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MASTER

HAZARD ANALYSIS REPORT

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ALLEGANY BALLISTICS LABORATORY

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HERCULES AEROSPACE DIVISION
HERCULES INCORPORATED
-ALLEGANY BALLISTICS LABORATORY
CUMBERLAND, MARYLAND

SAFETY ANALYSIS OF THE 700-HORSEPOWER
COMBUSTION TEST FACILITY

MAY 1981

B. D. BERKEY

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CAUTION

Conclusions presented in this hazards analysis report are based upon the hardware (or design), materials of construction, operating conditions, process materials and procedures as they existed at the time of the analysis (or as they were presented to Hercules for analysis). If changes in any of these parameters occur in the future, the conclusions of the current hazard analysis may be invalidated.

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I. SUMMARY

A. OBJECTIVE

The objective of the program reported herein was to provide a Safety Analysis of the 700 h.p. Combustion Test Facility (CTF) located in Building 93 at the Pittsburgh Energy Technology Center. This Safety Analysis conforms to DOE Order 5481.1⁽¹⁾ and was performed in accord with the "Management Implementation Plan for a Safety Analysis and Review System"⁽²⁾ developed as a separate task under the same contract, with one exception: an audit of the unit to demonstrate conformance with all guides, codes, and standards was excluded as being out of scope of the present contract. A Level 2 Safety Analysis is reported herein.

B. CONCLUSIONS

Extensive safety related measures have been incorporated into the design, construction, and operation of the Combustion Test Facility. These include: nitrogen addition to the coal storage bin, slurry hopper, roller mill and pulverizer baghouse, use of low oxygen content combustion gas for coal conveying, an oxygen analyzer for the combustion gas, insulation on hot surfaces, proper classification of electrical equipment, process monitoring instrumentation and a planned remote television monitoring system. Analysis of the system considering these factors has resulted in the determination of overall probabilities of occurrence of hazards as shown in Table I. Implementation of the recommendations in this report will reduce these probabilities as indicated. Also shown in Table I are the Recommendation Guidelines from Reference 2.

The identified hazards include coal dust ignition by hot ductwork and equipment, loss of inerting within the coal conveying system leading to a coal dust fire, and ignition of hydrocarbon vapors or spilled oil, or slurry.

The phenomenon of self-heating of coal was also investigated. Based on Bureau of Mines research, the assumption was made that any time the coal in the pulverizer system was exposed to atmosphere while hot ($>140^{\circ}\text{F}$) and left exposed for more than eight hours, the probability of self-heating to ignition is 1.0. The per hour probability of ignition is a function of the frequency of occurrence of the above events. Implementation of the recommendations in this report will reduce the ignition probability to no more than 1×10^{-6} per event.

In addition to fire and explosion hazards, there are potential exposures to materials which have been identified as hazardous to personal health, such as carbon monoxide, coal dust, hydrocarbon vapors, and oxygen deficient atmosphere, but past monitoring experience has not revealed any problem areas. The major environmental hazard is an oil spill. The facility has a comprehensive spill control plan.

C. RECOMMENDATIONS

No specific Risk Criteria were provided by PETC for the conduct of this analysis. In the absence of specific Risk Criteria, the Implementation Plan⁽²⁾ specifies a set of Recommendation Guidelines as 'triggers' for making recommendations. (These guidelines are reproduced in Table I.) The following recommendations are based on the safety analysis of the Combustion Test Facility, and are offered as means of reducing the likelihood or severity of hazards 'triggered' by the guidelines. Additional recommendations for reducing the frequency or severity of potential incidents are provided in Section III-B.

1. The slurry mix tank (33002) and slurry hold tank (35003) operate above the flash point of No. 6 fuel oil and are vented to the atmosphere. Ignition of the flammable mixture in the tank vents could lead to an explosion within the vessel and is considered a catastrophic hazard to employees and facilities. Addition of a nitrogen purge to the tank is recommended to reduce the probability of the formation of a flammable mixture in the tank. Recommended purge rates are given in Table III-I.
2. The following recommendations are aimed at reducing the probability of coal self-heating to ignition:
 - a. Avoid opening the system to atmosphere for more than eight hours without first allowing it to cool to less than 140°F.
 - b. Purge the system of coal as completely as possible before opening.
 - c. Check the temperature of the coal in the system upon opening the system and every two hours thereafter. If the temperature increases more than 20°F, close the system and inert.
 - d. Isolate and inert those parts of the system containing coal that do not require attention.
 - e. If the system must be left unattended for more than eight hours, isolate and inert the areas containing coal (particularly the baghouse).

TABLE I
RESULTS OF THE ANALYSIS

	Probability of Occurrence ⁽¹⁾		
	<u>Current System</u>	<u>System With Recommendations</u>	<u>Guideline Probability</u>
Hazards With Catastrophic Consequences to Employees	3×10^{-6}	3×10^{-9}	1×10^{-7}
Hazards With Catastrophic Consequences to Facilities	3×10^{-6}	3×10^{-9}	1×10^{-6}
Hazards With Critical Consequences to Employees	9×10^{-9}	9×10^{-12}	1×10^{-6}
Hazards With Critical Consequences to Facilities	2.2×10^{-6}	2.2×10^{-9}	1×10^{-5}

Consequences

- Catastrophic - Death or permanent total disability; or loss of large, expensive operation or building or off-site structure.
- Critical - Permanent partial disability; or loss of major equipment item, some damage to adjacent units, or loss of entire small operation.

(1) Based on one hour of operation.

II. INTRODUCTION

A. BACKGROUND

The 700 h.p. Combustion Test Facility comprises equipment for the preparation of coal-oil-mixtures (COM) and a boiler and ancillaries. It is currently used to study the feasibility of using COM feeds in commercial boilers. DOE Order 5481.1 requires that DOE Operations with hazards of a type or magnitude not routinely encountered and/or accepted by the public be analyzed to assure that potential hazards are systematically identified, potential impacts are analyzed, and that reasonable measures to eliminate, control, or mitigate the hazards have been taken. The Safety Analysis reported herein was conducted to meet these objectives. Work was carried out under Contract DE-AC22-80PC 30198. This report completes Task No. 2 of this contract.

B. SCOPE OF THE ANALYSIS

This analysis covers the Combustion Test Facility (CTF) in Building 93. The specific equipment items included are the coal handling and pulverizing system, the oil handling and coal-oil slurry preparation and feed systems, and the flue gas handling system. The 700 h.p. Nebraska boiler itself was not subject to analysis since it is covered by the Safety Analysis Exemptions in the Implementation Plan.⁽²⁾ In terms of the process flow, the analysis covers the coal from the time it enters the coal storage bin and the oil from the time it enters the storage tank until the coal-oil slurry is fed to the boiler. Also included in the analysis is the flue gas from the time it leaves the boiler until it is discharged to the atmosphere. Boiler feed water treatment and handling is not in scope.

Application of the criteria in the Implementation Plan⁽²⁾ resulted in the assignment of a Level 2 Safety Analysis to this operation. This documentation is provided as Appendix E.

The Safety Analysis reported herein conforms to DOE 5481.1 and the Implementation Plan⁽²⁾ developed under Task No. 4 of this contract with the one exception that an audit to demonstrate conformance to applicable guides, codes, and standards is not included. While this provision of DOE 5481.1 was noted, the vast number of applicable regulations was not evident until midway through the development of the Implementation Plan when the document specifying prescribed standards was identified and requested from PETC. The number of guides, codes, and standards which would have to be checked for applicability and then audited against is far beyond what anyone envisioned and is clearly beyond the scope of the present contract. The listing of prescribed standards is presented in Appendix C for reference.

C. BASIS

The basis for the analysis is the information provided to Hercules during visits to PETC and subsequent communications. This information consists of process drawings, operating instructions, equipment specifications, etc. A detailed list of the system documentation is given in Appendix A.

III. DISCUSSION

A. DESCRIPTION OF THE OPERATION

The Combustion Test Facility is currently used for testing the feasibility of substituting coal-oil slurries for oil in commercial boilers. The facility consists of a coal handling and pulverizing system, a slurry make-up system, a 700 h.p. Nebraska boiler, and a flue gas treatment system. A block diagram of the system is presented in Figures III-1 and -2.

The coal is fed to a storage bin by truck and then fed to the roller mill by a screw conveyor as needed. Heated, low oxygen combustion gas is introduced into the roller mill to convey the pulverized coal into a cyclone. The gas stream from the cyclone is split with two-thirds recycled to the roller mill and one-third fed to a baghouse for dust collection. The gas discharge from the baghouse is again split with two-thirds recycled to the roller mill after being reheated in a furnace fired with No. 2 fuel oil and one-third exhausted to the atmosphere. The coal collected in the cyclone and the baghouse is then fed by gravity through rotary valves to the coal supply hopper.

At this point in time, No. 6 fuel oil from a large storage tank located outside the building is introduced to the mix tank and heated to approximately 170°F. Coal from the supply hopper is then weighed and fed to the mix tank to make up the coal-oil slurry with coal concentrations up to 50%. The batch of slurry made up in this manner is then pumped to the slurry hold tank and maintained at 170°F before being fed to the boiler.

The flue gas from the boiler is treated with sodium bicarbonate for sulfur removal before entering a baghouse for dust collection.

Safety related precautions in the system include: nitrogen addition to the coal storage bin and supply hopper, use of nitrogen in the pulverizer system baghouse blowdown, use of low oxygen content (<11.5%) combustion gas in the pulverizer system, an oxygen analyzer on the gas discharge from the pulverizer system to detect changes in oxygen levels, insulation of ductwork and other heated surfaces, use of NEC Class II, Division 1, Group F electrical equipment in the pulverizer area, installation of continuous carbon monoxide, combustible gas and oxygen detectors inside the building and installation of a closed circuit TV system for remote monitoring of the building.

Figure III-1. Combustion Test Facility - Functional Block Diagram

Figure III-2. Combustion Test Facility - Coal Pulverizer System

B. SUMMARY OF RECOMMENDATIONS

The recommendations discussed in subsequent sections are summarized below. These recommendations are offered as a means of reducing the likelihood or the severity of potential hazardous incidents in the operation of the Combustion Test Facility. Recommendations are presented in two categories: (1) those 'triggered' by the Implementation Plan Recommendation Guidelines (see Table I in Section I - Summary), and (2) others, not triggered by the guidelines but nonetheless offered as a means of maximizing the level of safety in the operation.

1. Recommendations 'Triggered' by Recommendation Guidelines

- a. The slurry mix tank (33002) and slurry hold tank (35003) operate above the flash point of No. 6 fuel oil and are vented to the atmosphere. Ignition of the flammable mixture in the tank vents could lead to an explosion within the vessel and is considered a catastrophic hazard to employees and facilities. Addition of a nitrogen purge to the tank is recommended to reduce the probability of the formation of a flammable mixture in the tank.
- b. The following recommendations are aimed at reducing the probability of coal self-heating to ignition:
 - (1) Avoid opening the system to atmosphere for more than eight hours without first allowing it to cool to less than 140°F.
 - (2) Purge the system of coal as completely as possible before opening.
 - (3) Check the temperature of the coal in the system upon opening the system and every two hours thereafter. If the temperature increases more than 20°F, close the system and inert.
 - (4) Isolate and inert those parts of the system containing coal that do not require attention.
 - (5) If the system must be left unattended for more than eight hours, isolate and inert the areas containing coal (particularly the baghouse).

2. Other Recommendations - Equipment

- a. Install a slide gate valve between the coal pulverizer system cyclone (48001K) and the rotary valve

feeding the supply hopper. This will allow maintenance on the valve without emptying and opening the cyclone. (This may be impractical due to the limited clearance between the cyclone and the valve.)

- b. Interlock the fans feeding gas to the roller mill with the mill pressure switch to shut down the fans on high vacuum or positive pressure in the mill. This will help prevent introduction of excess air into the system under high vacuum conditions or release of coal dust from the mill under positive pressure conditions.

3. Procedures and Practices

- a. Emphasis should be placed on careful and immediate clean up of any spilled or released coal. This is particularly applicable to material spilled onto ductwork or operating equipment.
- b. Routine (monthly) inspection of insulation integrity is recommended to prevent the exposure of hot surfaces.
- c. The oxygen meter is on the end of the coal conveying system. While the coal dust in the main stream is likely to cause the meter to fail, making it impractical to move the meter, it should be remembered that the oxygen meter will detect loss of inerting in the system but will not necessarily prevent it.
- d. In order to provide up-to-date documentation of exposure levels in the building, it is recommended that a comprehensive survey of carbon monoxide, coal dust and hydrocarbon concentrations be performed. Such a survey would consist of area samples taken at several locations in the building under typical operating conditions. A noise survey may be included.
- e. The operating instructions for the unit should include a section on personal protective equipment required for the area, particularly that needed for sampling.
- f. Check to see that all guards and other process equipment safety features are in place before starting operation.
- g. Ensure that all detection instrumentation (carbon monoxide, oxygen, combustible gas, etc.) is calibrated on a regular basis and that the calibration is properly documented. This should include portable as well as installed instruments.

- h. A review of the spill control plan from the standpoint of spill prevention is recommended, particularly for the combustion test facility because of the large quantities of oil and coal that are handled.
- i. The No. 2 fuel oil feed to the furnace providing hot combustion gas for coal conveying should be regularly inspected for leaks.
- j. Review the facility to insure that escape routes are available and well marked and that if a fire does occur the offices above can be safely evacuated.

C. PROCESS HAZARDS

The Process Hazards Analysis is an evaluation of potential fire, explosion or hazardous material release events in the system. The results of the analysis are presented in tabular form in Tables III-3 and -4. A discussion of the analysis is presented here by process area.

1. Coal Pulverizer Area (Hazards 1-4)

There are three basic scenarios in this area which could lead to a coal dust fire or explosion. The first is a release of coal dust outside the system (Hazard 1). The most probable cause of this scenario is maintenance work on the system without emptying the system of coal or failure to use proper methods to clean up and control coal that is released. Another potential event is positive pressure on the roller mill caused by a leak on the suction side of the main fan (48001F). This fan draws the coal-laden gas stream out of the mill through a cyclone separator and then recycles most of the gas back to the mill. The coal feed to the mill is controlled by a pressure switch just downstream of the mill. When this switch shows a decrease in the vacuum, it increases the coal feed. However, if there is a decrease in vacuum due to a leak on the suction side of the fan, the increase in coal feed will not increase the vacuum, while the fan will continue to feed air to the mill decreasing the vacuum even further. When the vacuum level reaches 1 in. of H₂O, the coal feed is cut off but the blower remains in operation. The imbalance of air flows generated in this manner could then result in coal dust being blown out of the mill.

There are four identified potential ignition sources for released coal. First, Duct "B" which conveys hot gas from the furnace to the mill is likely to operate at or above the coal dust layer ignition temperature of 340°F(6,7) under normal operating conditions. This duct is insulated but any coal dust accumulation in an area where the insulation is damaged or missing is likely to lead to a fire. The electrical equipment in the area is the proper classification for dust areas but improper maintenance such as failure to maintain clearances or failure to replace bolts in the housing could cause sparking which could also lead to a fire. Other potential ignition sources are overheated bearings on rotating equipment and a temperature upset which causes overheating of an uninsulated portion of duct work or equipment.

The overall probability of a fire from these causes is 2×10^{-6} with a probability of personnel injury of 8×10^{-9} . These probabilities are within the recommendation guidelines set forth in the Implementation Plan⁽²⁾. Recommendations that may help to further reduce the probability of a fire in this area are:

- Careful and immediate clean up of any spilled or released coal, particularly of material spilled onto duct work or operating equipment.
- Installation of a slide gate valve between the cyclone and the rotary valve feeding the supply hopper. This will allow maintenance on the valve without emptying and opening the cyclone. (This may be impractical due to the limited clearance between the cyclone and the valve.)
- Interlocking of the fans feeding the roller mill with the mill pressure switch to prevent positive pressure in the mill.
- Routine (monthly) inspection of the insulation integrity.

The second scenario leading to a fire in the pulverizer area is the loss of inerting within the system (Hazard 2). Three events which could cause loss of inerting have been identified. The first of these is an air leak into the system caused by failure of an explosion vent or leakage around a flange in the ductwork. Another event is failure of the by-pass valve (48001N) between the main fan and the mill. This situation would greatly increase the vacuum drawn on the system causing air to be drawn in at the roller mill. Flame failure in the gas heating furnace (48001L) would also lead to an increase in oxygen in the system.

Assuming that loss of inerting has occurred, there are two identified ignition sources. The first of these is a temperature upset causing overheating in the system. The probability in this case is based on the probability of the failure of the operator to react to a high temperature alarm. Another potential ignition source is an overheated bearing in the roller mill.

The overall probability of a fire from these causes is 2×10^{-7} with a probability of personnel injury of 8×10^{-10} . These probabilities are within the recommendation guidelines set forth in the Implementation Plan⁽²⁾. Recommendations that may help to further reduce the probability of an incident from these sources are:

- Interlocking the roller mill pressure switch to shut down the main fan (48001K) if the vacuum is greater than the specified operating condition should help avoid introducing excess air into the system.
- Due to the dust content in the conveying system, placement of the oxygen analyzer in the main stream is not feasible. Therefore, when the oxygen analyzer shows excess oxygen, the entire system is already above the limits. The oxygen analyzer will detect, but not necessarily prevent flammable conditions in the conveying system.

The most probable hazard in the area is self-heating to ignition or spontaneous combustion of coal (Hazard 3). Bureau of Mines studies have shown that bituminous coals will self-heat to ignition from initial temperatures as low as 140°F ⁽⁸⁾. The time to ignition ranges from 8 to 75 hours. In addition to time and temperature, the likelihood of self-heating is also increased by smaller particle sizes and greater availability of oxygen. The coal pulverizer system operates at $200\text{--}250^{\circ}\text{F}$, well in excess of the required initial temperature for self-heating. Therefore, it is assumed that self-heating to ignition will occur if the pulverizer system is opened to atmosphere for a sufficient period of time (8 hours or more). The most likely site for ignition is the filter bags in the baghouse. This is due to the small particle size of the coal fines on the bags and the greater exposure to air. The cyclone, baghouse and coal supply hoppers would be less likely sites for ignition because the configuration of the hoppers makes it difficult for sufficient oxygen to reach the bulk of the coal. However, the coal in these hoppers may still self-heat, leading to ignition on exposure to oxygen. In the case of the supply hopper this could lead to an ignition source for flammable vapors in the slurry mix tank (see Hazard 6). In summary, the probability of self-heating to ignition is assumed to be 1.0 whenever the system is opened while hot and left open for 8 hours or more. Implementation of the following procedural recommendations will reduce the probability to 1×10^{-6} with a probability of personnel injury of 4×10^{-9} :

- Avoid opening the system to atmosphere for more than 8 hours without first allowing it to cool to less than 140°F .
- Purge the system of coal as completely as possible before opening.

- Check the temperature of the coal in the system upon opening the system and every two hours thereafter. If the temperature increases more than 20°F, close the system and inert.
- Isolate and inert those parts of the system containing coal that do not require attention.
- If the system must be left unattended for more than 8 hours, isolate and inert the areas containing coal (particularly the baghouse).

The temperature guideline of 140°F is based on the use of bituminous coal in the facility. Lignites and sub-bituminous coals can self-heat to ignition from initial temperatures as low as 86°F.⁽⁸⁾ The recommendation should be adjusted accordingly if these lower-rank coals are to be used in the test facility.

Another hazard in the pulverizer area is the potential for a No. 2 fuel oil fire caused by a leak from the furnace oil valve ignited by the hot surface of the furnace (Hazard 4). The probability of a fire from this cause is 3×10^{-8} . The oil feed to the furnace should be routinely inspected for leaks.

2. Coal-Oil Slurry Preparation Area (Hazards 5 and 6)

There are two situations of concern in this area: Release of oil or slurry (Hazard 5) and the existence of flammable vapors (Hazard 6). The most probable cause of an oil or slurry release is failure to close sample valves. Other causes are pump seal leaks and piping failure leaks. The only credible ignition source for such a release is a coal dust fire external to the system. Such incidents are more likely to lead to environmental problems than fire or explosion hazards. The probability of a fire involving oil or slurry is 2×10^{-9} .

The flammable vapors originate in the slurry mix tank and the slurry hold tank. These tanks operate at 170°F, 20°F above the 150°F flash point for No. 6 fuel oil. Therefore, a flammable mixture is assumed to be present in the tanks and the tank vents. As in the case of the oil or slurry spill an external coal dust fire is a potential ignition source. Another ignition source for the slurry mix tank is self-heated coal from the coal supply hopper that feeds the mix tank. As stated in the discussion of Hazard 3, coal confined in the supply hopper may self-heat but may not ignite in the hopper due to the lack of sufficient oxygen. However, this self-heated coal will ignite when introduced to the atmosphere in the mix tank also causing ignition of the flammable vapors in the tank.

Two abnormal events are required for self-heating of coal in the supply hopper: Failure of the nitrogen addition and failure of the operator to react to a high temperature alarm.

This hazard has the greatest potential for explosion in the system and is considered a catastrophic hazard to personnel and facilities with a probability of 3×10^{-6} . It thus violates the Recommended Guidelines for catastrophic hazards. Addition of a nitrogen purge to the mix tank and the hold tank is recommended and will reduce the incident probability to 3×10^{-9} . The tank should be purged before addition of any material and the purge rate from Table III-1 maintained.

TABLE III-1

MIX TANK AND HOLD TANK PURGE RATES

<u>Pump-Out Rate</u>	<u>Purge Rate</u> (a)(10) (For Each Tank)
0 gpm	3.5 ft ³ /hr
.5 gpm	7.5 ft ³ /hr
1 gpm	11.5 ft ³ /hr
1.5 gpm	15.5 ft ³ /hr
2 gpm	19.5 ft ³ /hr
3 gpm	27.5 ft ³ /hr
4 gpm	35.5 ft ³ /hr
5 gpm	43.5 ft ³ /hr

(a) Assuming 200 mm vent.

3. Flue Gas Treatment System

There are no credible fire or explosion hazards associated with this operation. There is potential for releases of sodium bicarbonate dust, fly ash or low oxygen gas which could cause workplace health hazards.

4. General Considerations

The analysis of consequences to personnel is based on the assumption that adequate means of escape are available in the event of a fire. It should be noted that the test facility is located in a somewhat congested area with other processes nearby and offices overhead. It is recommended that the facility be reviewed to insure that escape routes are available and well marked and that if a fire does occur the offices above can be safely evacuated.

5. Documentation of Identified Process Hazards

Individual identified process hazards are tabulated and documented on "Process Hazards Analysis" fact sheets. The following discussion provides a description and interpretation of each of the column entries on the fact sheets. A blank fact sheet is presented in Figure III-3 for reference.

a. Potential Event and Causative Factors

A description of the potential hazardous event accompanied by a description of the failure(s) which must occur for the event to occur, is entered in the first column. A sequential Hazard Number is assigned to the Potential Events for use in referencing the Table entry in the text of the discussion.

b. Event Probability

The calculated probability of occurrence of the 'Potential Event' described, based on the failure logic as described by 'Causative Factors' is entered in the second column. The calculation procedure is described in Appendix B and the failure data used are documented in Appendix C.

c. Potential Effect and Consequences

A description of the potential affect of the identified event accompanied by a description of the consequences to personnel and/or equipment is entered in the third column. Effects may be such things as equipment rupture, fire/explosion, or release of toxic material. Consequences describe the extent of potential injury/illness to personnel or damage to equipment.

d. Effect Probability (Effect Prob.)

Probability that the stated 'Potential Effect' will occur, given occurrence of the Potential Event, based on engineering analysis and judgment, is entered in the fourth column.

e. Consequence Probability (Conseq. Prob.)

Probability that the stated 'Consequence' will occur, given occurrence of the Potential Event and Potential Effect, based on engineering

SYSTEM: _____

SUBSYSTEM: _____

EQUIPMENT: _____

POTENTIAL EVENT CAUSATIVE FACTORS	EVENT PROB.	POTENTIAL EFFECT CONSEQUENCES	EFFECT PROB.	PERSONNEL			EQUIPMENT			EXISTING CONTROL MEASURES	COMMENTS AND RECOMMENDATIONS
				CONSEQ. PROB.	INC. PROB.	HAZ. CAT.	CONSEQ. PROB.	INC. PROB.	HAZ. CAT.		

Figure III-3. Process Hazards Fact Sheet

analysis and judgment, is entered in the first subcolumn for 'Personnel' or 'Equipment' as appropriate.

f. Incident Probability (Inc. Prob.)

The Incident Probability is obtained by multiplying the 'Event', 'Effect', and 'Consequence' probabilities, and represents the overall probability that the stated consequence will occur due to the indicated hazard.

g. Hazard Category (Haz. Cat.)

Hazard Severity Categories as defined in Table III-2 are entered.

h. Existing Control Measures

Existing measures and safeguards which control or mitigate the hazard are documented.

i. Comments and Recommendations

Recommendations for eliminating, controlling or mitigating the hazard, or comments are entered. Recommendations are mandatory for hazards which violate the Recommendation Guidelines (Table I, page 3).

TABLE III-2

HAZARD SEVERITY CATEGORIES

Hazard Category	Descriptor	Consequences to		
		People	Property	Environment
I	Catastrophic	Death or Permanent Total Disability	Loss of large, expensive Operation or Building(s) or Off-site structure(s).	<u>Large Scale Damage</u> Major cleanup costs or long-term water or soil contamination, potential enforcement action including civil suits or enforced shutdown.
II	Critical	Permanent Partial Disability	Loss of major equipment item(s), some damage to adjacent units, loss of entire small Operation, significant production loss.	<u>Moderate Scale Damage</u> Not sufficient to cause long-term problems, violations of regulations leading to potential enforcement action in the form of fines.
III	Marginal	Temporary Disability	Moderate damage to major equipment item(s), but repairable, minor damage to adjacent units.	<u>Some Damage</u> Incident noticable off-site, minor vegetation damage or fish kill.
IV	Negligible	First Aid Case or None	Minor damage to major equipment item(s), loss of minor equipment item or no damage.	<u>Little or No Damage</u>

TABLE III-3. CTF PROCESS HAZARDS ANALYSIS

PAGE 1 OF 3

SYSTEM: Combustion Test Facility

SUBSYSTEM: Coal Preparation Area

EQUIPMENT: All

POTENTIAL EVENT CAUSATIVE FACTORS	EVENT PROB.	POTENTIAL EFFECT CONSEQUENCES	EFFECT PROB.	PERSONNEL			EQUIPMENT			EXISTING CONTROL MEASURES	COMMENTS AND RECOMMENDATIONS
				CONSEQ. PROB.	INC. PROB.	HAZ. CAT.	CONSEQ. PROB.	INC. PROB.	HAZ. CAT.		
1. Fugitive Coal Dust Release Caused by:		Ignition of dust cloud or layer caused by:								Insulation on ductwork. Electrical equipment is NEC Class II, Divi- sion 1, Group F.	Build-up of dust layers on ductwork or opera- ting equipment should be avoided, particu- larly on duct B from the furnace to the mill. Routine inspection of insula- tion integrity is recommended.
- Maintenance work on system without emptying system or using proper dust con- trol or clean- up methods. or	1×10^{-3}	- Uninsulated por- tion of duct B. or	1×10^{-3}								
- Electrical spark from improperly maintained equip- ment. or		- Overheated bear- ing in mill or fan. or	1×10^{-3}								
- Positive pres- sure in roller mill caused by leak on suction side of main fan (48001F).	1×10^{-5}	- Temperature upset causing over- heating of un- insulated duct or equipment.	2×10^{-5}								Install slide gate valve between cyclone and rotary valve.
			1×10^{-6}								Interlock fans with mill pressure switch.
Overall dust release proba- bility	1×10^{-3}	Overall dust igni- tion probability	2×10^{-3}	4×10^{-3}	8×10^{-9}	II	1	2×10^{-6}	II		

TABLE III-3 (CONT'D.)

PAGE 2 OF 3

SYSTEM: Combustion Test Facility

SUBSYSTEM: Coal Preparation Area

EQUIPMENT: All

POTENTIAL EVENT CAUSATIVE FACTORS	EVENT PROB.	POTENTIAL EFFECT CONSEQUENCES	EFFECT PROB.	PERSONNEL			EQUIPMENT			EXISTING CONTROL MEASURES	COMMENTS AND RECOMMENDATIONS
				CONSEQ. PROB.	INC. PROB.	HAZ. CAT.	CONSEQ. PROB.	INC. PROB.	HAZ. CAT.		
2. Loss of Inerting in the System Caused by:		Ignition of dust within the system caused by:								Nitrogen addition to storage bin, roller mill, supply hopper and baghouse.	Interlock fans with mill pressure switch.
- Air leak into system	1×10^{-5}	- Overheating mill bearing	2×10^{-5}								Do not rely on oxygen analyzer to prevent combustion atmosphere in system.
or		or									
- By-pass valve (48001N) fails closed	5×10^{-5}	- Temperature upset.	1×10^{-3}							Use of low oxygen con- tent combustion for conveying coal. Oxygen analyzer for combustion gas.	Maintain calibration schedule for oxygen meter according to manufacturer's recom- mendations.
or											
- Heater flame failure	1×10^{-4}										
Overall Event Probability	2×10^{-4}	Overall effect probability.	1×10^{-3}	4×10^{-3}	8×10^{-10}	II	1	2×10^{-7}	II		
3. Opening System for Maintenance or Inspection with Coal Temp. over 140°F and exposure to atmosphere longer than 8 hours.	Unde- fined	Self-ignition of coal dust - parti- cularly in baghouse.	1	4×10^{-3}	4×10^{-3}	II	1	1	II		Avoid opening the system for more than 8 hours without first allowing it to cool to 140°F. Purge the system of coal as com- pletely as possible before opening. Check the temperature of the coal upon open- ing the sytem and every 2 hours there- after. Isolate and inert those parts of the system containing coal that do not re- quire attention. If the temperature rises more than 20°F, close the system and inert. If the system must be left unattended for more than 8 hours, iso- late and inert the areas containing coal (particularly the bag- house).

TABLE III-3 (CONT'D.)

PAGE 3 OF 3

SYSTEM: Combustion Test FacilitySUBSYSTEM: Coal Preparation AreaEQUIPMENT: All

POTENTIAL EVENT CAUSATIVE FACTORS	EVENT PROB.	POTENTIAL EFFECT CONSEQUENCES	EFFECT PROB.	PERSONNEL			EQUIPMENT			EXISTING CONTROL MEASURES	COMMENTS AND RECOMMENDATIONS
				CONSEQ. PROB.	INC. PROB.	HAZ. CAT.	CONSEQ. PROB.	INC. PROB.	HAZ. CAT.		
4. No. 2 Fuel Oil Leak from Feed to Furnace (4800IL)	3×10^{-8}	Ignition caused by hot surface of furnace.	1	4×10^{-3}	1×10^{-10}	III	1	3×10^{-8}	III		Inspect oil feed to furnace regularly.

TABLE III-4. CTF PROCESS HAZARDS ANALYSIS

PAGE 1 OF 1

SYSTEM: Combustion Test FacilitySUBSYSTEM: Coal-Oil Slurry Preparation AreaEQUIPMENT: All

POTENTIAL EVENT CAUSATIVE FACTORS	EVENT PROB.	POTENTIAL EFFECT CONSEQUENCES	EFFECT PROB.	PERSONNEL			EQUIPMENT			EXISTING CONTROL MEASURES	COMMENTS AND RECOMMENDATIONS
				CONSEQ. PROB.	INC. PROB.	HAZ. CAT.	CONSEQ. PROB.	INC. PROB.	HAZ. CAT.		
5. Release of Oil or Coal-Oil Slurry Caused by:		Ignition of released material caused by:									Clean up spills im- mediately.
Pump Seal Leak	7×10^{-6}	External coal dust	2×10^{-6}								
or		fire.									
Piping Flange	3×10^{-8}										
Leak											
or											
Failure to Close	1×10^{-3}										
Sample Valve											
or											
Overall Release	1×10^{-3}	Overall ignition	2×10^{-6}	4×10^{-3}	8×10^{-12}	II	1	2×10^{-9}	II		
Probability		probability									
6. Release of Flam- mable Vapor from Tank Vent:		Ignition of released material caused by:								Nitrogen addition to supply hopper.	Add nitrogen purge to tanks. See Table III-1 for recommended rates.
Tank ordinarily operates at 170°F above the flash point of 150°F ; therefore, a flam- mable mixture will exist in the tank vent under normal conditions.		External coal dust	2×10^{-6}							Temperature monitoring of supply hopper.	
		fire.									
		Self-heating coal	1×10^{-6}								
		from the supply									
		hopper.									
Overall release	1	Overall ignition	3×10^{-6}	1	3×10^{-6}	I	1	1×10^{-6}	I		
probability		probability									

C. WORKPLACE HEALTH ANALYSIS

The workplace health hazards associated with this operation are those related to exposure to carbon monoxide, hydrocarbon vapors, oxygen deficient atmospheres, coal dust, and nuisance dust such as sodium bicarbonate and fly ash. The specific hazards and the operations and equipment associated with them are outlined in Table III-6. PETC personnel have indicated that spot surveys in the past have not shown any exposures to any of the above materials beyond their threshold limit values or other recognized standards. Table III-5 lists the materials and standards. Installation of continuous carbon monoxide and oxygen detectors is planned, along with closed circuit TV surveillance of the process area. The recommended action for this area is a comprehensive sampling survey concentrating on dust and hydrocarbon exposures. This survey should consist of area samples covering periods of two to four hours in the areas of highest potential exposure during typical operating conditions. A noise level survey may also be included.

TABLE III-5
POTENTIAL HEALTH HAZARD MATERIALS - CTF

<u>Material</u>	Standards ⁽¹¹⁾ <u>TWA</u> (a)	<u>STEL</u> (b)
Coal Dust	2 mg/m ³ (c)	-
Carbon Monoxide	50 ppm	400 ppm
Nuisance Dust	10 mg/m ³	-
No. 2 Fuel Oil	-	-
No. 6 Fuel Oil	-	-
Noise	85 dBA	115 dBA

(a) 8-Hour Time-Weighted Average

(b) Short Term Exposure Limit

(c) Respirable Dust Fraction <5% SiO₂

TABLE III-6. CTF WORKPLACE HEALTH ANALYSIS

PAGE 1 OF 2

SYSTEM: Combustion Test Facility

SUBSYSTEM: _____

EQUIPMENT: _____

POTENTIAL HAZARD		CONSEQUENCES	EXISTING CONTROL MEASURES	COMMENTS AND RECOMMENDATIONS
EQUIPMENT ITEM OR PROCEDURAL STEP	RANKING			
1. Coal Preparation Area				
a. Exposure to coal dust. Coal pulverizer system.	May occur.	Potential long term health hazard due to silica content. ⁽¹²⁾	Exposure requires upset condition - previous surveys indicate no significant exposures under normal conditions.	Monitoring survey should be performed to verify previous surveys. Require respiratory protection during maintenance and clean-up operations.
b. Exposure to carbon monoxide and/or oxygen deficient atmosphere - coal pulverizer system.	Unlikely	Asphyxiation ⁽¹²⁾	General ventilation provided. Exposure requires upset condition - previous surveys indicate no significant exposures under normal conditions. Continuous monitoring system is planned along with closed circuit TV.	Maintain ventilation system. Maintain instrument calibration schedule.
c. Contact with No. 2 fuel oil or inhalation of vapors - combustion gas heater.	May occur	Contact dermatitis possible; moderate toxicity by inhalation potential carcinogenic hazard. ⁽¹²⁾		Maintain adequate ventilation. Wear face and skin protection.
d. Possible high noise levels. - roller mill.	May occur	Hearing loss. ⁽¹²⁾		Conduct noise survey.

TABLE III-6 (CONT'D.)

PAGE 2 OF 2

SYSTEM: Combustion Test Facility

SUBSYSTEM: _____

EQUIPMENT: _____

POTENTIAL HAZARD		CONSEQUENCES	EXISTING CONTROL MEASURES	COMMENTS AND RECOMMENDATIONS
EQUIPMENT ITEM OR PROCEDURAL STEP	RANKING			
2. Slurry Preparation and Feed Area				
a. Contact with No. 6 fuel oil, or inhalation of vapors. - mix tank, hold tank.	May occur	Contact dermatitis possible, toxicity unknown. Possible burns from hot liquid.(12)	General ventilation provided.	Require gloves and face shield during sampling. Monitoring survey should be performed to verify previous survey.
3. Flue Gas Treatment Area				
a. Exposure to sodium bicarbonate dust or fly ash. - sodium bicarbonate storage bin, fly ash, baghouse.	May occur	Nuisance dust hazard.(12)	General ventilation provided.	Use respiratory protection when handling.

D. WORKPLACE SAFETY ANALYSIS

The Workplace Safety Analysis is a constituent analysis of the overall safety analysis which addresses potential occupational injury hazards of the operation under normal operational conditions.

Identified potential occupational injury hazard for the Combustion Test Facility relate to rotating equipment, electrical equipment and high temperature surfaces. These hazards are documented in Table III-7 and discussed in the paragraphs below.

1. Rotating Equipment

Rotating equipment in this area includes pumps, fans, agitators and the roller mill. It is recommended that an audit be conducted to insure that all equipment is guarded, and that periodic inspections be made to insure all guards are in place.

2. High Temperature Surfaces

The bulk of the equipment in the Combustion Test Facility operates in excess of 150°F. Insulation integrity should be maintained and warning signs should be posted around areas where insulation is not practical.

3. Electrical Hazards

Electrical equipment in the Combustion Test Facility includes motor drives and associated wiring for such items as pumps, fans, rotary valves and the roller mill and control and instrumentation wiring. Equipment in the pulverizer area is specified as Class II, Division 1, Group F. Operators and maintenance personnel should be cognizant of the hazards associated with the types of equipment installed and should take proper precautions when maintenance, repair, or disassembly/assembly of equipment is required. Improper maintenance electrical equipment in the pulverizer can provide an ignition source for coal dust.

TABLE III-7. CTF WORKPLACE SAFETY ANALYSIS

PAGE 1 OF 1

SYSTEM: Combustion Test Facility

SUBSYSTEM: _____

EQUIPMENT: _____

POTENTIAL HAZARD		CONSEQUENCES	EXISTING CONTROL MEASURES	COMMENTS AND RECOMMENDATIONS
EQUIPMENT ITEM OR PROCEDURAL STEP	RANKING			
1. Pumps, Agitators, Fans, Roller Mill Rotary Valves, Screw Conveyor				
a. Potential for unguarded rotating equipment.	Unlikely	Operator injury if rotating element is contacted.	Equipment is enclosed or guarded.	Unit should be inspected prior to operation to ensure equipment is guarded and guards are in place.
2. Ductwork, Furnace, Slurry Mix and Hold Tanks, Flue Gas System and Ancillaries.				
a. High temperature metal surfaces.	May occur	Burn to personnel on contact with hot metal surface.	Insulation on most hot surfaces.	Maintain insulation integrity, areas which cannot be insulated should be clearly identified and labeled with appropriate warning signs.
3. Electrical Equipment				
a. Electric shock.	Unlikely			

E. ENVIRONMENTAL ANALYSIS

The magnitudes of the effluents from this facility are not sufficient to significantly impact the environment under normal conditions. However, upset conditions such as oil spills and fugitive dust releases can result in environmental problems. The spill response plans for the Bruceton Reserach Center are excellent from the standpoint of reaction to a spill that has occurred. The recommendation here is that the plans be reviewed with emphasis on prevention of spills and containment of spills before they reach the sewer system. Such a review should consider that coal fines will float and will contribute to visible pollution as well as suspended solids loading. Fugitive dust releases can be controlled by good housekeeping and careful operation. Environmental releases are documented in Table III-8.

TABLE III-8. CTF ENVIRONMENTAL ANALYSIS

PAGE 1 OF 1

SYSTEM: Combustion Test Facility

SUBSYSTEM:

EQUIPMENT:

MATERIAL RELEASE IDENTIFICATION CONSTITUENTS	TYPE OF RELEASE	QUANTITY	EXISTING CONTROL MEASURES	COMMENTS AND RECOMMENDATIONS
1. Flue Gas Containing SO ₂ , NO _x , CO, Particulates.	Vented to atmosphere.	20 lb/hr SO ₂ , small quantities of other materials.	Treatment with sodium bicarbonate for SO ₂ removal. Baghouse for particulate removal.	Magnitude is not sufficient to present a significant problem.
2. Miscellaneous Water Discharge.	Pump seal water, washdown and surface runoff.	Not defined. Total flow for DOR labs is 100 gpm.		Magnitude is not sufficient to present a significant emission problem.
3. Fugitive Emissions.	Oil spills, dust releases resulting from upset conditions.	Variable.	Spill control plan.	Plan should have more emphasis on prevention of spills.
4. Solid Waste.	Flue gas baghouse discharge.	166 lb/hr total containing ash, sodium bicarbonate sodium sulfate.	Collected for disposal.	

REFERENCES

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2. "Management Implementation Plan for a Safety Analysis and Review System," Report No. A08639-520-03-007, Hercules Aerospace Division, Hercules Incorporated, Allegany Ballistics Laboratory, April 1981.
3. WASH-1400, "Reactor Safety Study," Appendix III - Failure Data, U.S. Nuclear Regulatory Commission, October 1975.
4. Lees, F. P., et al, "Some Data on the Reliability of Instruments in the Chemical Plant Environment," The Chemical Engineer, London, 255, pp. 396-402, November 1971.
5. Bush, S. H., "Pressure Vessel Reliability," Journal of Pressure Vessel Technology, February 1975.
6. "The Flammability of Coal Dust-Air Mixtures," Bureau of Mines, RI 8360, 1979.
7. Hertzberg, M., C. D. Litton, and R. Garloff, "Studies of Incipient Combustion and Its Detection," Bureau of Mines, RI 8206, 1977.
8. Kuchta, J. M., V. R. Rowe, and D. S. Burgess, "Spontaneous Combustion Susceptibility of U.S. Coals," Bureau of Mines, RI 8474, 1980.
9. Fire Protection Guide on Hazardous Materials, National Fire Protection Association, Fifth Edition, 1973.
10. Bodurtha, R. T., Industrial Explosion Prevention and Protection, McGraw Hill Book Company, 1980.
11. Threshold Limit Values for Chemical Substances and Physical Agents in Workroom Environment, American Conference on Governmental and Industrial Hygienists, 1980.
12. Sax, N. Irving, Dangerous Properties of Industrial Materials, Fifth Edition, Van Nostrand Reinhold Co., 1979.

APPENDIX A
SYSTEM DOCUMENTATION

1. Engineering Drawings

<u>Drawing No.</u>	<u>Date</u>	<u>Rev.</u>	<u>Title</u>
D-7010	12-9-77	1	Bldg. 93 - Plot Plan
D-7011	12-9-77	2	Bldg. 93 - First Floor Plan
D-7012	8-22-77	-	Bldg. 93 - Partial Plans
D-7013	10-7-77	1	Bldg. 93 - Roof Plan
D-7014	12-9-77	2	Bldg. 93 Section A
D-7015	19-11-77	1	Bldg. 93 Section B
D-7016	12-9-77	2	Bldg. 93 Partial Plan & Section C
D-7017	10-7-77	1	Bldg. 93 Sections E and F
D-7018	3-3-77	-	Bldg. 93 Partial Plan & Elevation G
D-7019	12-9-77	1	Bldg. 93 Details
D-7020	10-11-77	1	Bldg. 93 Duct Assemblies
D-7021	10-11-77	1	Bldg. 93 Partial Plans & Sections
D-7022	10-7-77	1	Bldg. 93 Duct Assemblies
D-6981	1-21-81	1	Bldg. 93 P&I Identification Legend
D-6982	10-17-80	1	Bldg. 93 P&I Diagram
D-6983R	1-20-80	-	Fuel Delivery System Flow Diagram
D-6984	1-8-80	1	Bldg. 93 P&I Diagram
D-6985	1-21-81	1	Bldg. 93 P&I Diagram
D-6986	10-17-80	1	Bldg. 93 P&I Diagram
D-6987	10-28-80	1	Bldg. 93 P&I Diagram
D-6988	11-26-80	1	Bldg. 93 P&I Diagram
D-7034	9-9-77	9	Bldg. 93 Process Flow Diagram
D-7117	1-23-81	-	Bldg. 93 Safety Modifications

2. Equipment and Procedures Data

Instructions - North American Mfg. XS Air Dual Fuel Burners
 Safety Procedures for Operation of Williams Equipment
 Coal Pulverizer Sequence of Operation
 Boiler Operating Procedures - 700 h.p. CTF
 CTF Inspection and Maintenance Program
 700 h.p. Control Room Instrumentation
 Facility Inspection Report
 Miscellaneous Operation Description
 Best Management Practices Program Plan

3. Miscellaneous Data

Process Equipment Photographs

APPENDIX B

ANALYSIS METHODOLOGY

This appendix documents the general methodologies used to conduct the Safety Analysis. Discussion is presented for the four analysis components: process hazards, safety concerns, health concerns, and environmental concerns.

A. Process Hazards Analysis

The process hazards analysis was conducted in a four-step approach: (1) Hazards Identification, (2) Hazards Quantification, (3) Consequence Assessment, and (4) Design and Operating Criteria recommendations.

1. Hazards Identification

Hazards identification begins with system familiarization by the analyst to develop an intimate understanding of the process, of how it is intended to function, and of the important process variables. System familiarization consists of a review of process documentation, an on-site visit, and discussions with operations, engineering, and management personnel.

Potential hazards are identified by a systematic analysis of the system documentation; e.g., process flow diagrams, equipment drawings and data, material and energy balances, and operating procedures. Several techniques are used in the systematic analysis. The basic technique is usually identification by inspection, which is supplemented by the additional techniques of FMEA and logic modeling. This approach is preferred to rigid adherence to any single methodology. A straight FMEA is undesirable for the following reasons. First, each individual component may have numerous modes of failure, only several of which may represent potential hazards. Potential hazards are likely to get 'lost' or 'buried' among the many other line items in a FMEA. Second, the FMEA considers hazards arising from single failures only. Third, the logic of a FMEA is inductive rather than deductive. It thus becomes divergent rather than convergent in terms of thought processes and analysis 'bookkeeping.' A FMEA is useful for identifying hazards arising from single component failures, or for establishing cause and effect relationships in an equipment item, but is not preferred as a sole method or means of documenting an analysis.

Identification by inspection is the primary techniques used in the analysis. Potential hazards are identified from a detailed analysis which proceeds equipment item by equipment item, or by operational procedure. Causative factors (single or multiple component failures or operator errors) are determined by inspection of the system documentation. If equipment or control systems are particularly complex, logic-modeling techniques are used to develop the causative factor failure logic. Logic modeling is a rigorous and time-consuming technique, and therefore relatively expensive. Judicious application of logic modeling is therefore indicated to ensure it is cost-effective. Therefore, logic modeling is normally used as a supplementary technique, unless the size, complexity, or other considerations indicate otherwise.

Identified hazards are documented on a 'fact sheet' and entered as a description of a potential hazardous event, accompanied by a description of the causative factors (failure logic) required for the event to occur. A description of the potential effect(s) of the event is also documented.

2. Hazards Quantification

Identified potential hazardous events are quantified by applying failure data to the causative factor failure logic. Use of failure data based on actual operating experience, and which takes into account the operating environment and severity of service is used wherever possible.

Mathematically, failure probabilities are based on exponential distributions (unless otherwise indicated) and are given by

$$P_f = 1 - e^{-\lambda t} \approx \lambda t$$

λ = failure rate
 t = operating time

Certain failures may be time independent or data may be in terms of 'per demand' or 'per operation' and are handled accordingly.

Failure probabilities for multiple failures related by 'AND' Logic are determined by the product of the individual probabilities. For 'OR' Logic, the overall probability is approximated by the sum of the individual probabilities.

Effect probabilities for effects such as 'fire/explosion' or 'rupture' are determined from an engineering analysis which compares the potential of the process or event to the response required to produce the undesired effect in the same engineering terms (e.g., vessel pressure if potential event occurs versus pressure rating; or ignition source energy level versus minimum ignition energy of material). Quantification may be based on a probit analysis if probit data are available, or on a safety factor approach. If insufficient material data or design detail exists, and it is deemed not cost effective to develop the data, conservative effect probabilities are used. Should this result in an unacceptable hazard, then one alternative is to expend effort to develop data to determine the credibility of the effect.

Incident probabilities are calculated by multiplying the probabilities for occurrence of the event, the effect, and the specific consequences.

3. Consequence Assessment

The severity of the consequences of potential hazards are assessed, considering such factors as size and construction of equipment, quantity or flow rate of materials and their properties, location and layout of equipment, numbers and location(s) of personnel, and existing safeguards or mitigating factors. Hazard severity categories are assigned based on this assessment.

4. Design and Operating Criteria

Recommendations are provided for all identified incidents which violate specified risk criteria or recommendation guidelines. Recommendations are based on analyst knowledge of the causative factors, failure probabilities, process potentials and material response data. Recommendations may also be provided to further reduce the likelihood or severity of hazards, even though they meet the established criteria or guidelines. Recommendations may take the form of equipment substitution, design changes, procedural changes, or other engineering or administrative controls.

B. Safety Hazards

Work place safety hazards are identified by inspection of documentation and on-site review, and is usually based upon and builds upon information and knowledge generated during the process hazards analysis.

Specific attention is given to operator-equipment interaction, manual process operations, and potential equipment hazards. The work place safety analysis is intended to focus on process related hazards and is not intended to be or represent a complete OSHA compliance inspection or audit.

An assessment of likelihood and severity is made. Existing safeguards and controls are documented. Recommended control measures and comments are provided.

C. Health Hazards

Work place health hazards are identified by inspection of documentation and on-site review, and is usually based on information and knowledge developed in the course of the process hazards analysis. Potentially hazardous materials in use or likely to be generated in the process are identified and documented. Potential sources and modes of operator exposure are identified by inspection and an assessment of likelihood and consequences is made based on system design or procedure, quantity or rate of material, existing control methods, and monitoring data, if available. Recommendations for additional engineering controls, personal protective equipment, or monitoring are made based on the hazard evaluation. The work place health analysis is not intended to be a full-fledge occupational health, hygiene and monitoring program; but is intended to identify areas where attention should be focused and where controls, monitoring or personal protective equipment may be indicated.

D. Environmental Hazards

Environmental hazards are identified by inspection of documentation and monitoring data, where available, and is usually based on information and knowledge developed in the course of the process hazards analysis. Releases of material from the process are identified and characterized. Existing control measures are evaluated and documented. Recommendations for additional control measures or monitoring are developed as deemed advisable. The Environmental Analysis is not intended to represent a complete Environmental Impact Statement, but is intended as a check on the basis of the EIS, where applicable and data exist, as an aid to identifying areas where attention and monitoring should be focused to correct problems or determine if violations exist, or to document that violation, in fact do not exist.

APPENDIX C

FAILURE RATE DATA

The following failure rate data were used in quantifying hazards identified in the analysis.

Item	Failure Rate ⁽¹⁾	Source ⁽²⁾
Manual Valves		
Wrong Position	$1 \times 10^{-3}/D$	H
Plugged - clean(3)	$3 \times 10^{-4}/D$	W
- dirty	$3 \times 10^{-3}/D$	E
- slurry	$3 \times 10^{-2}/D$	E
External leak - liquid	$3 \times 10^{-8}/H$	W
- gas	$3 \times 10^{-6}/H$	E
Internal leak - clean	$2 \times 10^{-5}/H$	GB
- dirty	$1 \times 10^{-4}/H$	E
- slurry	$1 \times 10^{-3}/H$	E
Check Valves		
Fail to open	$3 \times 10^{-4}/D$	W
Reverse leak - clean	$1 \times 10^{-6}/H$	W
- dirty	$1 \times 10^{-5}/H$	E
- slurry	$1 \times 10^{-4}/H$	E
External leak - liquid	$3 \times 10^{-8}/H$	W
- gas	$3 \times 10^{-6}/H$	E
Air-Operated Valves		
Fail to operate	$1 \times 10^{-3}/D$	W
Plugged - clean	$3 \times 10^{-4}/D$	W
- dirty	$3 \times 10^{-3}/D$	E
- slurry	$3 \times 10^{-2}/D$	E
External leak - liquid	$3 \times 10^{-8}/H$	W
- gas	$3 \times 10^{-6}/H$	E
Internal leak - clean	$2 \times 10^{-5}/H$	L
- dirty	$1 \times 10^{-4}/H$	L
- slurry	$1 \times 10^{-3}/H$	E
Solenoid Valves		
Fail to operate	$3 \times 10^{-3}/D$	W
Internal leak - clean	$2 \times 10^{-5}/H$	L

APPENDIX C (CONT'D.)

<u>Item</u>	<u>Failure Rate⁽¹⁾</u>	<u>Source⁽²⁾</u>
Relief Valves		
Fail to open	$3 \times 10^{-5}/D$	W
Open prematurely	$3 \times 10^{-5}/H$	W
Leak	$2 \times 10^{-5}/H$	L
Pipe Rupture	$3 \times 10^{-9}/H$	W
Relays		
Fail to energize	$3 \times 10^{-4}/D$	W
N.O. contacts fail to close	$1 \times 10^{-6}/H$	W
Short across NO/NC contacts	$3 \times 10^{-8}/H$	W
Open NC contact	$3 \times 10^{-7}/H$	W
Pressure Switch		
Fail to operate	$3 \times 10^{-4}/D$	W
Pressure Vessel		
Catastrophic failure-noncorrosives	$5 \times 10^{-9}/H$	P
Rupture Disc	$5 \times 10^{-6}/H$	L
Pressure Regulator	$2 \times 10^{-4}/H$	
Temperature Measurement		
Thermocouple	$6 \times 10^{-5}/H$	L
Transducer	$1 \times 10^{-4}/H$	L
Solid State Relay	$2 \times 10^{-6}/H$	

(1) Failure Rates - Failures per demand on operator (D), or failures per operating hour (H).

(2) Sources - W --WASH 1400, Reference 3.
 E - Base failure rate adjusted for service environment.
 L - F. P. Lees, et al., Reference 4.
 P - Pressure vessel reliability, Reference 5.
 H - Several operator error failure rate, Hercules Data Bank.

(3) Streams - Clean - cooling water, instrument air, N₂, H₂, etc.
 Dirty - process fluid
 Slurry - process slurry

APPENDIX D

PRESCRIBED STANDARDS

DOE has adopted certain operational environment, safety, and health standards. These are classified as either prescribed standards or recommended standards. Prescribed standards define minimum requirements with which DOE and its contractors must comply, while recommended standards are those which shall be considered for guidance. Prescribed standards are presented for different classifications or types of hazards. Those, which in our judgment, are likely to be applicable to coal conversion processes, as opposed to other types of operations or facilities in general, are identified below. Specific standards which appear to be specifically or directly applicable are further identified by an asterisk (*).

EMERGENCY PREPAREDNESS

- (1) Executive Order 11490, Assigning Emergency Preparedness Functions to Federal Departments and Agencies, and Amendments
- (2) Emergency Planning, Preparedness and Response Program, Chapter 0601 and Appendix 0601.
- (3) Damage Assessment, Chapter 0621 and Appendix 0621.
- (4) Facilities General Design Criteria, Chapter 6301 and Appendix 6301.
- (5) Telecommunications, Chapter 0270 and Appendix 0270, Part VIII.
- (6) DOE Response to Accidents Involving Nuclear Weapons in the Custody of the DOD, Chapter 0527 and Appendix 0527.
- (7) Prevention of Accidental or Unauthorized Nuclear Detonations, Chapter 0460.
- (8) Immediate Evacuation Signal for Use in Industrial Installations Where Radiation Exposure May Occur, ANSI N 2.3-1967 (ANSI).

ENVIRONMENTAL PROTECTION

- *(1) Prevention, Control, and Abatement of Air and Water Pollution, Chapter 0510 (DOE IAD 0510-1), Implementing Executive Order 11752, Prevention, Control, and Abatement of Environmental Pollution at Federal Facilities, and the Following Standards, Regulations, and Guidelines Promulgated Pursuant to Federal Environmental Legislation:

APPENDIX D (CONT'D.)

ENVIRONMENTAL PROTECTION (CONT'D.)

(1) (a) Air

- 1 New Source Performance Standards (40 CFR 60)
- *2 National Hazardous Air Pollutant Standards (40 CFR 61).
- 3 Regulations Designating Air Quality Control Regions (40 CFR 81).

(b) Water

- *1 Discharge of Oil (40 CFR 110).
- *2 Oil Pollution Prevention (40 CFR 112)
- *3 National Oil and Hazardous Substances Contingency Plan (40 CFR 1510)
- *4 Water Quality Standards Approved by the Federal Government (40 CFR 120)
- *5 Thermal Discharges (40 CFR 122)
- *6 Policies and Procedures for the National Pollutant Discharge Elimination System (40 CFR 125)
- *7 Pretreatment Standards (40 CFR 128)
- 8 Secondary Treatment Information (40 CFR 133)
- 9 Transportation for Dumping, and Dumping of Material Into Ocean Waters (40 CFR 220-226)
- 10 Best Technology Available for the Design, Construction, and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact (40 CFR 401 and 40 CFR 402)

(c) Drinking Water

- 1 Interim Primary Drinking Water Regulations (40 CFR 141)
- 2 Interim Primary Drinking Water Regulations Implementation (40 CFR 142)

(d) Solid Waste

- *1 Thermal Processing of Solid Wastes and Land Disposal of Solid Wastes (40 CFR 240 and 241)
- *2 Solid Waste Storage and Collection (40 CFR 243)

(e) Radiation

- 1 Standards and Requirements for Radiation Protection, DOE 0524
- 2 Performance Testing and Procedural Specifications for Thermoluminescence Dosimetry (Environmental Applications) ANSI N 545-1975 (ANSI)

APPENDIX D (CONT'D.)

ENVIRONMENTAL PROTECTION (CONT'D.)

(1) (f) Pesticides

- 1 Environmental Safeguards on Activities for Animal Damage Control on Federal Lands (Executive Order 11643)
 - 2 Regulations for Enforcement of the Federal Insecticide, Fungicide, and Rodenticide Act (40 CFR 162)
 - 3 Regulations for the Acceptance of Certain Pesticides and Recommended Procedures for the Disposal and Storage of Pesticides and Pesticides Containers (40 CFR 165)
 - 4 Exemption of Federal and State Agencies for Use of Pesticides Under Emergency Conditions (40 CFR 166)
 - 5 Worker Protection Standards for Agricultural Pesticides (40 CFR 170)
 - 6 Certification of Pesticide Applicators (40 CFR 171)
- *(2) Interstate or Interstate Regulations of Environmental Protection Authorities.
- *(3) Effluent and Environmental Monitoring and Reporting, Chapter 0513.
- (4) Standards and Requirements for Radiation Protection, Chapter 0524.

FIRE PROTECTION

- *(1) Industrial Fire Protection, Chapter 0552
- *(2) General Design Criteria, Chapter 6301
- *(3) National Fire Codes (NFPA)
- (4) Standard for Fire Protection of AEC Electronic Computer Data Processing Systems. WASH 1245-1 (Compliance With this Standard Satisfies the Requirements for NFPA-75.)
- *(5) Lists of Inspected Appliances, Equipment, and Materials (UL)
- *(6) Factory Mutual Approval Guide (FM)
- (7) TP20-11 General Fire Fighting Guidance for Nuclear Weapons

APPENDIX D (CONT'D.)

HEALTH PROTECTION

a. Radiation Protection

- (1) Standards and Requirements for Radiation Protection, Chapter 0524
- (2) Occupational Radiation Exposure Information, Chapter 0525
- (3) Performance Specifications for Direct Reading and Indirect Reading Pocket Dosimeters for X and Gamma Radiation, ANSI N13.5-1972 (ANSI)
- (4) Radiation Symbol, ANSI N2.1-1969 (ANSI)
- (5) Radiological Safety in the Design and Operation of Particle Accelerators, ANSI N43.1-1969 (ANSI)
- (6) Specification and Performance of Onsite Instrumentation for Continuously Monitoring Radioactivity in Effluents, ANSI N13.10-1974
- (7) Personnel Neutron Dosimeters (Neutron Energies Less than 20 MeV), ANSI N319-1976
- (8) Implant Plutonium Monitoring for Personnel Protection, ANSI N317-1977
- (9) "Standards for the Unrestricted Release of Radioactively Contaminated Equipment and Facilities," ANSI N328
- (10) "Inspection and Test Specifications for Direct and Indirect Reading Quartz Fiber Pocket Dosimeters," ANSI N322-1977.

b. Occupational Medicine

- *(1) Occupational Medical Program, Chapter 0528
- *(2) DOE Employee Occupational Health Services Program, DOE 4161.

c. Industrial Hygiene

- *(1) Current Threshold Limit Values (ACHIH)
- *(2) Practices for Respiratory Protection, ANSI Z88.2-1969 (ANSI)

d. Public Health and Sanitation

Food

- (1) "Food Service Sanitation Manual," USPHS Publication No. 934 (1962)
- (2) "The Vending of Food and Beverages," USPHS Publication No. 546 (1965)

APPENDIX D (CONT'D.)

HEALTH PROTECTION (CONT'D.)

d. Public Health and Sanitation (Cont'd.)

Water

- (1) National Primary Drinking Water Regulations, 49 CFR 141, USEPA (1975)
- (2) "Manual for Evaluating Public Drinking Water Supplies," USEPA Publication No. 1820 (1971)
- (3) "Manual of Individual Water Supply Systems, USEPA Publication No. 430 9/73-003 (1975)
- (4) "Quality Standards for Bottled Water," USEPA (1973) 21 CFR 11
- (5) "A Sanitary Standard for Manufactured Ice," USPHS 1183 (1964)
- (6) GSA Handbooks on Performance Standards for Cleaning Public Buildings (General Services Administration).

OCCUPATIONAL SAFETY

a. General Safety

- *(1) General Design Criteria, Chapter 6301
- (2) Forest Service Safety Standards (USDA)
- *(3) Boiler and Pressure Vessel Code; Sections I-XI (ASME)

b. Construction Safety

- (1) Construction Safety Program, Chapter 0505
- (2) Pipeline Safety Standards Title 49 CFR Part 192

c. Crane Safety

- *(1) ANSI Series B 30.2 Through B 30.9 (ANSI)
- *(2) Crane Manufacturers Association of America, Specification No. 70 (CMAA)

d. Drilling Safety

- (1) Petroleum Safety Orders, Administrative Code, Title 8, Chapter 4, Subchapter 14, State of California (Except the Requirements of Paragraph (b) Section 6640, of Article 41 of the 1959 Orders is Permanently Waived-API RP 98 Applies)
- (2) Applicable Division of Production Specifications and Recommended Practices on Oil Field Equipment (API)
- (3) Safe Practices in Drilling Operations, Third Edition, 1967 RP 2010 (API)

APPENDIX D (CONT'D.)

e. Electrical Safety

- *(1) National Electrical Code, NFPA 70 (ANSI-C1)
- *(2) National Electrical Safety Code (ANSI-C2)

f. Explosives Safety

- (1) Safety Manual, AMCR 385-100, U. S. Army Materiel Development and Readiness Command
- (2) DOD Ammunition and Explosives Safety Standards, DOD 4145.27M (DOD)
- (3) Blaster's Handbook (DuPont)

g. Firearm Safety

- (1) Physical Protection Handbook (GSA-)
- (2) Pistols and Revolvers, FM 23-35, 7-60 (AMC)
- (3) Safety With Firearms Handbook (NRA)
- (4) Firearms Handling Handbook (NRA)

h. Mine and Tunnel Safety

- (1) Federal Metal and Nonmetallic Mine Safety Act, Public Law 89-5771, Standards, 30 CFR 55, 56, 57
- (2) Tunnel Safety Orders, Administrative Code, Title 8, Chapter 4, Subchapter 20, State of California
- (3) Mine Safety Orders, Administrative Code, Title 8, Chapter 4, Subchapter 12, State of California

APPENDIX E

SAFETY ANALYSIS REQUIREMENT DETERMINATION

For illustrative purposes, the technical sections of the Safety Analysis Requirement Determination have been completed and are included in the following pages.

SAFETY ANALYSIS REQUIREMENT DETERMINATION

SUMMARY AND SIGNATURES

OPERATION: COMBUSTION TEST FACILITYSub-Operation (if any): 700 H. P. NEBRASKA BOILER

1. SAR not required (Check as applicable)

- ☐ Solely construction activity
- ☐ Nuclear safety of weapon designs
- ☐ Contract, PETC/DOE will not assume ES&H responsibility

If any checked, proceed to Step 6.

2. SAR may be Required (Check as applicable)

- ☒ Contract, PETC/DOE will assume ES&H responsibility
- ☐ In-House operation

3. Complete Sheet 2 and attach

- ☒ SA not required. Go to Step 6.
- ☐ SA is required. Go to Step 4.

4. Complete Sheet 3 and attach.

Level _____ SA required

5. Complete Sheet 4 and attach

Cost estimate \$ _____

- ☐ New operation (SAR must be complete before operation commences)
- ☐ Pre-existing facilities. Should SAR be completed before facility put to next use?
- ☐ YES ☐ NO

6.

Signature of preparer_____
Title_____
Date

7.

☐ Concur☐ Do not concur_____
Signature of reviewer_____
Title_____
Date

Reasons and Comments:

SAFETY ANALYSIS REQUIREMENT DETERMINATION

HAZARDS GENERALLY ENCOUNTERED/ACCEPTED

OPERATION: COMBUSTION TEST FACILITYSub-Operation (if any) 700 H.P. NEBRASKA BOILER

1. Answer the following for the operation		YES	NO
• Any operating temperatures above 120°F or below -20°F?		☒	☐
• Any operating pressures above 15 psig or below ambient?		☒	☐
• Any equipment rotating above 4000 rpm?		☐	☒
• Any materials with NFPA Health Hazard Rating of 2 or above?		☐	☒
• Any materials with NFPA Flammability Rating of 2 or above?		☒	☐
• Any materials with NFPA Reactivity Rating of 2 or above?		☐	☒
• Any tools and/or equipment not typically found in the home or office?		☒	☐
• Any sources of ionizing radiation other than instrumentation?		☐	☒
• Any other factor(s) which indicate(s) a SA is needed		☐	☒
☐ All of the above checked NO. SA is not required			
☒ Some of the above checked YES. Proceed to Step 2			

2. Certain DOE operations may involve equipment and/or materials which result in an answer of YES in Step 1, but which represent only hazards of a type or magnitude which are routinely encountered and/or accepted by the public. Check as applicable:

☐ Motor vehicle operation, maintenance (types of vehicles used by the general public)	☐ Small quantities (≤5 gallons) of commercial fuels and lubricants used solely in operation of machinery and vehicles
☐ Kitchen and domestic appliances	☐ Office equipment
☐ Portable power tools	☐ Domestic water systems
☐ Machine shop equipment	☐ Domestic hot water systems
☐ Portable electric heaters	
☒ Utility boilers which meet the following conditions: Built, instrumented, inspected, and tested to ASME Code Capacity: ≤250,000 lb/hr at ≤250 psig	
☐ Other - Identify:	

3. Considering the exclusions of Step 2, are there any items in Step 1 which are still answered YES?

☐ YES SA is required ☒ NO SA is not required

4. _____

Signature of preparer Date

SAFETY ANALYSIS REQUIREMENT DETERMINATION

SUMMARY AND SIGNATURES

OPERATION: COMBUSTION TEST FACILITYSub-Operation (if any): NA

1. SAR not required (Check as applicable)

- ☐ Solely construction activity
- ☐ Nuclear safety of weapon designs
- ☐ Contract, PETC/DOE will not assume ES&H responsibility

If any checked, proceed to Step 6.

2. SAR may be Required (Check as applicable)

- ☒ Contract, PETC/DOE will assume ES&H responsibility
- ☐ In-House operation

3. Complete Sheet 2 and attach

- ☐ SA not required. Go to Step 6.
- ☒ SA is required. Go to Step 4.

4. Complete Sheet 3 and attach.

Level 2 SA required

5. Complete Sheet 4 and attach

Cost estimate \$ _____

- ☒ New operation (SAR must be complete before operation commences)
- ☐ Pre-existing facilities. Should SAR be completed before facility put to next use?
- ☐ YES ☐ NO

6.

Signature of preparer

Title

Date

7.

☐ Concur☐ Do not concur

Signature of reviewer

Title

Date

Reasons and Comments:

SAFETY ANALYSIS REQUIREMENT DETERMINATION

HAZARDS GENERALLY ENCOUNTERED/ACCEPTED

OPERATION: COMBUSTION TEST FACILITYSub-Operation (if any) NA

1. Answer the following for the operation		YES	NO
• Any operating temperatures above 120°F or below -20°F?		☒	☐
• Any operating pressures above 15 psig or below ambient?		☒	☐
• Any equipment rotating above 4000 rpm?		☐	☒
• Any materials with NFPA Health Hazard Rating of 2 or above?		☐	☒
• Any materials with NFPA Flammability Rating of 2 or above?		☒	☐
• Any materials with NFPA Reactivity Rating of 2 or above?		☐	☒
• Any tools and/or equipment not typically found in the home or office?		☒	☐
• Any sources of ionizing radiation other than instrumentation?		☐	☒
• Any other factor(s) which indicate(s) a SA is needed		☐	☒
☐ All of the above checked NO. SA is not required			
☒ Some of the above checked YES. Proceed to Step 2			

2. Certain DOE operations may involve equipment and/or materials which result in an answer of YES in Step 1, but which represent only hazards of a type or magnitude which are routinely encountered and/or accepted by the public. Check as applicable:

☐ Motor vehicle operation, maintenance (types of vehicles used by the general public)	☐ Small quantities (≤5 gallons) of commercial fuels and lubricants used solely in operation of machinery and vehicles
☐ Kitchen and domestic appliances	☐ Office equipment
☐ Portable power tools	☐ Domestic water systems
☐ Machine shop equipment	☐ Domestic hot water systems
☐ Portable electric heaters	
☒ Utility boilers which meet the following conditions: Built, instrumented, inspected, and tested to ASME Code Capacity: ≤250,000 lb/hr at ≤250 psig	
☐ Other - Identify:	

3. Considering the exclusions of Step 2, are there any items in Step 1 which are still answered YES?

☒ YES SA is required ☐ NO SA is not required

4. _____

Signature of preparer Date

SAFETY ANALYSIS REQUIREMENT DETERMINATION

LEVEL OF ANALYSIS

OPERATION: COMBUSTION TEST FACILITYSub-Operation (if any) NA

1. Short description: UNIT USED FOR TESTING VARIOUS CONCENTRATIONS OF COAL-OIL SLURRIES IN A COMMERCIAL BOILER ☐ State-of-the-Art ☒ Advanced Technology		
2. Type of operation ☐ Non-chemical ☐ Laboratory ☐ Bench-scale ☐ PDU ☒ Pilot plant ☐ Demonstration ☐ Commercial	3. Materials in use ☒ Explosive ☒ Flammable ☒ Toxic ☐ Corrosive ☒ Erosive ☐ None of the above	4. Personnel exposure ☐ Remote operation ☒ Occasionally exposed ☐ Frequently exposed ☐ Normally exposed
5. Operating parameters: Other considerations: Thruput or batch size <u>UP TO 2000 LB/HR OF COAL -</u> Operating temperature range <u>UP TO 950°F</u> Operating pressure range <u>UP TO 210 PSIG</u>		
6. Considering the type of operation, process, materials, personnel and siting factors, assign a Level of SA based on consequences of potential incidents as follows: <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>Non-chemical or laboratory unit:</div> <div>Level 1</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>Bench-scale unit:</div> <div>Level 1 or 2 using criteria below</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>Process development unit:</div> <div>Level 1, 2 or 3 using criteria below</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>Pilot plant:</div> <div>Level 2 or 3 using criteria below</div> </div> <div style="display: flex; justify-content: space-between; margin-top: 10px;"> <div>Demonstration or Commercial Units</div> <div>Level 3</div> </div>		
<div style="border: 1px solid black; display: inline-block; padding: 2px 5px; margin-bottom: 10px;">CRITERIA</div> <div style="margin-left: 40px;"> Level 3 - Potential for major off-site impacts Level 2 - Potential for permanent disability or death, or significant equipment/facility loss on-site Level 1 - Negligible potential for serious injury, and loss of equipment not a major concern </div>		
Based on the above, a Level 2 SA is assigned. (Highest level which applies)		
7. <div style="display: flex; justify-content: space-between; margin-top: 20px;"> <div style="width: 60%;"> Signature of preparer </div> <div style="width: 35%;"> Date </div> </div>		

SAFETY ANALYSIS REQUIREMENT DETERMINATION

BUDGETARY COST ESTIMATE

OPERATION: COMBUSTION TEST FACILITYSub-Operation (if any) NA

1. Complete this Step for backfit operations only, otherwise go to Step 2.

A. Operating experience

Years _____

Use _____

B. Previous Analysis

☐ None applicable☐ Qualitative☐ Quantitative

C. Accident experience

☐ No significant accident☐ Disabling injury☐ Facility damage☐ FatalityD. Considering the factors above, should the Safety Analysis be completed prior to the operation being put to next use? ☐ YES ☐ NO

2. The following Budgetary Cost Estimate Guidelines are based on a percentage of EITHER the construction cost of the operation OR the design engineering manpower cost. Use the upper end of the ranges for a complete Safety Analysis, the lower end of the ranges for a complete Process Hazards Analysis only. Better estimates can be made as SA experience is accumulated.

<u>SA Level</u>	<u>Percent of Construction Cost Basis</u>	<u>Percent of Design Engineering Basis</u>
1	0.1 - 0.3	2 - 4
2	1 - 2	5 - 10
3	2 - 4	5 - 10

For backfit operations consider the extent and applicability of existing analyses when determining budget allocation.

Level of SA (from Sheet 3): 2

Cost estimate _____ % of \$ _____ = \$ _____

Basis and reasoning:

3. _____
Signature of Preparer_____
Date

AEROSPACE DIVISION
ALLEGANY BALLISTICS LABORATORY
P.O. BOX 210, CUMBERLAND, MARYLAND 21502
TELEPHONE: RIDGELEY, WEST VIRGINIA 304-726-4500