A cost breakdown is given in Table VIII. Estimates of the work force and construction material requirements at Hanford are identical to those of option B-2. Costs, work force, and construction material requirements at Pantex for option H-1 are identical to those listed under option B-2.

TABLE VIII

COST ESTIMATES FOR OPTION H-1

Item	Cost ($ Millions)
Production and assembly complex	1309.8
Magazines (64 required)	33.3
Electrical and water distribution systems and sewerage treatment plant	43.7
20 miles of paved road	16.1
Main substation	4.6
Test-fire facility	3.2
Vehicle maintenance and garage facility	8.1
Coal-fired cogeneration plant	53.6
Security system	6.6
Total	1479.0

X. TERMINATION ALTERNATIVE (T-1)

The termination alternative assumes no new facilities would be built other than those presently under construction and that the Pantex Plant would be closed. Costs and work force and construction material requirements at Pantex are identical to those estimated for options B-2 and H-1.

XI. CONCLUSIONS

Methods have been developed to estimate the costs, labor, and construction material requirements for each alternative discussed in the Pantex EIS. The accuracy of the cost and construction material estimates is believed to be ±25%. Estimates of maximum work force depend on construction schedules, which may vary significantly from those assumed here. Errors in the estimates of maximum work force may be as large as 50%.

REFERENCES

Berger 1980: Berger & Associates, Cost Consultants, The 1980 Berger Building and Design Cost File (Van Nostrand Reinhold Co., New York, 1980).

Berger 1981: Berger & Associates, Cost Consultants, The 1981 Berger Building and Design Cost File (Van Nostrand Reinhold Co., New York, 1981).

LATA 1981: R. J. Kingsbury, J. M. Greenwood, R. A. Riley, and A. M. Osternak, "Suitability Evaluation of Candidate Sites for Nuclear Weapons Assembly Facilities," Los Alamos Technical Associates, Inc., LATA-LSL-25-02 (July 1981).

MHSM 1972: "Burlington AEC Plant Master Plan," Mason and Hanger-Silas Mason Co., Inc. (September 1972).

Rapp 1974: D. A. Rapp, "Impact - An Assessment of the Impact of Oil Shale Development - Volume 5 Population Analysis," Office of the Governor, State of California (December 1974).

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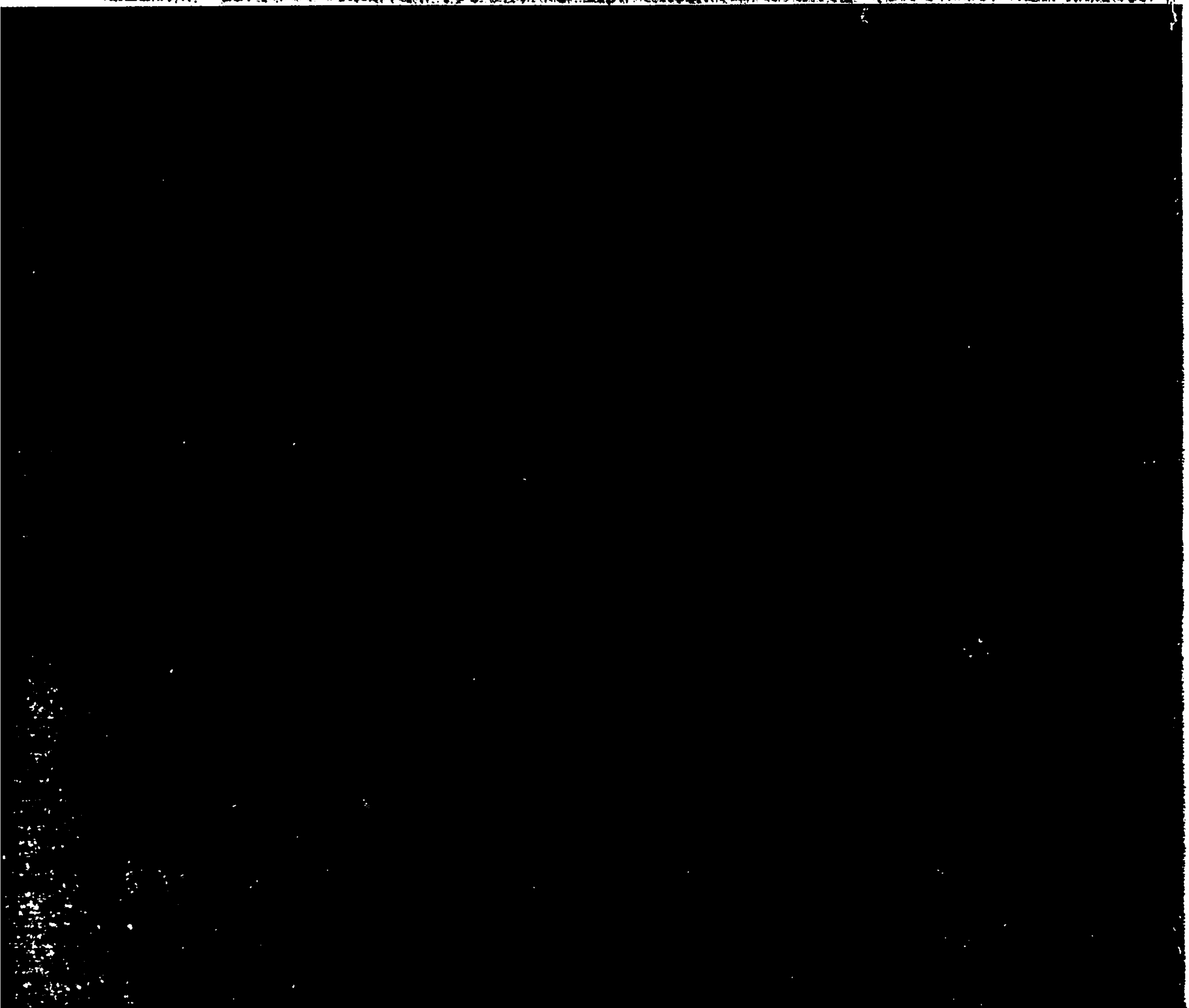

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