should not exceed $8 per ton. The selection of Alternative 2 was recommended until agglomeration studies show the feasibility of agglomerating Western coals.

A2. Environmental Risk Analysis

Overview

There are fundamentally three problems which must be resolved or defined in order to evaluate the "risk" or rather practicability of the successful operation of the Coal Gasification Plant.

1. Is sulfur removal necessary? If so, at what level?
2. Will best available control technology (BACT) be required on the "end use" equipment, in Erie's case the Pellet Plant.
3. How will regulations concerning present "unknowns" affect the monitoring and economics of the process? Specifically:
   a. The fate of trace elements which exist in coal; for example, gas combustion, tars and oils combustion, ash-sulfur and other by-product storage or disposal.
   b. Development of Occupational Health and Safety Regulations or Mine Health and Safety Regulations (although not in themselves environmental considerations) on handling and using coal-oil/tars which may contain various carcinogenic materials.
   c. Will an Environmental Impact Statement be required for the Commercial and/or Demonstration Plant?

In order to obtain normal business assurnaces that coal gasification, as envisioned by the Erie/DOE Project, is indeed practicable, it is necessary to conceive within reasonable parameters the criteria which will meet both economic and environmental goals.

The "Environmental" risk of proceeding is very complex and will require technical development of both control and monitoring technologies to optimally protect the environment in an economically acceptable manner.

As our ability to monitor and control processes have developed, regulations and standards have been promulgated. Many of these standards will require costly equipment which significantly increase both capital and operating costs.

From the inception of the project, Erie has, in all cases, considered that the Gasification Plant will be a closed loop system with essentially "zero effluent" to the environment bordering the Erie plantsite. Designs, equipment operation and waste disposal have been developed to meet this goal as well as State and Federal Regulations as they currently exist. Additional estimates have been made for compliance with current State and Federal Regulations.

Essentially, the "risks" related to environmental concerns are not "technical." Erie feels that the technology is available to control the Gasification Plant effluents to meet State and Federal Standards. There are, however, technical questions concerning how the "end-use" cleanup would be effected should "best available control technology" be required on the Erie plant as a result of construction of the gasification facility. Further studies will be required to determine the leaching potential of the ash and sulfur in

order to adequately design the disposal site and to determine the fate of trace elements which occur in coal.

Primarily, the "risk" factor concerning environmental requirements is related to the capital and operating costs to meet "best available control technology" on existing facilities and disposal of waste products.

1. Sulfur Removal

No Sulfur Removal

Under the existing State requirements, Erie is allowed to burn a maximum 2% sulfur in oil or coal. There is for all practical purposes little risk in operating the gas plant at these levels. Adequate supply of both Eastern and Western coals are available within compliance limits.

No sulfur cleanup and recovery systems would be required. Waste water cleanup and disposal of spent chemicals from the sulfur cleanup system is minimized.

With Sulfur Removal

With a full sulfur removal system assumed for all coals, sulfur cleanup and waste disposal costs increase the capital cost of the plant. Similarily, operating costs are increased.

Clearly should sulfur removal be required on all coals, the economic penalty imposed could reduce the economic viability of using low-BTU gas in a commercial operation. The extent of such a reduction would be dependent on each user's alternate fuel capability and cost of alternate fuels.

In Erie's case, we do not anticipate that sulfur removal will be economical in the foreseeable future. (Ref. Section VI, Cost Summary)

Although the commercial facility could technically operate under "today's" regulations, the risk of being required to provide sulfur cleanup is considerable in light of current EPA and DOE positions concerning proposed environmental standards for coal-fired power generating facilities.

2. Control Technology Requirements

The present Erie facilities are in compliance with and meet all Federal, State and Local environmental requirements. If Erie were to change the fuel used in its pelletizing facility from the present combination of natural gas and No. 6 oil to the gas from the Coal Gasification Plant being discussed, its emissions to the ambient air would be no greater than, but more likely less than, those at the present time. It is our understanding that despite the foregoing, both EPA and DOE consider that the facilities using the gas from a Commercial Gasification Plant may nevertheless be required to retrofit the existing pellet facilities

in order to conform to the definition of "best available control technology."

We estimate that approximately 50-70 million in capital and (as yet undermined increases) additional operating costs would be incurred as a result of such a ruling.

The economic consequences of such a ruling would render any Commercial or Demonstration Plant used in fuel conversion at an existing facility (such as at Erie) impractical, uneconomical and would result in increased energy consumption per unit of manufactured product.

Further, the nation's economy, the National Energy Policy (coal conversion conservation) and the President's Economic Guidelines would be adversely affected by the needless imposition of such standards.

3. Regulations

As the interpretation of current regulations signficantly alter the economics of coal gasification (the requirement for best available control technology on existing facilities served by the Gasification Plant) of both the Commercial and Demonstration Plant, we must access the risk of future regulations concerning what are at present "unknowns."

Monitoring and mitigation of the effects of these "unknowns" could add significant risk to development of a commercially viable Gasification Plant system. Risks may not be limited to economics. In particular, the fate of trace elements in coal as a result of the gasification process may prove difficult to monitor, costly to contain and present serious technical difficulties.

Similarly, development of Occupational Health and Safety or Mine Health and Safety Regulations on handling and using oils and tars from the gasification process which may contain carcinogenic materials are expected as research and knowledge matures from the relative "unknown" state of information currently developed.

The need to monitor and investigate these "unknown" areas in itself will reduce the economic viability and increase the risk of reaching a practicable Commercial Coal Gasification Facility.

Should, during "Phase II" it be determined that a full Environmental Impact Statement be required, additional extra cost and delay of construction could be anticipated.

The Assessment developed in Phase I was designed to provide as near a complete document as possible considering the time and cost restrictions.

There would, however, be extra cost to update the draft Assessment and determine leaching potential from waste disposal as well as the fates of trace metals in the process.

B1. Technical Process

Overview

The Small Scale Demonstration Plant Program provided a unique opportunity for the Department of Energy and the industrial partner, Erie Mining Company and Pickands Mather & Co., Managing Agent, to provide a program of coal gasification in an industrial environment under actual operating conditions. The intent of the program is to provide a reliable economic fuel which utilizes our Nation's most abundant source of energy, coal.

Erie Mining Company, in accordance with the provisions of the Erie/DOE contract, provided the design and plan for procurement, construction, operation and testing of the Demonstration Coal Gasification Plant.

The Program provides for use of commercially available technology to supply approximately one-third of the fuel required to operate the Erie iron ore pelletizing plant in Hoyt Lakes, Minnesota. The Demonstration Plant is designed as the initial module of a Commercial Plant which could be expanded to eventually replace all of the natural gas being consumed at Erie for pellet induration.

The coal gasification facilities of the Demonstration Plant were designed to produce 7.4×10^9 BTU/day of low BTU gas (160-180 BTU/cu. ft.) using approximately 500 tons/day of coal.

This design was then expanded to provide the requirements for the Commercial Plant in a manner which is economical and utilizing technology which encourages energy and environmental conservation. The Commercial Plant was designed to produce 20×10^9 BTU/day using approximately 1400 tons of coal per day.

The plant designs have the ability to process coals of at least 2.5% sulfur content (moisture and ash-free basis) and a free-swelling index of at least 5.0.

Design criteria included retrofit of the existing pellet plant and the requirement to use and test various coal feedstocks.

The design basis coals which were contemplated for testing included Brookville, Clarion, Davis, DeKovan or Kittanning coals (Eastern coals) and Rosebud or McKay coals (Western coals).

Technical assessment is primarily focused around problems which were encountered during design activities in Phase I. Technical problems may be categorized by technical risks (problems that require an answer before the project becomes technically feasible) and detailed technical problems that arose during the progress of this project. The later category would normally be resolved during Phase II activities of the project by continuing trade-off studies and further evaluations during detailed engineering.

To establish basic technical background, reference should be made to Design Manuals, both for the Demonstration Plant and the Commercial Plant.

B2. Technical Risk

Erie Mining Company essentially concurs with the Technical Risk Analysis performed by Analytics, Applied Technology Division in June, 1978.

To Summarize:

Western Coal Operation

"Operation of the gasifiers on Western coal is a low risk" providing a warranty on the gasifier is provided by the vendor.

Note: Assumes gasification of sized coal.

Eastern Coal Operation

The operation of the gasifier on Eastern coals is an acceptable risk provided "hedges" are provided to reduce the developmental risks.

Under the general analysis listed above, Erie has proceeded on the basis for design as stated.

Coal handling, utilities and gas cleanup equipment has been designed utilizing commercially available equipment, which in Erie's opinion, will provide a technically feasible operation if operated in accordance with normal operating procedures under the terms and conditions of standard warranties which have been negotiated or are expected to be obtained should construction proceed.

During the course of Phase I, trade-off studies and other evaluations have resulted in some redefinition and measures which will be required to minimize or obviate several technical or economic problems (high risk to commercial success).

Gasifiers

1. The central core of the gasifier has been designed to operate with or without a stirrer.
2. The initial plant installation would include only one stirred gasifier until the stirrer can be "proven."
3. Provision for briquetting of coal fines was included but not defined in the plant designs.

Equipment Sizing

A large measure of the success of any Commercial Plant (and as our contract provided for) will be the plant's ability to handle both caking and non-caking coals (Eastern and Western, respectively). Sizing considerations were defined to allow for a reasonable range of commercially available coal. As a result, the plant throughput was sized for Western low-caking coal, reflecting the moisture content and lower BTU content of the Western coal. Equipment so sized will have a greater capacity when operated on the high-BTU low-moisture Eastern coal. Oil and tar cleanup facilities were sized on Eastern coal feedstock and are oversized when operating on Western coal which contains less volatile matter.

These design considerations have been made to assure commercial viability, maintain continuous operation and meet Erie/DOE contractural requirements.

Briquetting

The coal handling method used to transport coal from a mine site to the plantsite became a complex design problem due to the various alternatives involved with delivery of Eastern coal, Western coal and handling various levels of coal fines. The Eastern coal is to be shipped by boat through the Great Lakes system and then transported by rail to the plantsite. The Western coal is to be transported exclusively by rail. The two coals presented 102 different alternatives for transportation and handling fines. A computerized analysis and the Coal Trade-Off Study was conducted to optimize handling facilities. This study was issued on August 30, 1978 as Technical Progress Report No. 5. The report stated that the most viable technical and economical alternative for Eastern coal would be the shipment of Eastern low-sulfur coal to Taconite Harbor (Erie's own harbor facility) and then transfer at Taconite Harbor to rail for shipment to the plantsite. The Eastern coal shipment system involved conventional means of boat unloading, transferring to railroad cars and unloading at the plantsite and presented a very low technical risk.

Western coal presented a more unique problem than Eastern coal because Western coal has a larger amount of fines as it leaves the mine site.

The computer evaluation determined that the most economical way to handle Western coal would be to receive mine-run Western coal at the plantsite and then briquette the fines. There is no operational experience with gasifiers using coal briquettes; and, therefore, this method involves the highest technical risk. This technical risk could be lessened, or at least defined, by an independent test program prior to construction of the plant and an extensive testing program carried out in the Demonstration Plant after construction.

Stirred Gasifier

Stirrers have only been used on single-stage gasifiers. Stirrer design on two-stage gasifiers has not been commercialized. Since the reaction time is longer in a two-stage gasifier, the stirrer operates under a more severe condition than in a single-stage gasifier. Due to the longer reaction time, the stirrer must be buried in several feet of coal to reach the critical zone or the plastic zone of the coal. The stirrer design criteria must include such things as material used for the stirrer, instrumentation necessary to indicate when there is an overtorque condition for the stirrer and, if any, what means of cooling should be used for the stirrer device. The gasifier subcontractor, Babcock Contractors, Inc., has performed the preliminary engineering for the stirrer. In review of preliminary design, it is apparent the bulk of the engineering is largely based on engineering assumptions; and, therefore, the stirred gasifier becomes a high technical risk

area. To reduce the risk, the stirred gasifier should be tested during Phase III of the contract. During this test phase, it is advisable that only one of the gasifier units be equipped with a stirrer and as the success of the stirrer is proven, then the other units should be retrofitted.

Gasifier Operation with Coal Fines

The gasifier can operate utilizing about 10 percent fines. After this percentage has been exceeded, the gasifier shows a marked decrease in efficiency. The efficiency decreases because of lack of good gas distribution through the coal bed. In commercially operated plants, coal feed has been screened prior to going into the gasifier. The Western coals present a problem because of their large quantities of fines. As previously mentioned, briquetting is a possible way of handling coal fines, except this does represent a high technical risk area. Therefore, it is desirable to introduce as many fines as possible into the gasifier. Currently, Babcock Contractors, Inc., has indicated that up to approximately 10 percent fines could be introduced to the gasifier without a severe loss of efficiency. During Phase III of this contract, the amount of the fines that can be effectively used in a gasifier should be tested. After this test work has been completed, then a trade-off study should be conducted on which is more economical--briquetting or introduction of fines into the gasifier. Tests should include fines processing with the stirred and nonstirred gasifiers.

Coal Sizing

During February, 1978, when preliminary procurement activities were initiated, it became apparent that an economical source of sized coal or run-of-mine coal with a minimum of fines for gasifier feed was not assured.

Run-of-mine coals were observed to contain 50 to 60% fines (coal fines are considered as those sizes below which gasifier manufacturers would not warrant operation). Further, Western coal samples were observed to generate an inordinate amount of coal fines during handling and storage.

Subsequent testing of samples and a detailed coal handling study was required to review the availability and insure minimum degradation of selected coals and alternate coals were selected as contractual coals were determined unsatisfactory.

Alternate uses of Eastern and Western coal fines were investigated and over 100 alternatives were defined and evaluated in computer simulation.

The "optimum" alternative with the lowest equivalent cost per million BTU's was identified as Western coal with agglomeration of fines.

Utilization of Western coal will be dependent on the ability to satisfactorily agglomerate and utilize the agglomerated fines in a gasifier.

Handling and disposal of large amounts of coal fines is not practicable as facility costs and raw material costs are significantly increased.

Coal Feed - Eastern Vs. Western

Specific Risks

	Eastern Coal	Western Coal
Stirred Gasifier	High	Not Determined
Briquetting	Not Required	Medium
Fines	Low	High

Eastern

Risk of using Eastern coal is dependent on the performance of the caking coal and the success of the deep bed stirrer. Erie has recommended to DOE that initially only one stirred gasifier be installed until the optimum mechanical design can be established. The central core of the gasifier has been designed to accomodate both the stirred and non-stirred internal components.

Western

Due to problems in coal sizing and degradation in handling commercially available, economically priced Western coals, gasification of Western coal, in our opinion, is not practicable and is a high risk.

As our coal handling and coal procurement activities delineated, Western coal use is not practical or economical without briquetting and successful gasification of the briquetted fines.

To reduce this risk, Erie recommended to DOE that an agglomeration study be initiated, justified by the potential savings in operating and capital costs. Our request was deferred.

In order to satisfactorily utilize Western coal, the following parameters must be resolved and defined. Such definition would include production of briquettes for selected feedstocks and testing under both simulated and actual gasification. Particular parameter for:

1. Compressive strength (cold).
2. Strength and character during gasification.
3. Binder - effect on downstream equipment.
4. For caking coals:
   Effect of caking tendency.
   Reaction to temperature change.
5. Reaction to stirrer.
6. Sizing for optimum gasification.

Erie recommends that it is in the best interest of the government to satisfactorily resolve this "high risk" area prior to or during further design work prior to any actual construction of the Erie or other similar gasification project.

B3. Detailed Engineering Review

As previously mentioned, there are several areas that were encountered during the development of Phase I that require additional detail engineering or Trade-Off Studies that would be included in Phase II activities. All of the problems or details are considered solvable by normal engineering practices. To organize the discussion of these problem areas, they will be discussed in the same categories that McKee used for design purposes.

Site Work

A preliminary subsurface soil investigation was conducted by Soil Testing Service. Their report, issued on July 26, 1978, revealed that there were three distinct layers of material. The first layer, which was probably a fill material of mine waste rock, varying in depths of 4 to 9 feet deep and then below that a layer from 2 to 9 feet of organic peat-type material. The last layer was essentially glacial outwash or glacial till. The recommendation of Soil Testing Service (used for design by McKee) was to remove all of the overburden material through the organic peat layer and then backfill with well compacted fill. There was some ground water present; however, during the excavation and backfilling process it was felt that this could be best handled with a simple sump and pump method. Due to the large plot plan area involved and the depths to which the overburden must be removed, several thousands

of yards of material would have to be removed and an equal amount of material brought in as fill material. Before detail engineering work could be completed on foundations, additional holes would have to be drilled and a further look at which would be the best way to solve this problem. Pilings or casings could be placed underneath the building foundations. This requires further investigation during Phase II.

Surface drainage becomes a very important part of site preparation on this project not just from the standpoint of structural problems but due to the many environmental restrictions. The coal pile must be adequately drained and collected so that no effluent from the coal pile would enter any of the State waterways. Likewise, plantsite buildings must have drainage to a central collection pond. Drainage has been provided for by the McKee design, a settling pond was designed into the plot plan.

Material Handling

The largest problem in this area is where to obtain the coal. To understand the background and the meaningful problem involved here, it is recommended that the coal handling trade-off study be reviewed and studied. This study was issued on August 30, 1978, as Technical Progress Report No. 5. The study considered both Eastern and Western coal. Western coal was the most promising choice provided briquetting of

Western coal would be successful. As mentioned under high risk areas, the success of briquetting is measured on its performance in the gasifier. To date, there has been no usage of briquettes in a gasifier so this becomes an unknown area. Low-sulfur, low-caking Eastern coal is the next best selection in coal feedstock. Since this coal requires no briquetting, it may be the best selection.

Plantsite coal handling was designed for the receipt of coal via railroad cars. Western coal would be shipped in 100-car unit trains. The unit trains would be marshalled into 50 car cuts at a siding called Old Measbi located some 4 miles from the plantsite. Fifty car cuts then would enter into the plantsite loop arrangement. Once they are in the plantsite loop, they would be dumped by the use of rotary car dumper and automatic car positioner.

There is a question as to whether the rotary car dumper would be required for this operation. Perhaps a bottom dump method could be used. There are several considerations that must be taken into account before a dumping unit is decided. With unit train receipts, the problem of demurrage having to be paid on a unit train after it is on the plantsite for more than 24 hours. Another consideration is receiving coal during freezing months of the year. Presently, the design is based on receipt of coal during warm weather. However, a thorough investigation of receiving coal year-round might reveal that cheaper rates can be achieved

by receiving coal during both the winter and summer months. A thaw shed has been designed in the plantsite loop track. The thaw shed should be eliminated if coal is going to be received in nonfreezing seasons.

The design of the plantsite railroad trackage did allow for the connection of the present Erie pellet shipment track to the plantsite track. This allows for the receipt of Eastern coal through Erie's Taconite Harbor facility. The coal would be shipped from Taconite Harbor on the Erie Mainline track to the coal gasification plantsite. The plantsite trackage is adequate for handling Eastern coal trains for the Demonstration Plant.

Conveying and stacking systems for coal handling seemed to be adequate in their design. The design has shown several different vibrating feeders in the system. Erie Mining Company has had a great deal of experience with vibrating feeders and has found that during cold weather there is usually a freeze buildup on vibrating feeders and also, vibrating feeders have a high maintenance cost record. It is therefore recommended that the use of vibrating feeders be reviewed.

McKee in their design has indicated that there are two methods of stacking coal on the stockpile. The method used on the drawing is the lowering tubes and the other method is the use of an arc stacking

conveyor. Erie has had experience with both types of stacking systems and has found that the arc stacker performs much better and is less expensive than the lowering tube method.

Gasification Area

The coal storage bunkers above the gasifiers were designed for a 12-hour live storage. This design should be reviewed and, if possible, expanded to a 20-hour storage capacity. The additional capacity would then allow one operator to fill coal bunkers on an 8-hour shift and then, two shifts later, another operator would fill the bunkers once again. The same operator would also have duties in hauling ash and sulfur to the ash and sulfur disposal area. A 20-hour storage would allow this operator to perform his duties of filling the coal bunkers anytime during his 8-hour shift.

Coal is discharged from the coal bunkers down a series of lock hoppers, conveyors, coal tubes and a distribution system at the top of the gasifier. A general review of this handling system should be made. There seems to be too many potential plugging areas.

The stirrer is the central focus of attention in the gasification area. This item has already been discussed under technical risks. In summary, to date there has been no use of a stirrer on a two-stage gasifier. All the technology that has gone into the design of the stirrer has

been based on a single-stage stirrer. There are a number of small items in the stirrer design that could be discussed but the true success of the gasifier will only be known after a gasifier has been built with a stirrer installed. Therefore, it is recommended that only one stirrer be installed initially. After this stirrer has adequately performed, then additional stirrers could be installed in other gasifiers.

The ash level detection system, as designed, could be improved. The design uses one thermocouple located at the center and on top of the ash grate. This system does not detect a tilted bed condition. Phase II activities should include a review of this system, as well as review of the manual "poking" system with the intent to automate these functions.

The ash removal system in the gasifier is designed as a dry system. The ash is discharged from the grates of the gasifier into a hopper, then through a lock hopper assembly where it is cooled and discharged onto a belt conveyor. In reviewing this system, there is a question as to whether or not a belt conveying system should be used or a pneumatic handling system. Erie Mining Company believes that the best system would be the pneumatic conveying system in consideration of cold weather handling problems which could occur in a "wet" conveyor system.

Sulfur Removal Area

The sulfur removal area only had a very few minor design problems. The sulfur removal unit is an off-the-shelf Stretford system. The system was designed by Ralph M. Parsons. The Stretford process has been used on various applications ranging from coke oven gas to processing claus tail gas at oil refineries.

During Phase I, site visits were made to various installations of the Stretford process. All of the installations that were visited were working well and effectively removing the hydrogen sulfide from the gas streams. The Stretford process produces two by-products; one is the elemental sulfur and the other is the Stretford solution purge stream. The elemental sulfur can be handled in various ways. The system designed by Ralph M. Parsons would produce a flaked, dry sulfur. This flaked sulfur then would be transported from the plantsite area to a special sulfur ash disposal site. The elemental sulfur is removed at a high purity level. Since the sulfur is of high quality, it may be possible that it could be marketed locally. A preliminary investigation of possible markets had revealed that there may be potential customers. During Phase II of the project, a more thorough investigation of this market and possible usage of sulfur should be included.

The Stretford purge stream presented a problem of an environmental concern. The present plan calls for mixing of the Stretford purge

stream into the ash and then disposing in the ash disposal area. Further investigations of disposal methods are necessary in Phase II.

Gas Transmission Area

The gas transmission area mainly consists of the necessary gas compressors for taking the gas from the gasifiers and compressing it to the proper pressure necessary to enter the combustion chambers of the pelletizing furnaces. Present design includes two compressors for the Demonstration Plant and three compressors for the Commercial size plant; both plants then would be operating with one spare unit. Several discussions were held on this subject and also a Trade-off Study conducted on the number and size of compressors necessary. The spare unit concept may seem redundant; however, it should be remembered that the total output of the plant is being funneled through the compressors; and, for this reason, spare compressor capacity has been determined as essential.

Waste Water Treatment

The waste water to be treated is the condensate that is collected from the gas stream before cooling prior to the Stretford unit. McKee developed a Trade-off Study on incineration versus biological treatment. The conclusion of the Trade-off Study indicated that incineration would be the most economical means of disposing of the waste water. This system was designed on the usage of Western coal. (With Eastern coal, there is less condensate.) Should Western coals be eliminated from the

design basis, a thorough review should be conducted of the waste water treatment facility requirements.

Another area that should be reviewed is the evaporation pond for disposing of coal pile, plantsite runoff and ash-sulfur disposal area. Presently, the design calls for a 5.5 acre settling pond which allows for evaporation of coal pile and plantsite run-off. If the flow into the settling pond exceeds the evaporation rate, then some other means of disposing of the waste water will have to be designed. As runoff from ash and sulfur disposal areas is defined in Phase II, Redesign or Further Trade-off Studies (Evaporation or incineration, etc.) will be required.

Utilities

The major portion of required utilities are provided for tie-ins to existing facilities. The cooling water system, as designed, receives water from Erie's Concentrator Building and returns the used water back to the Concentrator Building. This system is designed as a gravity system using two 24-inch lines. A more thorough investigation of this system may be in order to reduce the line size.

The fire water system uses an independent storage tank and pump. A review of this system with Factory Mutual revealed that tieing into the existing Erie Mining Company's fire water protection system may be adequate. Without adding a storage tank and pump, additional review of this system would be required in Phase II.

Safety Systems

The safety system, as designed by McKee, is comprised of a ground flare. The ground flare's purpose is to protect the transmission line from overpressured conditions due to sudden power failures and also to aid in startup procedures. The only potential problem, in this area, seems to be whether or not environmental regulations can all be met. Before a final flare system is designed, appropriate approval should be obtained from the necessary environmental agencies. A detailed analysis and quantification of potential emissions is required during finalization of plant design.

Retrofit

This area covers the piping and burner modifications necessary in the existing pellet plant to burn and control the low Btu gas. In addition to burning the low Btu gas, the burners must be able to use multiple fuels, natural gas, bunker C oil and low BTU gas will be burned in the combustion chambers.

A proposal clarification trip to John Zinc Corporation revealed that there are many burners being used for multiple fuels. Controls will have to be reviewed in the final engineering to insure that proper control can be maintained in the pelletizing furnace. It is anticipated that there should be no great engineering problems in this area. This activity would replace "Burner Tests" currently included in the Phase II Scope of Work.

Employee Facilities

The employee facilities are currently designed to be a stand-alone, pre-engineered building, which would be approximately 50 feet x 50 feet in size and capable of handling 70 employees. The building is designed for the Commercial Plant capacity. A change in number of employees would require redesign. The number required to operate the plant will not be finalized until the plant has actually performed in its Phase III operation.

Erie normally tries to include necessary employee facilities within the plant battery limits. Service facilities are provided from central locations as needed.

DOE requirements may require a stand-alone Administrative area; however, Erie would recommend that elimination of "stand-alone facilities" versus "integrated facilities" be reviewed in Phase II.

C. Economic Assessment

The economic assessment of the Demonstration and Commercial Plants presented for DOE review is based on contract requirements as per the Erie/DOE Contract EW-78-C-02-5066 and is presented as follows:

A detailed review of contract costs was provided to DOE during the Contract Pricing Review Meeting January 19, 1979. Section VI of this report includes final and updated cost estimates based on front end engineering completed since that time.

General - In defining the basis of assessment for the McKee Economic Evaluations, Erie took into consideration the manner in which the various alternates for the plant could be constructed. In view of the front end engineering delays due to subcontract negotiation difficulties, it was necessary for McKee to use information in preparing the Economic Evaluations, which was available at the time, in order to meet the scheduled delivery date of the cost estimates. In the areas where final data is substantially different from that which is presented in the Economic Evaluations, Erie has updated the base estimate (included as Item 6 of this report). The gasifier front end engineering estimate for gasification (Area 02) is the original preliminary estimate provided by Babcock Contractors, Inc., as amended by the final cost estimate provided by BCI with the final package of deliverables. The cost estimate for sulfur removal is the data provided by the Ralph M. Parsons Company in

the response to the bid proposal and with further estimating by McKee, contingency for the Parsons' design could increase the cost as presented in the proposal of $3.6 million to $5.5 million. Stretford operating costs, used in the economic evaluation, of $311,000 were evaluated in the Stretford selection process to be $675,000 for the Demonstration Plant and $1.1 million for the Commercial Plant. As Parsons' activities were cancelled due to contractual problems, Erie has not updated the Stretford estimate.

In preparing the cost estimates for the Economic Evaluations, McKee did not incorporate site estimates provided by Erie. These items are included in Erie's evaluation of the cost estimates.

The following cost reductions are in Erie's view "potential" and would be the basis for further "trade-off studies" and review during final design (in Phase II). Costs have not been reduced from Phase I estimates.

Several approaches to material handling, in particular the coal handling costs, are appraised. The coal handling facility as designed is sized for the Commercial Plant. The idea of engineering and building a system sized for a Demonstration Plant with the objective of expanding or replacing such a system to a commercial size facility would increase gasification costs further. Therefore, Erie continues to recommend, in accordance with our existing contract provisions, sizing certain areas of the plant to the commercial size. These areas include the coal handling facilities, gas

compression facilities, gas transmission lines, utilities and disposal areas. Also to be included is the excavation and plant base preparation for the Commercial Plant.

Contract negotiations outlining financial arrangements must be made concerning any deferred costs on designs deferred to the Commercial expansion.

The coal handling facility is such an item. Erie's present system with certain modifications, is capable of transporting the coal tonnage necessary to operate a Demonstration Plant. However, increased operating costs with such coal handling procedures would substantially increase Phase III costs. Modifications to the present coal handling design are possible if this facility is to be constructed and should be taken into consideration for both the Demonstration and Commercial Plants.

Capital Cost Reductions

Potential capital reductions and additions, as summarized, indicate that although there is some potential for cost savings, further anticipated cost additions negate any significant net reduction.

A summary of possible Capital Cost adjustments is presented for review:

Thaw Shed	$ 182,300
Arc Conveyor	860,000
Spare Gasifier	2,072,000
Waste Water Incinerator	337,000
Fire Pumps	45,300
Employee Facility Building	189,000
Construction Management and Professional Services	5,500,000
Car Dumper Building	730,000
Conveyor Galleries	342,000
Vacuum Cleaning	197,000
Material Costs - Three Stirrers	1,750,000
Subtotal	$12,204,600

Thaw Shed: Potential $182,300

McKee estimated coal delivery for eight months to eliminate cold weather handling of coal. Erie agrees with an eight-month delivery, therefore, the thaw shed in the design would be eliminated. This does necessitate, however, special negotiations for receipt of Western coals by unit train. Coal prices would be higher for an eight-month operation as compared to a year-round operation. Further evaluation would be required should final design proceed.

Arc Conveyor: Potential $860,000

Erie suggests replacing the lowering tubes in the McKee design with a radial arc conveyor. Increased flexibility in handling various coals, decreased capital costs and decreased operating costs due to the reduction in conveyors substantiate the substitution of the arc conveyor for the lowering tubes.

Spare Gasifier: Potential $2,072,000

If high-moisture, low-BTU Western coal is not utilized and only high-BTU, low-moisture Eastern coal would be chosen as feedstock, Erie recommends that the spare gasifier could be eliminated. The design output would be maintained by the "high throughput" for Eastern coals. Further Trade-Off Studies and economic analysis would be required in Phase II as well as Erie/DOE contractual changes to redefine feedstock, Phase III Operating Plan and overall program objectives.

Waste Water Incinerator: Potential $337,000

The waste water incinerator is oversized and recommendations should be considered to eliminate the system from the design. Eastern coals are very low-moisture and excess water is not expected to be an operating or environmental problem. The waste water incineration system was added to the design to process excess moisture from Western coals. Agglomerated Western coals are expected to be low-moisture and high-BTU following accepted agglomerating procedures. As a result, it is expected that the waste water incinerator may be unnecessary in the plant design, should Western coals be eliminated from the design basis.

Fire Pumps: Potential $45,300

The fire system for the coal handling facility in the McKee design is larger than necessary for the expected size of the facility. The present water system at Erie may be capable of handling the volume of water required for adequate protection. Therefore, it may be possible to eliminate the fire water pumps included in the cost estimate.

Employee Facilities Building: Potential $189,000

Erie recommends the elimination of the employee facility building. Those integrated facilities deemed necessary should be included in the gasification building or present plant facilities. Further evaluation and redesign would be required in Phase II to determine requirements and savings.

Construction Management and Professional Fees: Potential $5,500,000

Erie's assessment of the indirect costs associated with the capital expenditures reveal construction management fees of 28% of the total plant investment.

Erie proposes that 17-1/2% is more realistic under normal conditions. Various alternates are available for construction management. Management services can be acquired through bidding procedures, McKee can be retained for managemen' services or the Taconite Contracting Corp. may be appointed construction manager. McKee utilized 28% reflecting added costs to perform under Government procedures and project control requirements. Erie would recommend that DOE minimize reporting and control requirements to those normally utilized by industry.

Engineering assessment of the professional services outlined by McKee resulted in a reduction from 234 man-year hours to 156 man-year hours. This estimate is based on the engineering done to date, assuming normal business practice. DOE should consider minimizing reporting and other government administrative requirements.

Additional add-ins would be included for Erie's construction management costs and the costs associated with reporting and procurement through Phase III.

Car Dumper Building: Potential $730,000

A sophisticated building for housing the rotary car dumper has been designed into the material handling facilities. It is an accepted standard at Erie to install pre-engineered buildings wherever possible. Installation of a pre-engineered building could result in a potential cost saving and should be considered in Phase II.

Conveyor Galleries: Potential $342,000

Since coal delivery is expected to be a warm-weather operation, Erie recommends elimination of all conveyor galleries, provided that control of fugitive emissions could be designed to meet environmental requirements. Verification of environmental concerns would be required in Phase II before any potential savings could be realized.

Vacuum Cleaning: Potential $197,000

A dust collection system is installed for dust control. In addition, a vacuum system is installed to supplement the dust collectors. Erie recommends elimination of the vacuum system as it is unnecessary.

Material Costs - Three Stirrers: Deferred $1,750,000

Pending technical and operating confirmation of stirrer feasibilities, Erie would recommend that only one stirrer be installed in the Demonstration Plant until testing and confidence in the stirring procedure during gasification was gained. Additional stirrers could then be installed. Capital costs of the additional stirrers are a possible saving or deferred cost. Contract amendment would be required with DOE concurrence to extend or modify the contractual operating requirements of Phase III.

CAPITAL COST ADDITIONS

Engineering Additions

Additional costs not included in the December cost estimates as a result of Erie's review or modifications to engineering since December 1978, are as follows:

Sulfur-Ash Disposal	$ 1,750,000
Erie Construction/Program Management	2,000,000
Structural Steel, Concrete	5,000,000
Gasifier Subcontract	15,000,000
Stretford Subcontract	Unestimated
Other Potential Additions	Unestimated
TOTAL	$23,750,000

Sulfur-Ash Disposal: Addition $1,750,000

As a result of site drilling and environmental studies, ash and sulfur disposal area preparation is currently estimated at $1,750,000, to ensure that environmental regulations are met. Further site drilling and analysis is required in Phase II to confirm and substantiate preliminary drilling and current estimates.

Runoff from the disposal areas must be adequately disposed of when defined in Phase II. Additional costs will be incurred.

Erie Construction/Program Management: Addition $2,000,000

Erie'e costs to manage and develop the Erie/DOE Program are estimated in addition to the capital and operating costs presented by subcontractors in the plant cost estimates.

Structural Steel/Concrete: Addition $5,000,000

Further engineering assessment of the economic evaluation reveals that subcontractors estimated the cost of concrete (installed) at $280/cu. yd; actual recent experience in Hibbing, Minnesota cost is $300/cu. yd. Subcontractors estimated structural steel at $1,255-2,017/ton. Actual experience at Hibbing costs $2,250-3,000/ton. Other estimating differences include: Trackwork estimated at $52/ft., actual $78/ft.; overpass estimated at $231/ft., actual $540/ft.; and, piping estimated at $60-72/ft., actual $75/ft.

Gasifier Subcontract Estimates: Addition $15,000,000

The preliminary gasifier estimate used in December 1978 for current project costs did not reflect the final data from the BCI Front End Engineering effort.

Final cost estimate submitted by BCI in March 1979, indicated additional capital costs for the gasifiers and related equipment.

Stretford Subcontract

A potential add-in is expected in this area due to inflation and engineering contingency. However, at this time, the exact number is not available due to lack of a finalization of Stretford Subcontract.

Other Potential Additions

Erie feels the following items could be expected to result in significant cost additions to the construction and operation of the completed plant.

In light of the environmental uncertainties and the intent of reduced scope of work to minimize activities, Erie has not attempted to quantify or further define the following potential areas for cost additions.

1. Additional costs to develop a gasifier stirrer that meets commercial criteria for operating and maintenance reliability.
2. Delays in construction due to regulatory permitting.
3. Construction contracting under DOE procurement regulations.
4. Coal briquetting, development, testing and establishment of firm costs.
5. Regulatory - Environmental and Others Directly Related:
   a. Environmental Impact Statement
   b. Health and Safety Standards
   c. Best Available Control Technology Applied to Total Erie Operation
   d. Environmental Reporting and Monitoring Requirements
   e. Sulfur Removal from all Coals

PMD 79-2085

Pickands Mather & Co.
1100 Superior Avenue
Cleveland, Ohio 44114

August 1, 1979

Mr. R. W. Laza
Contracting Officer
U. S. Department of Energy
Chicago Operations Office
9800 South Cass Avenue
Argonne, Illinois 60439

SUBJECT: Erie Mining Company
Coal Gasification Project
DOE Contract EW-78-C-02-5066
REF: ERDA - 404

Dear Mr. Laza:

In accordance with your letter of June 6, 1979 and subsequent discussions, we have modified Section VI-Cost Summary and VII-Recommendations of the final report submitted May 15, 1979.

Twenty copies of Section VI and VII are provided for replacement of the previous sections. Please destroy the old sections.

Descriptive comments have been added to the Cost Summarys as discussed with Mr. Rader.

Our previous curves for gas costs did include amortization and were generated to show the sensitivity of gas cost with variable capital costs. Curves and tables were modified for a 15% DCF and escalation was made at 10% as requested. Descriptive narrative was also provided.

We did not utilize 1977 costs as per our discussion and your verbal concurrence. All costs generated in Phase I were in 1978 dollars. Escalation was based from 1978.

De-escalation of the detailed costs generated during the project would require an extensive and costly re-estimation of the project and entail re-opening of subcontracts which have been closed or terminated.

Technical and environmental risks are now summarized in the Section VII Revision with reference to the detailed risk analysis which was previously included in Section V Parts A2 and B2.

Costs incurred for the above referenced clarifications were considered part of wrap-up activities in Task 10 per the reduced scope of deliverables.

Funds in addition to the current estimated cost of the contract (3.999 million) were not required.

Your earliest acceptance of this final report is requested in order to allow completion of the 60 day Government Decision Period, as referenced in your correspondence of May 15, 1979 and subsequent reference in your letter of June 6, 1979.

If there are any further questions or clarifications, please contact us.

Sincerely,

ERIE MINING COMPANY
PICKANDS MATHER & CO.
MANAGING AGENT

J. H. Fatum
Project Director

JHFatum/cap

cc: H. P. Whaley
C. A. Stiles
J. Gannon

VI. COST SUMMARY INDEX

VI. COST SUMMARY

The following revised charts and tables explain the various capital costs, operating costs and contract costs. The original charts were presented at the Contract Pricing Review held in Cleveland, Ohio, on January 19, 1979.

The cost data shown on the charts are generated from McKee's Economic Evaluation of the Commercial and Demonstration Plant, Erie's cost estimate, and cost data received after the January meeting.

Adjustments have been made to reflect changes in the December McKee estimate resulting from final costs received from final documents and Front End Engineering Design Manuals delivered in March, 1979.

Cost adjustments have not been made for "Potential" Cost Savings resulting from design changes and further Trade-off Studies which would be performed in Phase II should the project proceed. Further engineering and or regulatory clearances would be required to authenticate and define any such Potential Cost Reductions.

Potential Cost Additions, with the exception of the Gasifier and Ash Disposal Area, have not been included as adjustments. As in the case of "Potential Cost Savings", Potential Additions will require more definition and/or engineering in Phase II should the project proceed.

A. CAPITAL COST SUMMARY

DEMONSTRATION PLANT

(000 Omitted)

McKee Battery Limits	$ 57,244
Erie Off-Sites	1,750
Total Direct Cost	$ 58,994
Total Indirect Cost	19,357
Escalation to 1981 @ 10%/annum 3½ yrs.	28,541
Contingency at 10% (on $78,351)	7,835
TOTAL CAPITAL INVESTMENT	$114,727

DIRECT CAPITAL COST

DEMONSTRATION PLANT

(000 Omitted)

McKee		
01	Material Handling	$15,984
02	Gasification	19,507
03	Sulfur Removal	4,537
04	Gas Compression	2,075
05	Waste Treatment	787
06	Utilities	12,655
07	Safety Systems	143
08	Retrofit	1,367
09	Employee Facilities	189
Erie		
10	Sulfur & Ash Disposal	1,750
	TOTAL DIRECT COST	$58,994

INDIRECT CAPITAL COST

DEMONSTRATION PLANT

(000 Omitted)

Construction Management	$ 3,362
Professional Services	11,722
Royalties	192
Taxes	1,576
Insurance	505
BCI Increase	2,000
TOTAL INDIRECT COST	$19,357

CAPITAL COST SUMMARY

COMMERCIAL PLANT

(000 Omitted)

	EASTERN COAL WITH STRETFORD	WESTERN COAL WITHOUT STRETFORD	DEMONSTRATION WITH STRETFORD
Mckee Battery Limits	$85,433	$62,514	$57,244
Erie Off-Sites	14,250	1,750	1,750
Total Direct Cost	$99,683	$74,264	$58,994
Total Indirect Cost	29,466	25,133	19,357
Escalation to 1981 (3¼ yrs) @ 10% rate	47,046	36,208	28,541
Contingency at 10%	12,915 (on 129,149)	9,940 (on 99,397)	7,835 (on 78,351)
TOTAL CAPITAL INVESTMENT	$189,110	$145,545	$114,727

DIRECT CAPITAL COST

COMMERCIAL PLANT

(000 Omitted)

	EASTERN COAL WITH STRETFORD	WESTERN COAL WITHOUT STRETFORD	DEMONSTRATION WITH STRETFORD
McKee			
01 Material Handling	$15,984	$15,984	$15,984
02 Gasification	38,303	35,864	19,507
03 Sulfur Removal	10,480	--	4,537
04 Gas Compression	3,074	3,074	2,075
05 Waste Treatment	855	855	787
06 Utilities	13,367	13,367	12,655
07 Safety Systems	143	143	143
08 Retrofit	3,038	3,038	1,367
09 Employee Facilities	189	189	189
Erie			
10 Sulfur & Ash Disposal	1,750	1,750	1,750
11 Taconite Harbor	12,500	--	--
TOTAL DIRECT COST	$99,683	$74,264	$58,994

INDIRECT CAPITAL COST

COMMERCIAL PLANT

(000 Omitted)

	EASTERN COAL WITH STRETFORD	WESTERN COAL WITHOUT STRETFORD	DEMONSTRATION WITH STRETFORD
Construction Management	$ 4,906	$ 4,235	$ 3,362
Professional Services	16,635*	13,845	11,722
Royalties	525	204	192
Taxes	2,504	2,210	1,576
Insurance	896	639	505
BCI Increase	4,000	4,000	2,000
TOTAL INDIRECT CAPITAL	$29,466	$25,133	$19,357

*510,000 Man-Hours

B. ANNUAL OPERATING COST SUMMARY

OF

DEMONSTRATION AND COMMERCIAL PLANTS

(000 Omitted)

	DEMONSTRATION PLANT		COMMERCIAL PLANT	
ITEM	EASTERN COAL	WESTERN COAL	EASTERN COAL	WESTERN COAL
Labor	$ 3,243	$ 3,064	$ 4,286	$ 3,652
Operating Materials	7,462	5,921	19,846	15,710
Maintenance Materials	1,036	1,036	1,653	1,220
Power	670	554	1,448	1,182
Miscellaneous	2,345	2,277	3,660	2,787
Subtotal	$14,756	$12,852	$30,893	$24,551
Less Credits	(3,411)	(448)	(9,630)	(2,028)
TOTAL	$11,345	$12,404	$21,263	$22,523
Cost for Gas/$\overline{M}$Btu	$ 4.20	$ 4.60	$ 2.91	$ 3.09
Combined Cost/$\overline{M}$Btu (Gas Tars & Oils)	$ 3.90	$ 4.50	$ 2.94	$ 3.08

To determine the operating cost per million BTU of energy produced at the Erie Mining Co. Coal Gasification Project.

LET A = OPERATING COST — Ref. Page VI-6
B = COAL CREDIT — " " VI-13
C = OIL AND TAR CREDIT — " " VI-13 and criteria below
D = ANNUAL PRODUCTION RATE — criteria below

CRITERIA

- Annual Production Rate, Demonstration Plant 2,701 Billion BTU
- " " " Commercial Plant 7,300 Billion BTU
- Daily " " " " 20 Billion BTU
- " " " Demonstration Plant 7.4 Billion BTU
- Oil and Tar Credit for useage or sales $3.00/M BTU
- Coal Fines Credit, Taconite Harbor Useage $37.75/T Eastern Coal

Calculation of operating cost is based on inclusion of oil and tar useage in economic analysis.

DERIVED FORMULA

$$\frac{A - B}{D + \left(\frac{C}{3} \times 1{,}000{,}000\right)}$$ $/1,000,000 BTU

Calculation of operating cost is based on exclusion of oil and tar useage in the economic analysis.

DERIVED FORMULA

$$\frac{A - (B+C)}{D}$$ $/1,000,000 BTU

ANNUAL OPERATING COSTS

LABOR

	DEMONSTRATION PLANT		COMMERCIAL PLANT	
	EASTERN COAL	WESTERN COAL	EASTERN COAL	WESTERN COAL
SALARIED				
Operating	7	7	8	8
Maintenance	1	1	1	1
SUBTOTAL	8	8	9	9
HOURLY				
Operating	49	44*	59	54*
Maintenance	6	6	10	10
SUBTOTAL	55	50	69	64
TOTAL WORK FORCE	63	58	78	73
TOTAL COST	$3,243	$3,064	$4,286	$3,652

(000 Omitted)

*Reflects Elimination of Sulfur Removal Plant Operators.

ANNUAL OPERATING COSTS

OPERATING MATERIALS

(000 Omitted)

ITEM	DEMONSTRATION PLANT		COMMERCIAL PLANT	
	EASTERN COAL	WESTERN COAL	EASTERN COAL	WESTERN COAL
COAL				
Tons/Year	173	183	468	497
Cost/Ton	$ 40	$ 31	$ 40	$ 31
Subtotal	$6,926	$5,701	$18,724	$15,415
CHEMICALS/GAS				
Inert Gas	$ 26	$ 26	$ 50	$ 50
Nitrogen	14	14	24	24
Stretford Chemicals	299	-	811	-
Misc. Chemicals	5	5	10	10
Subtotal	$ 344	$ 45	$ 895	$ 84
OTHER OPERATING MATERIALS	192	175	227	211
TOTAL	$7,462	$5,921	$19,846	$15,710

ANNUAL OPERATING COSTS

MAINTENANCE MATERIALS

(000 Omitted)

	DEMONSTRATION PLANT		COMMERCIAL PLANT	
ITEM	EASTERN COAL	WESTERN COAL	EASTERN COAL	WESTERN COAL
Maintenance Materials	$1,036	$1,036	$1,653	$1,220

NOTE: 1.5% of Plant Investment.

ANNUAL OPERATING COSTS

OPERATING POWER

	DEMONSTRATION PLANT		COMMERCIAL PLANT	
ITEM	EASTERN COAL	WESTERN COAL	EASTERN COAL	WESTERN COAL
Operating Power				
KWH	4,025	3,327	8,692	7,095
Cost/KWH	$ .02	$ .02	$ .02	$ .02
TOTAL COST	$670,000	$554,000	$1,448,000	$1,182,000

ANNUAL OPERATING COSTS

MISCELLANEOUS ITEMS

(000 Omitted)

ITEM	DEMONSTRATION PLANT		COMMERCIAL PLANT	
	EASTERN COAL	WESTERN COAL	EASTERN COAL	WESTERN COAL
Water	$ 41	$ 30	$ 99	$ 80
Ash Disposal	64	66	129	134
Stretford Purge Disposal	12	-	32	-
Sulfur Disposal	20	-	41	-
General Overhead	481	454	603	539
Taxes & Insurance	1,727	1,727	2,756	2,034
TOTAL	$2,345	$2,277	$3,660	$2,787

ANNUAL BY-PRODUCT CREDITS

(000 Omitted)

ITEM	DEMONSTRATION PLANT		COMMERCIAL PLANT	
	EASTERN COAL	WESTERN COAL	EASTERN COAL	WESTERN COAL
Excess Tars/Oils to Pellet Plant	$2,625	$448	$7,508	$2,028
Coal Fines to Taconite Harbor	786	____	2,122	____
TOTAL	$3,411	$448	$9,630	$2,028

OPERATING COST SUMMARY OF DEMONSTRATION AND COMMERCIAL PLANTS

ITEM	DEMONSTRATION PLANT		COMMERCIAL PLANT	
	EASTERN COAL	WESTERN COAL	EASTERN COAL	WESTERN COAL
Gas Cost/MBtu	$4.20	$4.60	$2.91	$3.09
Combined Cost/MBtu (Gas, Tars & Oils)	$3.90	$4.50	$2.94	$3.08

EXPLANATION OF CHARTS

GAS SELLING COST

The following graphs are provided for reference and indication of the cost required to produce low-BTU gas from the Contractural Plant configurations.

Curves were generated from the cost estimate and economic evaluation issued in December, 1978. Detailed criteria used to generate the curves were provided in the above referenced documents.

(000 Omitted)

Commercial	Eastern Coal With Stretford	Western Coal Without Stretford	Demonstration With Stretford
Direct	$ 99,683	$74,264	$58,994
Indirect	29,466	25,133	19,357
TOTAL	$129,149	$99,397	$78,351

CURRENT ESTIMATED COSTS

(000 Omitted)

(1978 $)

		CONTRACT	FINAL
Phase I	Preliminary Design	$ 2,200	$ 3,700*
Phase II	Construction	24,768	80,351
Phase III	Operation	20,426	23,839
		$47,394	$107,890

*Estimated, Parson's paid $145,000

Escalation and contingency not included

Escalation	28,541
Contingency	7,835
Total cost of project	144,266

PHASE II COSTS ($000)

(000 Omitted)

	PLANT AREA	CONTRACT	FINAL ESTIMATE
01	Material Handling	$ 2,889	$15,984
02	Gasification	8,759	14,507
	BCI Increase	-0-	5,000
03	Sulfur Removal	2,020	4,537
04	Gas Transmission	581	2,075
05	Waste Treatment	600	787
06	Utilities	679	12,655
07	Safety Systems	-0-	143
08	Retrofit	150	1,367
09	Employee Facilities	125	180
10	Sulfur-Ash Disposal	-0-	1,750
	Escalation 1976-77	1,663	Included
	TOTAL DIRECT COST	$17,466	$ 58,994

PHASE II COSTS

(000 Omitted)

(PROJECTED THROUGH CONSTRUCTION 1981)

	CONTRACT	FINAL
Direct Cost	$17,466	$ 58,994
Construction Management	1,633	3,362*
McKee Services	4,830	11,722
Royalties	88	192
Insurance	-0-	505
Taxes	-0-	1,576
BCI Increase	-0-	2,000
Subtotal	$24,017	$ 78,351
Erie Costs	751	2,000
Total Estimated	$24,768	$ 80,351
Escalation for 1978-1981	3,574	28,541
Cost to Construct	$28,342	$108,892**

*No Contingency Included.

**No Environmental Costs Included for Impact Statements or Monitoring.

2-YEAR OPERATING COST - PHASE III

(000 Omitted)

	CONTRACT	FINAL ESTIMATE
Labor and Supervision	$ 5,067	$ 6,307
Operating Material	13,469	13,383
Maintenance Material	1,500	2,072
Equipment Distribution	350	Included
Other Services	40	5,846
Oil Credits	Included	(3,859)
	$ 20,426	$ 23,839

GENERAL ASSUMPTIONS

1. Utilized discrete period compounding; 23 time periods.

   McKee employed continuous compounding; same time frame.

2. Timing of capital expenditure was split equally between the three years--1979, 1980 and 1981.

3. 85% of the capital expenditure was classified as "equipment", the remainder was "building".

4. Depreciation Methods

   For Tax Purposes:

   Building = 150% declining balance, 40 years, no residual value

   Equipment = double declining balance, 13 years, no residual value

   Per discussion with PM & Co. Tax Department:

   ADR class would be either Class 13.3 .....13 yrs.
   or
   Class 28 ..... 9 yrs.

   Utilized 13 yrs.

   For Book Purposes:

   Straight-time depreciation; 40 years for building; 15 years for equipment; no residual value.

5. Residual Value

The undepreciated balance (for tax purposes) of the building and the change in net working capital are shown as a cash inflow in the final period (year 2001).

6. Escalation of cost and revenues was at 10% annually.

DEMONSTRATION PLANT - ASSUMPTIONS

	Eastern		Western
Productive Capacity	3,000	Billion Btu/A.	3,000
Productive Volume	2,568	Billion Btu/A.	2,568
Selling Price	Var.		Var.
Semi-Var. costs (Fixed Costs)	$6,547,000		$6,324,000
Variable Rate	$3.90*	M Btu	$4.50*
Other Income	$2,625,000		$448,000

	Eastern		Western	
	Base	Esc.	Base	Enc.
Cost of Building ($000 omitted)	$12,928	17,209*	12,928	17,209*
Cost of Equipment ($000 omitted)	$73,258	97,518*	73,258	97,518*
TOTAL	$86,186	114,727*	86,186	114,727*
Changes in Working Capital		$2,389,300		$2,389,000

*
Revised: All other amounts per McKee Runout

COMMERCIAL PLANT - ASSUMPTIONS

	Eastern plus esc.		Western plus esc.
Productive Capacity	7,500	Billion Btu/A.	7,500
Productive Volume	6,940	Billion Btu/A.	6,940
Selling Price	Var.		Var.
Semi-Var. costs (Fixed Costs)	$8,552,000		$7,447,000
Variable Rate	2.94*	M Btu	3.08*
Other Income	$9,630,000		$2,028,000

	Eastern Base	Eastern Esc.	Western Base	Western Esc.
Cost of Building ($000 omitted)	21,309.6	28,366.5*	16,401	21,831.75*
Cost of Equipment ($000 omitted)	120,754.4	160,743.5*	92,936	123,713.25*
TOTAL	142,064	189,110 *	109,337	145,545 *
Changes in Working Capital		4,608.2		4,434.7

*
Revised: All other amounts per McKee Runout

Friday JUL 20, 1979 15:29

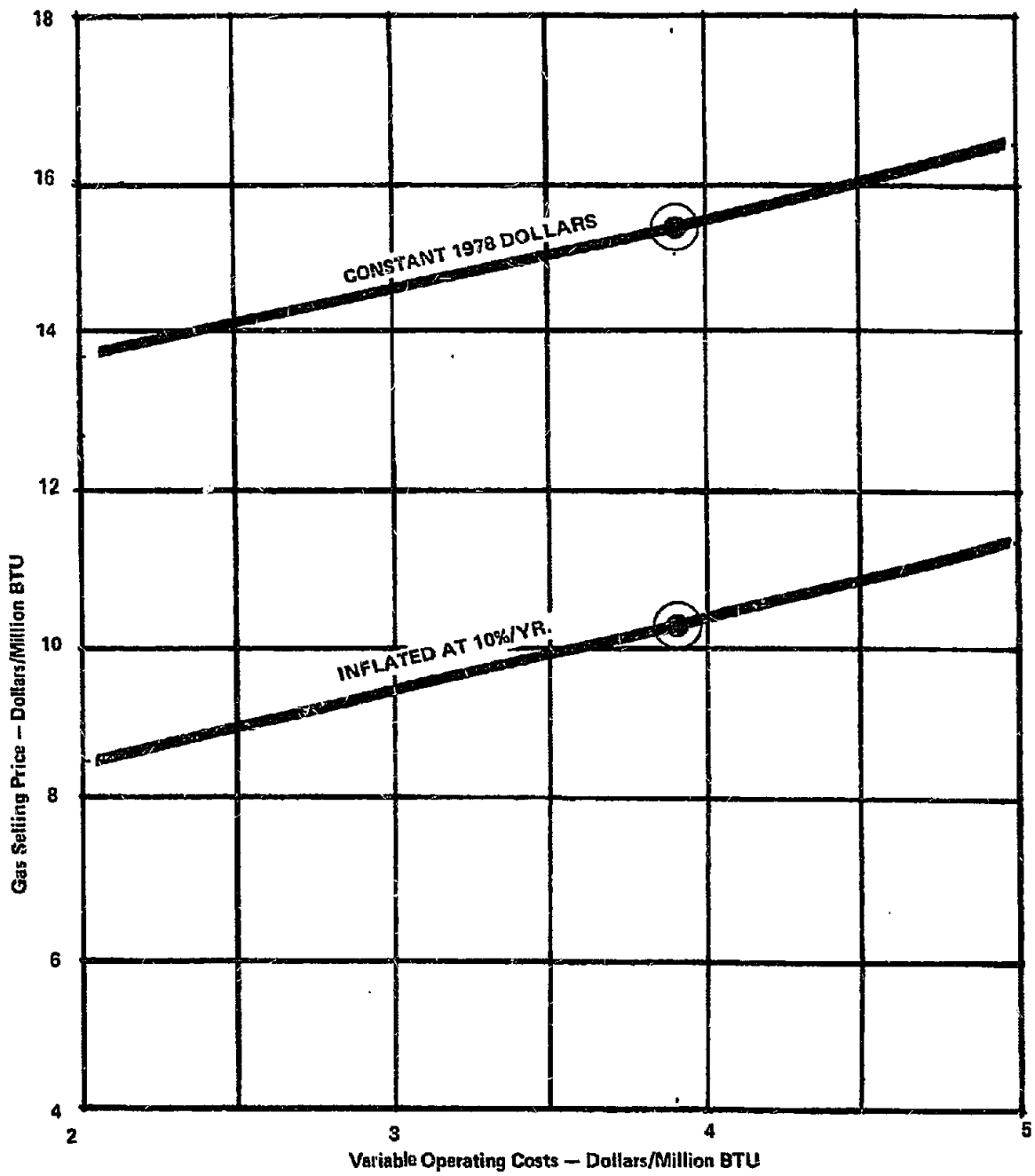
DEMONSTRATION PLANT --- EASTERN COAL --- 1978 CONSTANT DOLLARS

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1993	1998	1999	2000	2001	TOTAL
PRODUCTIVE VOLUM	0	0	0	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	51360
PROJCTED P&L																
REVENUE	0	0	0	40009	40009	40009	40009	40009	40009	40009	40009	40009	40009	40009	40009	800188
SEMI-VAR. COST	0	0	0	6547	6547	6547	6547	6547	6547	6547	6547	6547	6547	6547	6547	130939
VARIABLE COSTS	0	0	0	10015	10015	10015	10015	10015	10015	10015	10015	10015	10015	10015	10015	200304
OPERATING PROFIT	0	0	0	23447	23447	23447	23447	23447	23447	23447	23447	23447	23447	23447	23447	468944
OTHER INCOME	0	0	0	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	2625	52500
DEPRECIATION	0	0	0	2604	5207	5207	5207	5207	5207	5207	5207	323	323	323	323	79560
PRETAX PROFIT	0	0	0	23469	20865	20865	20865	20865	20865	20865	20865	25749	25749	25749	25749	441884
TAX-CURRENT	0	0	0	10097	7597	8238	8644	9049	9454	9859	11880	12891	12891	12891	12891	220614
TAX-DEFFERRED	0	0	0	1637	2836	2195	1789	1383	978	573	-1448	-16	-16	-16	-16	328
NET INCOME	0	0	0	11734	10433	10433	10433	10433	10433	10433	10433	12875	12875	12875	12875	220942
CASH FLOW																
NET INCOME	0	0	0	11734	10433	10433	10433	10433	10433	10433	10433	12875	12875	12875	12875	220942
DEPRECIATION	0	0	0	2604	5207	5207	5207	5207	5207	5207	5207	323	323	323	323	79560
TAX-DEFFERRED	0	0	0	1637	2836	2195	1789	1383	978	573	-1448	-16	-16	-16	-16	328
RESIDUAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5970	5970
CAPITAL EXPENDIT	28729	28729	28729	2389	0	0	0	0	0	0	0	0	0	0	0	88575
CASH FLOW	-28729	-28729	-28729	13586	18476	17835	17429	17023	16618	16213	14192	13182	13182	13182	19152	218225
DCFROR	15.01															
ASSUMPTIONS																
SELLING PRICE				15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	15.58	
VARIABLE COST RATE				3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	3.90	
COST OF BUILDING	4309.30	4309.30	4309.30													12927.88
COST OF EQUIP.	24419.39	24419.39	24419.29													73258.06
CHANGE IN NWC				2389.30												2389.30

Friday JUL 20, 1979 15:42

DEMONSTRATION PLANT ---- EASTERN COAL --- INFLATED AT 10%/YEAR

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1993	1998	1999	2000	2001	TOTAL
PRODUCTIVE VOLUM	0	0	0	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	51360
PROJCTED P&L																
REVENUE	0	0	0	38897	42786	47065	51772	56949	62643	68908	110976	178728	196600	216260	237886	2227791
SEMI-VAR. COST	0	0	0	9585	10544	11598	12758	14034	15437	16981	27348	44044	48449	53294	58623	549002
VARIABLE COSTS	0	0	0	14663	16130	17742	19517	21468	23615	25977	41836	67376	74114	81525	89678	839829
OPERATING PROFIT	0	0	0	14648	16113	17724	19497	21446	23591	25950	41792	67307	74038	81441	89585	838963
OTHER INCOME	0	0	0	3843	4228	4650	5115	5627	6190	6809	10965	17659	19425	21368	23505	220120
DEPRECIATION	0	0	0	3466	6931	6931	6931	6931	6931	6931	6931	430	430	430	430	105907
PRETAX PROFIT	0	0	0	15026	13409	15443	17681	20142	22849	25827	45826	84536	93033	102379	112660	953176
TAX-CURRENT	0	0	0	5334	2929	4800	6459	8229	10122	12151	24840	42289	46538	51211	56351	476151
TAX-DEFFERRED	0	0	0	2179	3775	2922	2382	1842	1302	763	-1927	-21	-21	-21	-21	437
NET INCOME	0	0	0	7513	6705	7722	8840	10071	11425	12913	22913	42268	46516	51189	56330	476588
CASH FLOW																
NET INCOME	0	0	0	7513	6705	7722	8840	10071	11425	12913	22913	42268	46516	51189	56330	476588
DEPRECIATION	0	0	0	3466	6931	6931	6931	6931	6931	6931	6931	430	430	430	430	105907
TAX-DEFFERRED	0	0	0	2179	3775	2922	2382	1842	1302	763	-1927	-21	-21	-21	-21	437
RESIDUAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7947	7947
CAPITAL EXPENDIT	38242	38242	38242	3498	0	0	0	0	0	0	0	0	0	0	0	118225
CASH FLOW	-38242	-38242	-38242	9660	17411	17575	18153	18844	19658	20608	27917	42677	46925	51598	64686	472654
DCFROR	15.01															
ASSUMPTIONS																
SELLING PRICE	11.38	12.52	13.77	15.15	16.66	18.33	20.16	22.18	24.39	26.83	43.22	69.60	76.56	84.21	92.63	
VARIABLE COST RATE	4.29	4.72	5.19	5.71	6.28	6.91	7.60	8.36	9.20	10.12	16.29	26.24	28.86	31.75	34.92	
COST OF BUILDING	5736.35	5736.35	5736.35													17209.03
COST OF EQUIP.	32506.00	32506.00	32506.00													97518.00
CHANGE IN NWC				3498.17												3498.17



GAS SELLING PRICE VS. VARIABLE OPERATING COSTS

DEMONSTRATION PLANT
EASTERN COAL

CONSTANT IRR – 15%

The gas selling price was determined for a range of variable operating cost levels, assuming a required internal rate of return of 15%.

The analysis was performed utilizing a constant dollar and inflated dollar approach. The constant dollar approach assumed 1978 dollars over the entire time frame, while the inflated method is based upon the escalation of the capital expenditure and the inflation of revenues and costs at 10% annually.

At the most likely variable operating cost level, 3.90/M Btu (in 1978 dollars), the selling price necessary to achieve the desired IRR is (in 1978 dollars):

CONSTANT	$15.58/M Btu
INFLATED	$10.35/M Btu

BASE CASE

EASTERN COAL

VARIABLE OPERATING COST VS. SELLING PRICE

($/M Btu)

	VO$	SELLING PRICE
	1.00	12.66+
	1.50	13.16+
	2.00	13.66+
	2.50	14.16+
	3.00	14.66+
	3.50	15.16+
	4.00	15.66+
	4.50	16.16+
	5.00	16.66+
Most Likely	3.90	15.58

IRR 15%

ESCALATED CASE (10%)

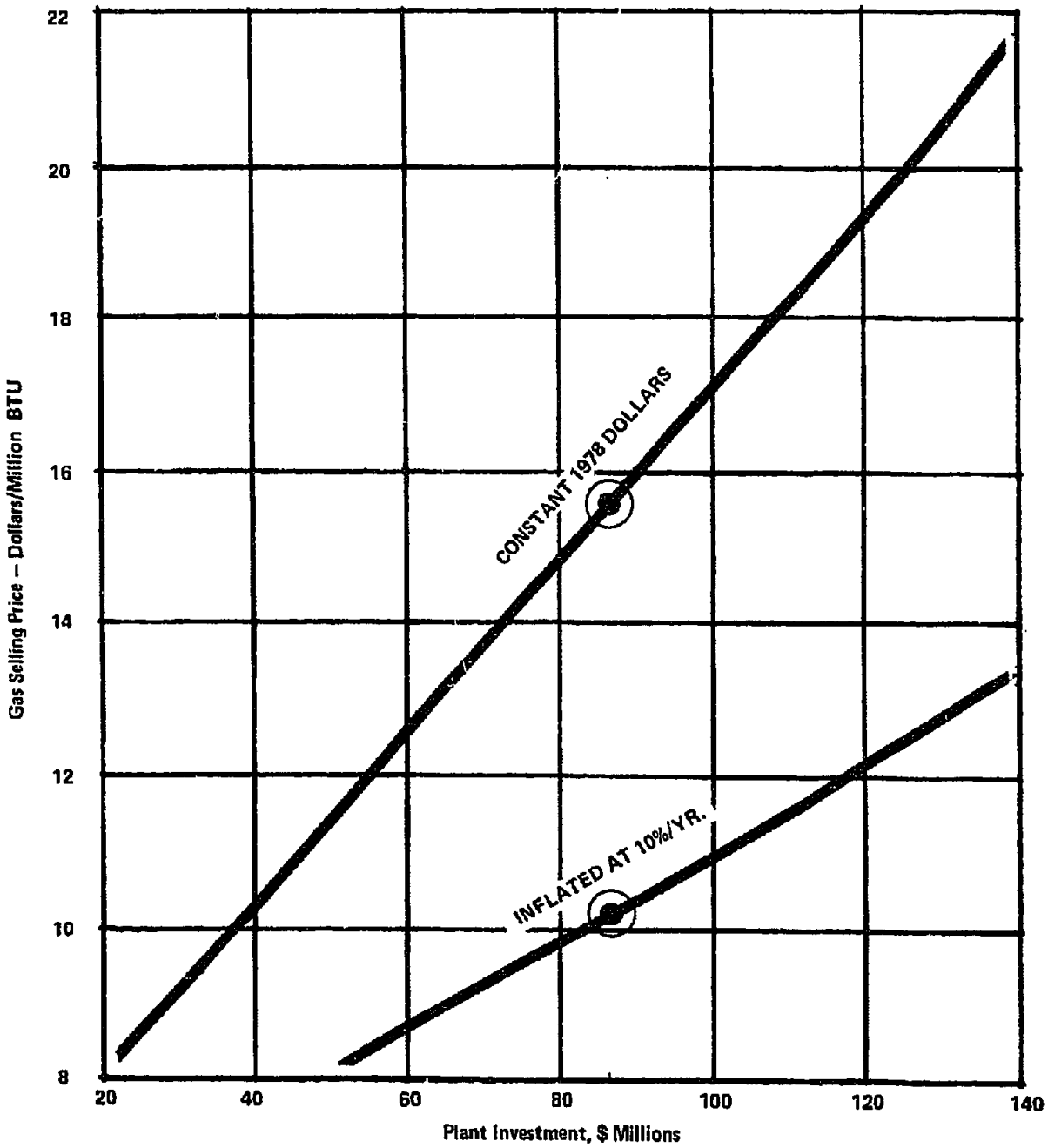
EASTERN COAL

VARIABLE OPERATING COST VS. SELLING PRICE

($/M Btu)

	VO$		SELLING PRICE	
	1978	1979	1978	1979
	.50	.55		
	1.00	1.10	7.42	8.17+
	1.50	1.65	7.92	8.72+
	2.00	2.20	8.42	9.27+
	2.50	2.75	8.92	9.82+
	3.00	3.30	9.42	10.37+
	3.50	3.85	9.42	10.92+
	4.00	4.40	10.42	11.47+
	4.50	4.95	10.92	12.02+
	5.00	5.50	11.42	12.57+
Most likely	3.90	4.29	10.35	11.38

IRR 15%



GAS SELLING PRICE VS. PLANT INVESTMENT

DEMONSTRATION PLANT
EASTERN COAL

CONSTANT IRR – 15%

The gas selling price was determined for a range of plant investments, assuming a required internal rate of return of 15%.

The analysis was performed utilizing a constant dollar and inflated dollar approach. The constant dollar approach assumes 1978 dollars over the entire time frame, while the inflated method is based upon the escalation of the capital expenditure and the inflation of revenues and costs at 10% annually.

At the most likely level of plant investment $86,186,000 (in 1978 dollars) and $114,727,000 (escalated), the selling price required to achieve the desired IRR is (in 1978 dollars):

CONSTANT	$15.58/M Btu
INFLATED	$10.35/M Btu

This, of course, is the same selling price computed in the previous graph: Gas selling Price vs. Variable Operating Costs.

BASE CASE

EASTERN COAL

PLANT INVESTMENT VS. SELLING PRICE

	PLANT INVESTMENT ($000 omitted)	SELLING PRICE ($/M Btu)
9,000 51,000	60,000	12.57
12,000 68,000	80,000	14.87
15,000 85,000	100,000	17.16
18,000 102,000	120,000	19.45
21,000 119,000	140,000	21.74

PROJECTED 86,186

IRR 15%

ESCALATED CASE

EASTERN COAL

PLANT INVESTMENT VS. SELLING PRICE

PLANT INVESTMENT ($000 omitted)		SELLING PRICE ($/M Btu)	
BASE	ESCALATED	1978	1979
	133%		
60,000	79,800	8.88	9.77
80,000	106,400	9.99	10.99
100,000	133,000	11.10	12.21
120,000	159,600	12.20	13.43
140,000	186,620	13.32	14.65
PROJECTED 86,186	114,727		
IRR 15%			

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COMMERCIAL PLANT. --- EASTERN COAL --- 1978 CONSTANT DOLLARS

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1993	1998	1999	2000	2001	TOTAL
PRODUCTIVE VOLUM	0	0	0	6940	6940	6940	6940	6940	6940	6940	6940	6940	6940	6940	6940	138794
PROJCTED P&L																
REVENUE	0	0	0	62319	62319	62319	62319	62319	62319	62319	62319	62319	62319	62319	62319	1246374
SEMI-VAR. COST	0	0	0	8552	8552	8552	8552	8552	8552	8552	8552	8552	8552	8552	8552	171040
VARIABLE COSTS	0	0	0	20403	20403	20403	20403	20403	20403	20403	20403	20403	20403	20403	20403	408056
OPERATING PROFIT	0	0	0	33364	33364	33364	33364	33364	33364	33364	33364	33364	33364	33364	33364	667281
OTHER INCOME	0	0	0	9630	9630	9630	9630	9630	9630	9630	9630	9630	9630	9630	9630	192600
DEPRECIATION	0	0	0	4292	8583	8583	8583	8583	8583	8583	533	533	533	533	533	131142
PRETAX PROFIT	0	0	0	38703	34411	34411	34411	34411	34411	34411	42461	42461	42461	42461	42461	728738
TAX-CURRENT	0	0	0	16653	12531	13587	14257	14925	15593	16261	19592	21257	21257	21257	21257	363828
TAX-DEFFERRED	0	0	0	2698	4675	3618	2949	2280	1612	945	-2387	-26	-26	-26	-26	541
NET INCOME	0	0	0	19351	17206	17206	17206	17206	17206	17206	17206	21231	21231	21231	21231	364369
CASH FLOW																
NET INCOME	0	0	0	19351	17206	17206	17206	17206	17206	17206	17206	21231	21231	21231	21231	364369
DEPRECIATION	0	0	0	4292	8583	8583	8583	8583	8583	8583	8583	533	533	533	533	131142
TAX-DEFFERRED	0	0	0	2698	4675	3618	2949	2280	1612	945	-2387	-26	-26	-26	-26	541
RESIDUAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	14448	14448
CAPITAL EXPENDIT	47355	47355	47355	4608	0	0	0	0	0	0	0	0	0	0	0	146672
CASH FLOW	-47355	-47355	-47355	21733	30463	29407	28738	28069	27401	26733	23402	21737	21737	21737	36185	363829
DCFROR	14.98															

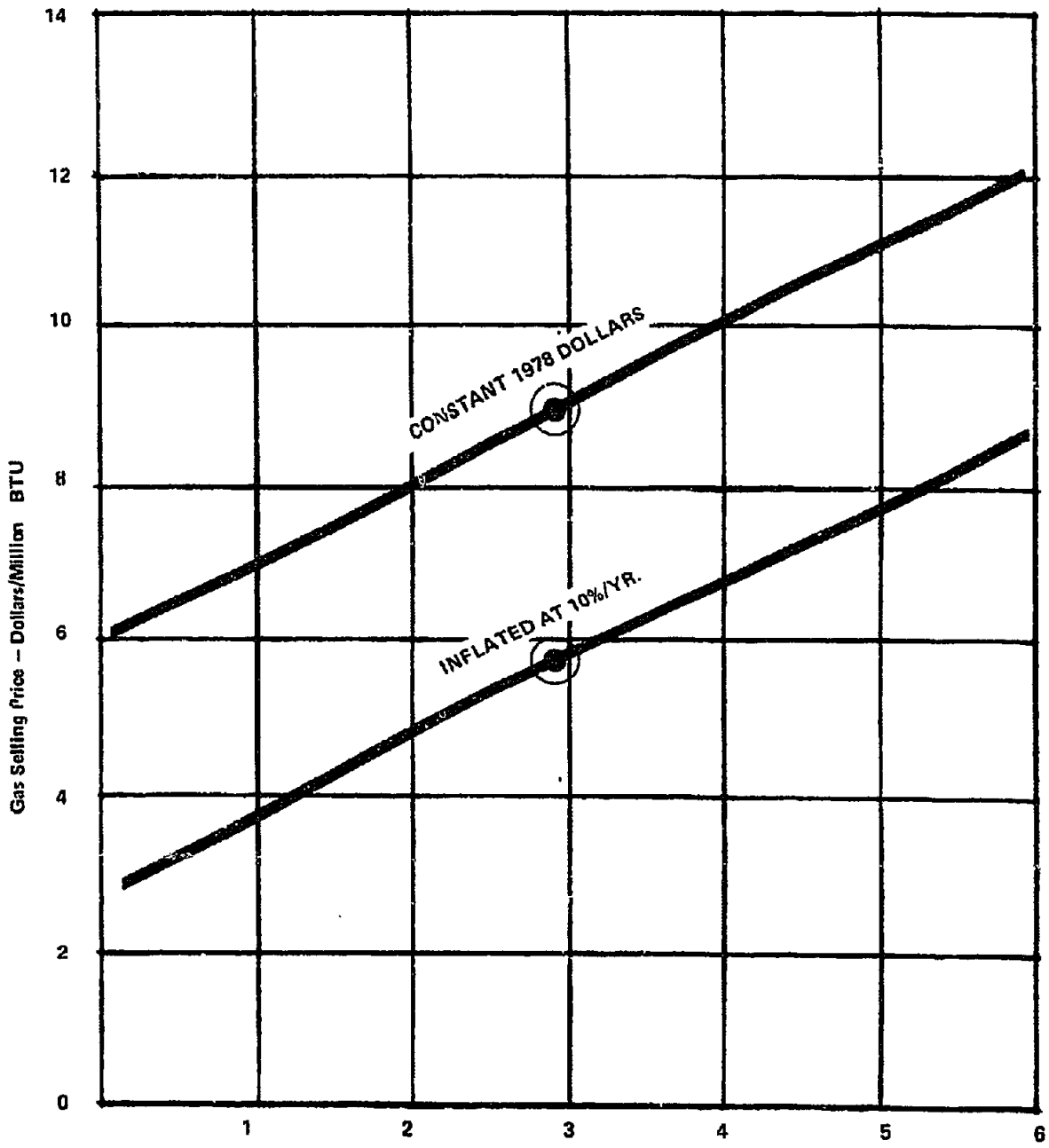
ASSUMPTIONS

SELLING PRICE				8.98	8.98	8.98	8.98	8.98	8.98	8.98	8.98	8.98	8.98	8.98	8.98
VARIABLE COST RATE			2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94	2.94
COST OF BUILDING	7103.19	7103.19	7103.19												
COST OF EQUIP.	40251.39	40251.49	40251.39												
CHANGE IN NWC				4608.20											

Friday JUL 20, 1979 13:46

COMMERCIAL PLANT --- EASTERN COAL --- INFLATED AT 10%/YEAR

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1993	1998	1999	2000	2001	TOTAL
PRODUCTIVE VOLUM	0	0	0	6940	6940	6940	6940	6940	6940	6940	6940	6940	6940	6940	6940	138794
PROJCTED P&L																
REVENUE	0	0	0	58838	64722	71194	78314	86145	94759	104235	167871	270357	297393	327132	359845	3369929
SEMI-VAR. COST	0	0	0	12521	13773	15150	16665	18332	20165	22182	35723	57533	63286	69615	76576	717132
VARIABLE COSTS	0	0	0	29872	32859	36145	39759	43735	48109	52919	85227	137258	150984	166082	182691	1710888
OPERATING PROFIT	0	0	0	16446	18090	19899	21889	24078	26486	29134	46921	75566	83123	91435	100578	941911
OTHER INCOME	0	0	0	14099	15509	17060	18766	20643	22707	24978	40227	64785	71264	78390	86229	807528
DEPRECIATION	0	0	0	5713	11425	11425	11425	11425	11425	11425	11425	709	709	709	709	174571
PRETAX PROFIT	0	0	0	24832	22174	25534	29230	33295	37767	42687	75722	139642	153677	169115	186098	1574865
TAX-CURRENT	0	0	0	8824	4864	7951	10689	13612	16737	20086	41038	69856	76874	84593	93084	786713
TAX-DEFFERRED	0	0	0	3592	6223	4816	3926	3036	2146	1258	-3177	-35	-35	-35	-35	720
NET INCOME	0	0	0	12416	11087	12767	14615	16648	18884	21343	37861	69821	76838	84558	93049	787433
CASH FLOW																
NET INCOME	0	0	0	12416	11087	12767	14615	16648	18884	21343	37861	69821	76838	84558	93049	787433
DEPRECIATION	0	0	0	5713	11425	11425	11425	11425	11425	11425	11425	709	709	709	709	174571
TAX-DEFFERRED	0	0	0	3592	6223	4816	3926	3036	2146	1258	-3177	-35	-35	-35	-35	720
RESIDUAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	19845	19845
CAPITAL EXPENDIT	63037	63037	63037	6747	0	0	0	0	0	0	0	0	0	0	0	195857
CASH FLOW	-63037	-63037	-63037	14974	28735	29009	29966	31109	32455	34026	46109	70495	77512	85232	113568	786714
DCFROR	15.00															
ASSUMPTIONS																
SELLING PRICE	6.37	7.01	7.71	8.48	9.33	10.26	11.28	12.41	13.65	15.02	24.19	38.96	42.85	47.14	51.85	
VARIABLE COST RATE	3.23	3.56	3.91	4.30	4.73	5.21	5.73	6.30	6.93	7.63	12.28	19.78	21.76	23.93	26.33	
COST OF BUILDING	9455.49	9455.49	9455.49													
COST OF EQUIP.	53581.19	53581.19	53581.09													
CHANGE IN NWC				6745.86												



GAS SELLING PRICE VS. VARIABLE OPERATING COSTS

COMMERCIAL PLANT
EASTERN COAL

CONSTANT IRR – 15%

The gas selling price was determined for a range of variable operating cost levels, assuming a required internal rate of return of 15%.

The analysis was performed utilizing a constant dollar and inflated dollar approach. The constant dollar approach assumes 1978 dollars over the entire time frame, while the inflated method is based upon the escalation of the capital expenditure and the inflation of revenues and costs at 10% annually.

At the most likely variable cost level, $2.94/M Btu (in 1978 dollars), the selling price necessary to achieve the desired IRR is (in 1978 dollars):

CONSTANT	$8.98/M Btu
INFLATED	$5.79/M Btu

BASE CASE

EASTERN COAL

VARIABLE OPERATING COST VS. SELLING PRICE

($/M Btu)

	VO$	SELLING PRICE
	1.00	7.04+
	1.50	7.54+
	2.00	8.04+
	2.50	8.54+
	3.00	9.04+
	3.50	9.54+
	4.00	10.04+
	4.50	10.54+
	5.00	11.04+
MOST LIKELY:	2.94	8.98

IRR 15%

ESCALATED CASE

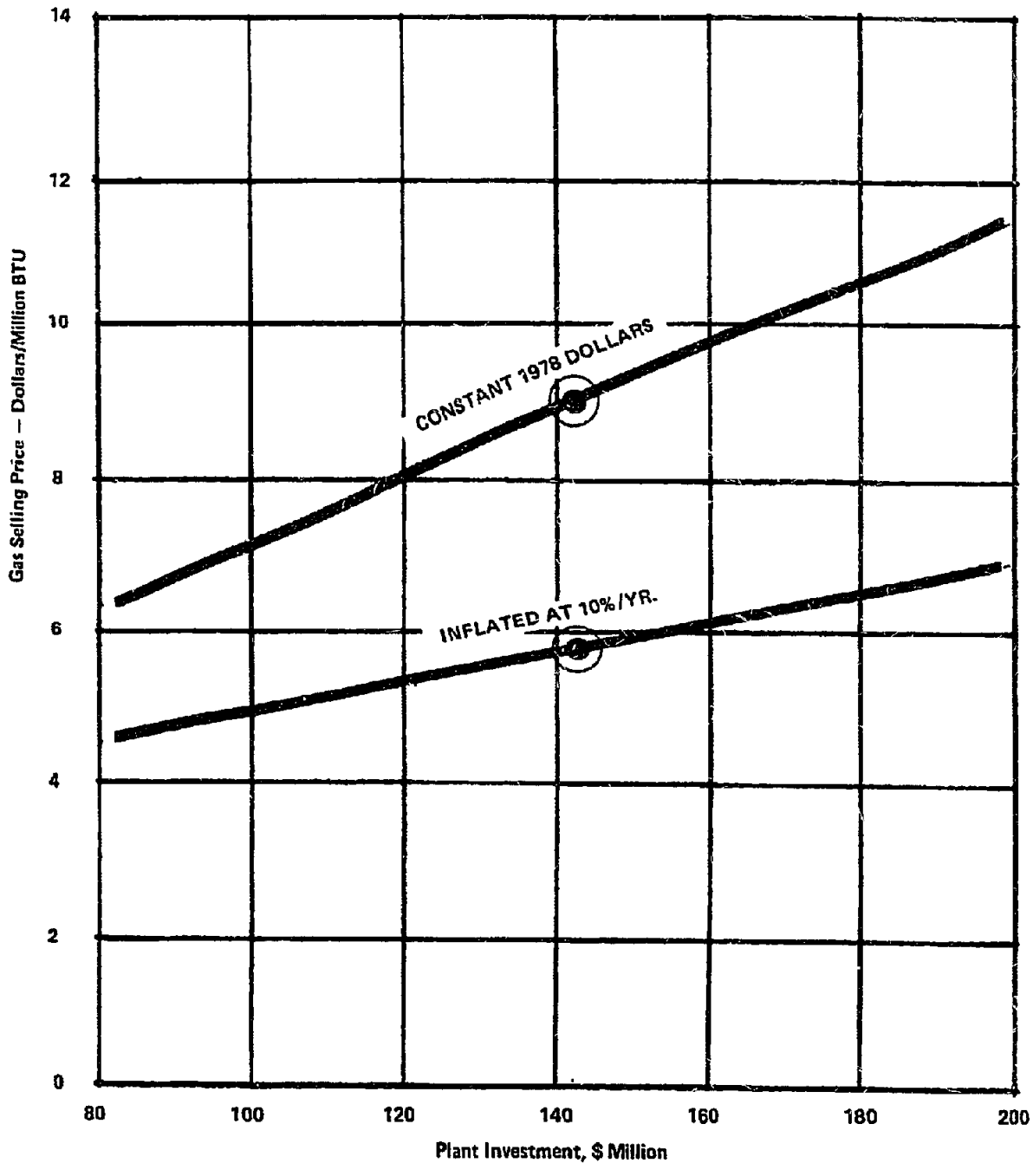
EASTERN COAL

VARIABLE OPERATING COST VS. SELLING PRICE

($/M Btu)

	VO$		SELLING PRICE	
	1978	1979	1978	1979
	1.00	1.10	3.85	4.23+
	1.50	1.65	4.35	4.78+
	2.00	2.20	4.85	5.33+
	2.50	2.75	5.35	5.88+
	3.00	3.30	5.85	6.43+
	3.50	3.85	6.35	6.98+
	4.00	4.40	6.85	7.53+
	4.50	4.95	7.35	8.08+
	5.00	5.50	7.85	8.63+
Most likely	2.94	3.234	5.79	6.37

IRR 15%



GAS SELLING PRICE VS. PLANT INVESTMENT

COMMERCIAL PLANT
EASTERN COAL

CONSTANT IRR – 15%

The gas selling price was determined for a range of plant investments, assuming a required internal rate of return of 15%.

The analysis was performed utilizing a constant dollar and inflated dollar approach. The constant dollar approach assumed 1978 dollars over the entire time frame, while the inflated method is based upon the escalation of the capital expenditure and the inflation of revenues and costs at 10% annually.

At the most likely level of plant investment--$142,064,000 (in 1978 dollars) and $189,110,000 (escalated)--the selling price required to achieve the desired IRR is (in 1978 dollars):

CONSTANT	$8.98/M Btu
INFLATED	$5.79/M Btu

BASE CASE

EASTERN COAL

PLANT INVESTMENT VS. SELLING PRICE

PLANT INVESTMENT ($000 omitted)	SELLING PRICE ($/M Btu)
60,000	5.50
80,000	6.35
100,000	7.20
120,000	8.05
140,000	8.90
160,000	9.75
180,000	10.60

MOST LIKELY: 189,110
- 47,046

142,064

IRR 15%

ESCALATED CASE

EASTERN COAL

PLANT INVESTMENT VS. SELLING PRICE

PLANT INVESTMENT 1978	PLANT INVESTMENT 1979	SELLING PRICE 1978	SELLING PRICE 1979
($000 omitted)		($/M Btu)	
	+33%		
60,000	19,800	4.10	4.51
80,000	106,400	4.51	4.96
100,000	133,000	4.92	5.41
120,000	159,600	5.33	5.86
140,000	186,200	5.74	6.31
160,000	212,800	6.15	6.76
180,000	239,400	6.55	7.21
MOST LIKELY 142,064	189,110		
IRR 15%			

Friday JUL 20, 1979 14:18

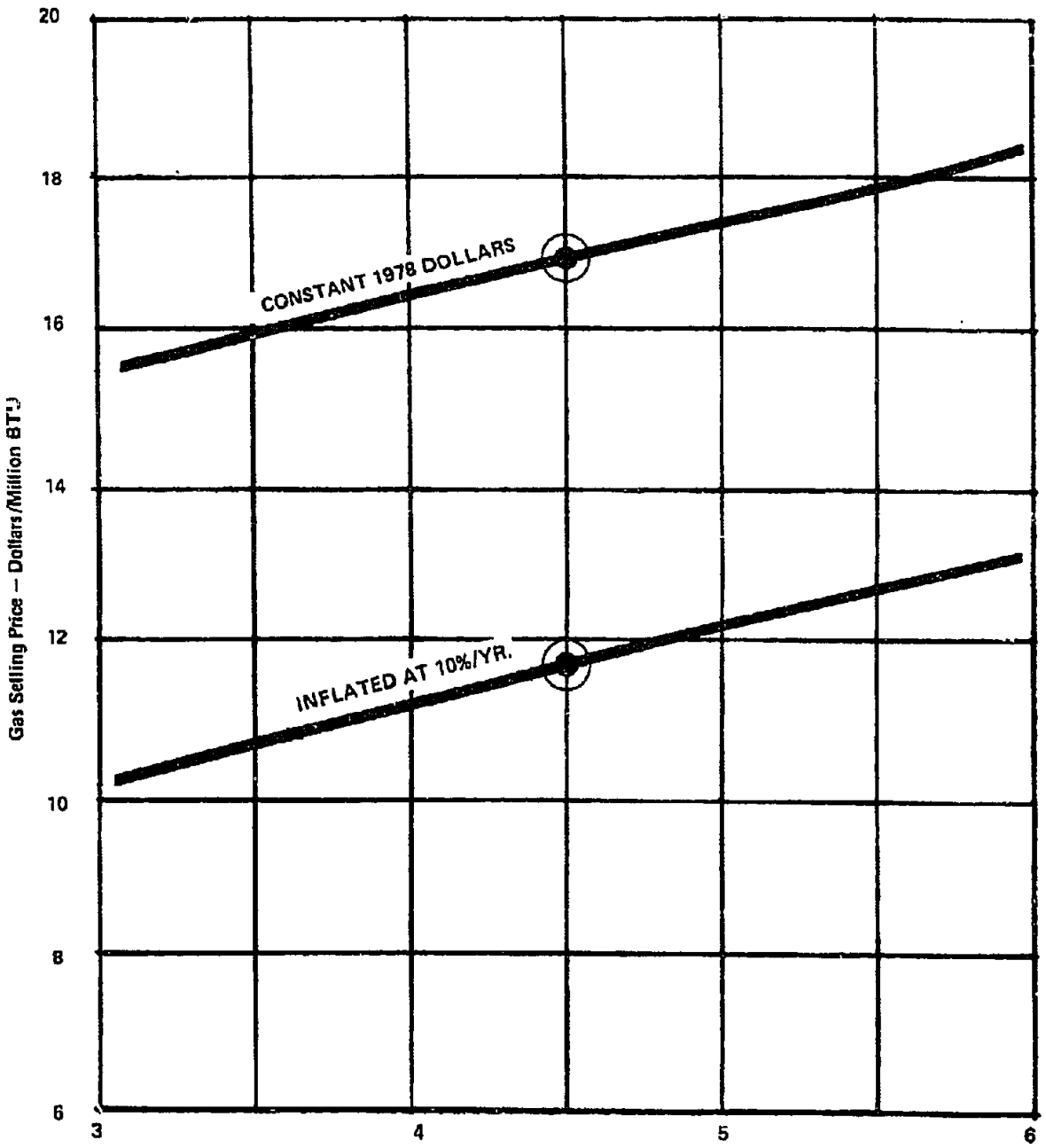
DEMONSTRATION PLANT --- WESTERN COAL --- 1978 CONSTANT DOLLARS

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1993	1998	1999	2000	2001	TOTAL
PRODUCTIVE VOLUM	0	0	0	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	51360
PROJCTED P&L																
REVENUE	0	0	0	43451	43451	43451	43451	43451	43451	43451	43451	43451	43451	43451	43451	869010
SEMI-VAR. COST	0	0	0	6324	6324	6324	6324	6324	6324	6324	6324	6324	6324	6324	6324	126480
VARIABLE COSTS	0	0	0	11556	11556	11556	11556	11556	11556	11556	11556	11556	11556	11556	11556	231119
OPERATING PROFIT	0	0	0	25571	25571	25571	25571	25571	25571	25571	25571	25571	25571	25571	25571	511410
OTHER INCOME	0	0	0	448	448	448	448	448	448	448	448	448	448	448	448	8960
DEPRECIATION	0	0	0	2604	5207	5207	5207	5207	5207	5207	5207	323	323	323	323	79560
PRETAX PROFIT	0	0	0	23415	20811	20811	20811	20811	20811	20811	20811	25695	25695	25695	25695	440810
TAX-CURRENT	0	0	0	10070	7570	8211	8617	9022	9428	9833	11854	12864	12864	12864	12864	220077
TAX-DEFFERRED	0	0	0	1637	2836	2195	1789	1383	978	573	-1448	-16	-16	-16	-16	328
NET INCOME	0	0	0	11708	10406	10406	10406	10406	10406	10406	10406	12848	12848	12848	12848	220405
CASH FLOW																
NET INCOME	0	0	0	11708	10406	10406	10406	10406	10406	10406	10406	12848	12848	12848	12848	220405
DEPRECIATION	0	0	0	2604	5207	5207	5207	5207	5207	5207	5207	323	323	323	323	79560
TAX-DEFFERRED	0	0	0	1637	2836	2195	1789	1383	978	573	-1448	-16	-16	-16	-16	328
RESIDUAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5970	5970
CAPITAL EXPENDIT	28729	28729	28729	2389	0	0	0	0	0	0	0	0	0	0	0	88575
CASH FLOW	-28729	-28729	-28729	13559	18449	17808	17402	16996	16591	16186	14165	13155	13155	13155	19125	217688
PCFROR	14.98															
ASSUMPTIONS																
SELLING PRICE				16.92	16.92	16.92	16.92	16.92	16.92	16.92	16.92	16.92	16.92	16.92	16.92	
VARIABLE COST RATE				4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	4.50	
COST OF BUILDING	4309.30	4309.30	4309.30													12927.88
COST OF EQUIP.	24419.39	24419.39	24419.29													73258.06
CHANGE IN NWC				2389.30												2389.30

Friday JUL 20, 1979 15:04

DEMONSTRATION PLANT --- WESTERN COAL --- INFLATED AT 10%/YEAR

	1979	1980	1981	1982	1983	1984	1985	1986	1987	1988	1993	1998	1999	2000	2001	TOTAL
PRODUCTIVE VOLUM	0	0	0	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	2568	51360
PROJCTED P&L																
REVENUE	0	0	0	43990	48389	53227	58550	64405	70846	77930	125507	202129	222342	244576	269033	2519480
SEMI-VAR. COST	0	0	0	9259	10185	11203	12324	13556	14912	16403	26417	42544	46799	51478	56626	530301
VARIABLE COSTS	0	0	0	16919	18611	20472	22519	24771	27248	29973	48272	77742	85516	94068	103474	969034
OPERATING PROFIT	0	0	0	17812	19593	21552	23707	26078	28686	31554	50818	81843	90027	99030	108933	1020148
OTHER INCOME	0	0	0	656	722	794	873	960	1056	1162	1871	3014	3315	3647	4011	37567
DEPRECIATION	0	0	0	3466	6931	6931	6931	6931	6931	6931	6931	430	430	430	430	105907
PRETAX PROFIT	0	0	0	15002	13383	15414	17649	20107	22811	25785	45758	84426	92912	102246	112514	951808
TAX-CURRENT	0	0	0	5322	2916	4785	6443	821.	10103	12129	24806	42235	46477	51144	56278	475467
TAX-DEFFERRED	0	0	0	2179	3775	2922	2382	1842	1302	763	-1927	-21	-21	-21	-21	437
NET INCOME	0	0	0	7501	6691	7707	8824	10053	11405	12892	22879	42213	46456	51123	56257	475904
CASH FLOW																
NET INCOME	0	0	0	7501	6691	7707	8824	10053	11405	12892	22879	42213	46456	51123	56257	475904
DEPRECIATION	0	0	0	3466	6931	6931	6931	6931	6931	6931	6931	430	430	430	430	105907
TAX-DEFFERRED	0	0	0	2179	3775	2922	2382	1842	1302	763	-1927	-21	-21	-21	-21	437
RESIDUAL	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7947	7947
CAPITAL EXPENDIT	38242	38242	38242	3498	0	0	0	0	0	0	0	0	0	0	0	118225
CASH FLOW	-38242	-38242	-38242	9648	17398	17560	18137	18826	19639	20587	27883	42622	46865	51532	64613	471970
DCFROR	14.99															
ASSUMPTIONS																
SELLING PRICE	12.87	14.16	15.57	17.13	18.84	20.73	22.80	25.08	27.59	30.35	48.87	78.71	86.58	95.24	104.76	
VARIABLE COST RATE	4.95	5.44	5.99	6.59	7.25	7.97	8.77	9.65	10.61	11.67	18.80	30.27	33.30	36.63	40.29	
COST OF BUILDING	5736.35	5736.35	5736.35													17209.03
COST OF EQUIP.	32506.00	32506.00	32506.00													97518.00
CHANGE IN NWC				3498.17												3498.17



GAS SELLING PRICE VS. VARIABLE OPERATING COSTS

DEMONSTRATION PLANT
WESTERN COAL

CONSTANT IRR — 15%

The gas selling price was determined for a range of variable operating cost levels, assuming a required internal rate of return of 15%.

The analysis was performed utilizing a constant dollar and inflated dollar approach. The constant dollar approach assumed 1978 dollars over the entire time frame, while the inflated method is based upon the escalation of the capital expenditure and the inflation of revenues and costs at 10% annually.

At the most likely variable operating cost level, $4.50/M Btu (in 1978 dollars), the selling price necessary to achieve the desired IRR is (1978 dollars):

CONSTANT	$16.92/M Btu
INFLATED	$11.69/M Btu

BASE CASE

WESTERN COAL

VARIABLE OPERATING COST VS. SELLING PRICE

	VO$ ($/M Btu)	SELLING PRICE ($/M Btu)
	1.00	13.42
	1.50	13.92
	2.00	14.42
	2.50	14.92
	3.00	15.42
	3.50	15.92
	4.00	16.42
	4.50	16.92
	5.00	17.42
Most Likely	4.50	16.92
IRR 15%		

ESCALATED CASE

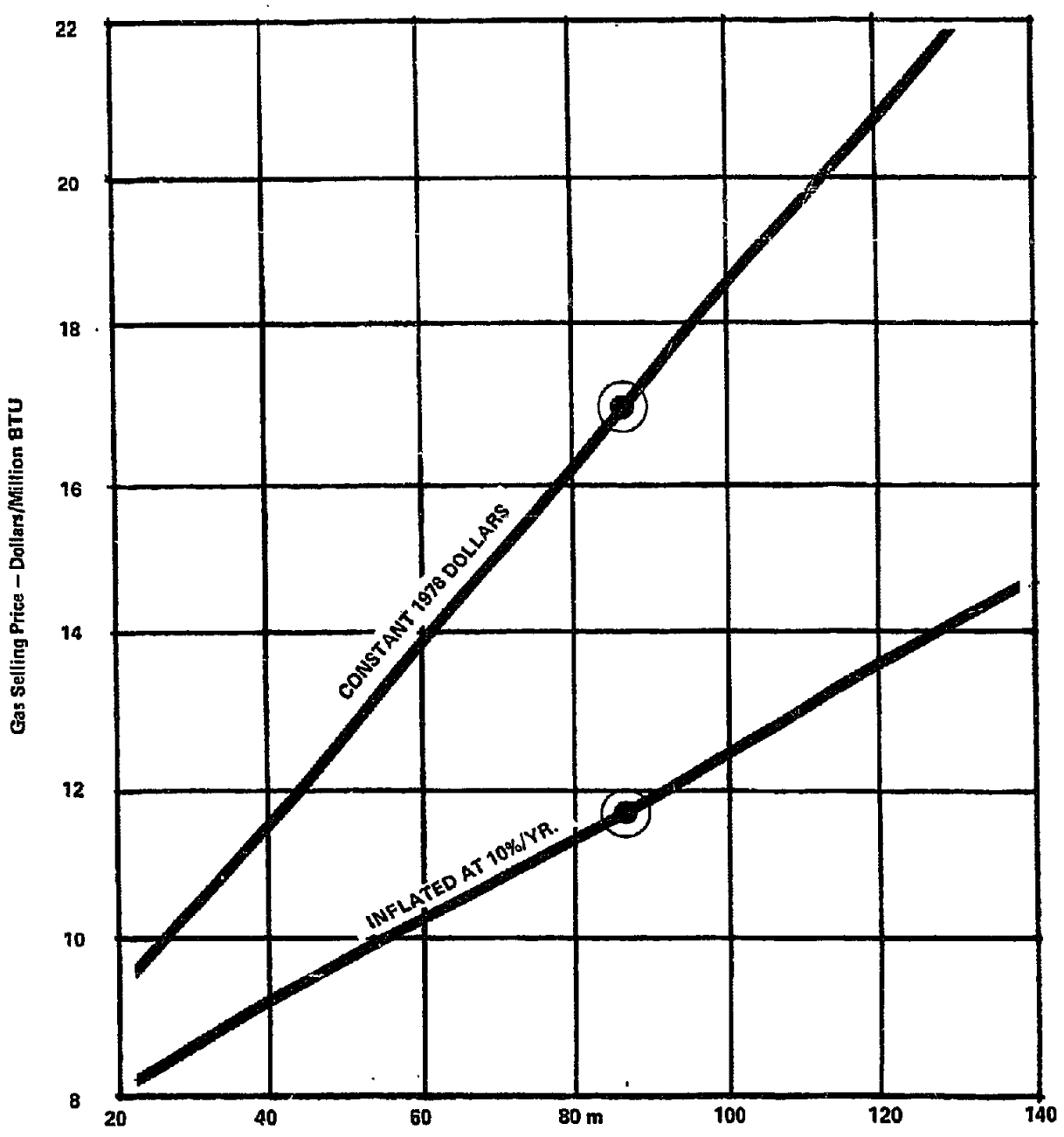
WESTERN COAL

VARIABLE OPERATING COST VS. SELLING PRICE

($/M Btu)

	VO$		SELLING PRICE	
	1978	1979	1978	1979
	.50	.55		
	1.00	1.10	8.19	9.01
	1.50	1.65	8.69	9.56
	2.00	2.20	9.19	10.11
	2.50	2.75	9.69	10.66
	3.00	3.30	10.19	11.21
	3.50	3.85	10.69	11.76
	4.00	4.40	11.19	12.31
	4.50	4.95	11.69	12.86
	5.00	5.50	12.19	13.41
Most Likely	4.50	4.95	11.69	12.86

IRR 15%



GAS SELLING PRICE VS. PLANT INVESTMENT

DEMONSTRATION PLANT
WESTERN COAL

CONSTANT IRR – 15%

The gas selling price was determined for a range of plant investments, assuming a required internal rate of return of 15%.

The analysis was performed utilizing a constant dollar and inflated dollar approach. The constant dollar approach assumed 1978 dollars over the entire time frame, while the inflated method is based upon the escalation of the capital expenditure and the inflation of revenues and costs at 10% annually.

At the most likely level of plant investment--$86,186,000 (in 1978 dollars), and $114,727,000 (escalated)--the required selling price (in 1978 dollars) is:

CONSTANT	$16.92/M Btu
INFLATED	$11.69/M Btu

BASE CASE

WESTERN COAL

PLANT INVESTMENT VS. SELLING PRICE
($000 omitted)

PLANT INVESTMENT	SELLING PRICE
60,000	13.93
80,000	16.22
100,000	18.51
120,000	20.81
140,000	23.09

PROJECTED 86,186

IRR 15%

ESCALATED CASE

WESTERN COAL

PLANT INVESTMENT VS. SELLING PRICE

PLANT INVESTMENT ($000 omitted)		SELLING PRICE ($/M Btu)	
BASE	ESCALATED	1978	1979
60,000	79,800	10.25	11.27
80,000	106,400	11.35	12.49
100,000	133,000	12.46	13.71
120,000	159,600	13.57	14.93
140,000	186,620	14.68	16.15
PROJECTED 86,186	114,727		

IRR 15%