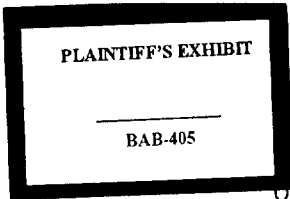


File
Cherokee No 2
Boiler



Purchaser's
Identification:
Order No. NY-771602
Spec. No. PSCC-C2-102-SG
Date of Spec.
October 1, 1958

Revision Dates:
R1 August 14, 1959
R2
R3

EBASCO SPECIFICATION
SPECIFICATION EBASCO 56-50
STEAM-GENERATING UNITS AND ACCESSORIES

OPERATING COMPANY PUBLIC SERVICE COMPANY OF COLORADO
STATION CHEROKEE STEAM ELECTRIC STATION
PROJECT 1959 - 110 000 KW EXTENSION UNIT NO. 2
LOCATION DENVER, COLORADO (1 mile north of city limits)

SELLER _____

<u>Rev.</u>	<u>Prepared by:</u>	<u>Reviewed by:</u>	<u>Pages Affected:</u>
FC			
R1			
R2			
R3			

SPECIFICATION EBASCO
STEAM-GENERATING UNITS AND ACCESSORIES

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SPECIFICATION EBASCO
STEAM-GENERATING UNITS AND ACCESSORIES

- 1 This specification covers performance and construction features of steam-generating unit and certain accessories. It is not the intent completely to specify all details of design and construction of equipment; however equipment shall conform in all respects to high standards of engineering, design and workmanship. Complete steam-generating unit and specified accessories shall be delivered with supervision of erection and shall be demonstrated capable of performing in continuous commercial operation up to Seller's guarantees and in a manner acceptable to Purchaser. SCOPE
- 2 Date October 1, 1958 CURRENT PROJECT
Operating Company Public Service Company of Colorado
Station Cherokee Steam Electric Station
Situating at Denver, Colorado (1 mile north of city limits)
Turbine Unit No. 2 Rating 110 000 kw
Designation Steam-Generating Unit No. 2
Elevation above sea level 5130 ft
Weather Conditions medium snowfall, medium high winds and sub-zero temperatures in winter; light yearly rainfall
Inspection by Hartford Steam Boiler Inspection & Insurance Company
- .1 Principal fuel is pulverized Colorado sub-bituminous (lignite); natural gas as secondary fuel.
- .2 Steam generator shall be installed with respect to protection from weather, as follows:
- | | |
|--------------------------------------|---|
| a Boiler | <u>Outdoors</u> |
| b Economizer | <u>Outdoors</u> |
| c Air-heater | <u>Outdoors</u> |
| d Forced-draft fans | <u>Outdoors (in louvered enclosure)</u> |
| e Induced-draft fans | <u>Outdoors</u> |
| f Dust Separator (Mechanical) | <u>Outdoors (in louvered enclosure)</u> |
| g Dust Separator (Future Electrical) | <u>Outdoors</u> |

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- 3 Steam-generating unit and accessories shall comply with applicable specifications and codes (latest revision) of American Standards Association, American Society for Testing Materials, American Society of Mechanical Engineers and National Board of Fire Underwriters. Construction shall comply with laws of State where equipment is installed, and with any local ordinances, as may be required. STANDARDS
- 4 Capability of each steam-generating unit shall be: CAPABILITY
- a Maximum rate of heat absorption 1,004,000 kB per hr
- b Maximum continuous steam output 852 000 lb per hr

DESIGN DATA

- 5 Steam-generating unit shall be of type indicated and shall be designed for operating conditions as follows: DESIGN CONDITIONS
- a Type and design reheat, radiant, single drum, divided suction furnace, top fired, outdoor with enclosed Firing Aisle Level
- b Design boiler drum pressure 1725 psig
- c Design steam pressure at superheater outlet 1550 psig
- d Steam temperature at superheater outlet 1005 F
for range of 650 000 to 852 000 lb per hr (with principal fuel) and for range of 650 000 to 852 000 lb per hr (with secondary fuel)
- e Feed water temperature at maximum output 500 F
- f Total solids at maximum output (basis of performance)
- In feed water 15 ppm
- In boiler water(% alkalinity of solids) 1000 ppm
- In steam leaving boiler drum 1 ppm
- g Type of firing (principal fuel) vertical firing down-ward through roof of furnace
- h Type of firing (secondary fuel) vertical firing down-ward through roof of furnace
- i Ambient air temperature minimum -20 F, maximum 90 F, design 80 F

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DESIGN
CONDITIONS
(Cont'd)

- j Air required for combustion (with principal fuel) 26.5%
excess leaving economizer
- k Forced-draft fan capacity margin required: 132% head,
115% volume in excess of requirements 850 000 lb steam
per hr, with pulverized lignite firing as designated
by Seller at 26.5 excess air
- l Induced-draft fan capacity margin required 132 %
head, 115% volume in excess of requirements at 852 000
lb steam per hr, with pulverized lignite firing as
designated by Seller at 26.5% excess air
- m Draft in furnace 0.9 in. water
- n Minimum draft in setting 0.1 in. water
- *o Saturated steam for auxiliaries 8.0% at all loads
- p Rate of heat liberation at 852 000 lb/hr output
and pulverized lignite firing:
Per cu ft furnace volume 14,300 Btu/hr
Per sq ft projected water-wall surface 49,800 Btu/hr
- q Special design features shall be as follows:
- 1) Unit shall be capable of maximum continuous output
with increased reheat flow (775 000 lb/hr) with a
feed water temperature entering economizer of 444F,
resulting from removal of top high pressure
heaters from the extraction cycle.
 - 2) Boiler steel shall be designed to take wind loading
of Purchaser's adjacent structure (turbine room and
bunkers). In addition, boiler steel shall be designed
for loads of louvered wall Forced Draft Fan enclosure
(By Purchaser), solid wall firing aisle enclosure,
piping loads from Purchaser's main steam, reheat steam
and boiler feed discharge systems and wind load of ad-
jacent elevator structure.
 - 3) Single connections shall be provided for Purchaser's
main steam, hot reheat steam, cold reheat steam and
boiler feed discharge piping.
- * All extraction feed water heaters must be in service.

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- 4) Enclosure shall be provided for the firing aisle, complete with access doors, windows, working area, etc. Weatherproof skin tight enclosure shall be provided for each end of the steam drum. DESIGN CONDITIONS (Cont'd)
- 5) Connections for all safety valves, including Power Control Valve, shall be furnished on boiler headers or piping.
- 6)
- 7) Provision shall be made for air flow measurement device.
- 8) Provision shall be made for shielding ash in the hoppers from direct furnace radiation.
- 9) Provision shall be made in the flue gas ducting for future installation of an electrostatic dust separator ahead of the Induced Draft Fans.
- 10) All piping nozzles shall have sufficient length to permit rewelding.
- 11) All safety valves shall be of the weld end type (this does not include Power Control Valve).
- 12) Flues and ducts shall be insulated. Heat insulation shall be applied externally on flues and ducts carrying gas and hot air.
- 13) The Forced and Induced Draft Fans shall be designed so that one fan of each service may be used up to approximately 60 per cent of maximum continuous superheated steam output.
- 14) Time required for complete automatic sequential soot blowing cycle, when burning pulverized lignite, will not exceed 7 hrs.
- 15) Minimum stable operation with all coal burners and pulverizers in operation is _____ lb/hr superheated steam output.
- 16) Emergency temperature control shall be provided by means of spray desuperheaters in the boiler superheater piping between the primary outlet and secondary inlet headers and in the reheat piping before the reheater inlet. Normal sources of the spray water shall be boiler feed pump discharge for superheater desuperheater and shell drains from 6th stage extraction feed water heater for reheater desuperheater. Alternate source of water for the reheater desuperheater will be boiler feed pump discharge. Spray system may not be used to demonstrate performance guarantees. Spray system will, however, be permitted to operate if necessary to achieve maximum continuous superheater output with top high pressure heater removed from the extraction cycle.

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- 17) Fans shall be designed to provide a minimum margin of 15 per cent on capacity and 32 per cent on pressure. Some portion of these margins may be used to achieve maximum continuous superheater output with top high pressure heater removed from the extraction cycle. Fans shall be of Sturtevant TV-10 design and shall be complete with control levers for vanes and dampers, for connection to Purchaser's control drives located at grade. All fans shall have air cooled bearings. Gas recirculating fans shall be located at grade with its suction on the discharge side of the dust collector, recirculating cold gas. Fans shall not be released for production until details of design and fabrication have been reviewed and agreed upon by Purchaser.
- 6 Steam-generating unit shall be fired with sub-bituminous (lignite)
of characteristics as given below:
- .1 a Character
- Size designation run of mine
District Weld County
Seam Northern Colorado
- b Analysis of coal, as supplied from boiler bunker (per cent by weight)*
- | | |
|------------------------------|--------------------|
| Source | <u>Weld County</u> |
| Carbon | <u>55.24</u> % |
| Hydrogen | <u>3.08</u> % |
| Oxygen | <u>10.78</u> % |
| Nitrogen | <u>1.14</u> % |
| Sulfur | <u>0.61</u> % |
| Ash | <u>5.15</u> % |
| Water | <u>24.00</u> % |
| Heating value (high) | <u>9280</u> Btu/lb |
| Softening temperature of ash | |
| Reducing | <u>2090</u> F |
| Ash-fluid temperature | |
- * Fuel on which performance and guarantees are based.

SPECIFICATION EBASCO
STEAM-GENERATING UNITS AND ACCESSORIES

Reducing	<u>2250</u>	F	FUEL DATA (Cont'd)
Grindability (Hardgrove)	<u>45</u>		
c Proximate analysis of coal supplied from boiler bunker as fired (per cent by weight)			
Moisture	<u>24.00</u>	%	
Volatile matter	<u>28.80</u>	%	
Fixed Carbon	<u>42.00</u>	%	
Ash	<u>5.20</u>	%	
Total	<u>100.00</u>	%	
Sulfur (separate)	<u>0.61</u>	%	
.2 Natural gas (per cent by volume) (dry)			
Methane	<u>81.0</u>	%	
Ethane and higher	<u>6.8</u>	%	
Carbon dioxide	<u>0.3</u>	%	
Nitrogen	<u>11.9</u>	%	
Heating value (high) (dry, at 60F 30.0 in. Hg)	<u>943</u>	Btu/cu ft	
7 Completed steam-generating unit in operation, shall be guaranteed to meet specific performance requirements, as follows:			SPECIFIC PERFORMANCE
.1 Steam generator and accessories, when operating with principal fuel under conditions specified in paragraph 5 shall deliver steam at superheater outlet continu- ously at an output of <u>852 000</u> lb per hr, at a gross efficiency of not less than <u>86.39%</u> (no tolerance allowed) with <u>26.5%</u> excess air for combustion.			
.2 Steam generator and accessories, when operating with secondary fuel under conditions specified in paragraph 5 shall deliver steam at superheater outlet continu- ously at an output of <u>852 000</u> lb per hr, at a gross efficiency of not less than <u>83.23%</u> (no tolerance allowed) with <u>13.0%</u> excess air for combustion. (This is predicted performance)			
.3 Steam generator and accessories shall operate through entire range of capacity without undue or injurious vi- bration, pulsation or noise.			

SPECIFICATION EBASCO
STEAM-GENERATING UNITS AND ACCESSORIES

SPECIFIC
PERFORMANCE
(Cont'd)

- .4 Steam and water circulation through boiler, reheater and superheater at all loads shall be such as to prevent "starvation" of supply to and consequent overheating of heat-absorbing surfaces; if inadequate circulation is experienced Seller shall make improvements requisite to provide adequate circulation and demonstrate adequacy of design in this respect.
- .5 When firing principal fuel, steam shall be produced at the following conditions:
 - a Temperature at superheater outlet shall be automatically controlled at 1005F for steam outputs from 650 000 lb per hr to 852 000 lb per hr, plus or minus 10F tolerance allowed
 - b Steam leaving boiler drum and before superheater inlet shall contain not more than 1 ppm total solids, for conditions specified in paragraph 5.
 - c Temperature at reheater outlet shall be automatically controlled at 1005F for steam outputs from 650 000 to 852 000 lb steam per hr, plus or minus 10F tolerance allowed.
- .6 Forced- and induced-draft fans shall supply air required for combustion and remove products of combustion, over entire range of output up to and including maximum conditions specified in paragraph 5, without exceeding power input requirements as specified in paragraph 30.1 and 31.1, when using principal fuel.
- .7 Under all conditions of steam output it shall be possible to maintain:
 - a Negative pressure in all parts of boiler setting of not less than 0.1 in. of water
 - b Complete combustion in furnace proper, as evidenced by absence of CO or unburned hydrocarbons at entrance to superheater
- .8 Loss of pressure or draft from resistance in portions of steam generator (readings referred to same level) shall not exceed the following:
 - a Loss of steam pressure through superheater, at flow of 852 000 lb per hr, not to exceed 75 psi-10% tolerance

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- b Loss of draft from furnace to inlet of Induced-Draft Fans, not to exceed 13.0 in. water-10% tolerance (primary fuel) includes 0.5 in. water allowance for future Elect. Dust Collector.
- c Loss of air pressure from outlet of Forced-Draft Fans to furnace, not to exceed 12.6 in. water - 10% tolerance (pulverized lignite fuel)
- d Loss of steam pressure through reheater, at flow of 852 000 lb per hr, not to exceed 30 psi - 10% tolerance

SPECIFIC
PERFORMANCE
(Cont'd)

SPECIFICATION ON EBASCO
STEAM-GENERATING UNIT AND ACCESSORIES
EXPECTED PERFORMANCE

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EXPECTED
PERFORMANCE

8.0 The following is a tabulation of expected performance.

Operation At		Limit of Temperature Control		Maximum Load		Limit of Temperature Control		Maximum Load	
Continuous steam output at Secondary Superheater outlet, M lb/hr		650	In	Out	In	Out	650	In	Out
Top extraction feed water heater								852	852
Fuel		Lignite	Lignite	Lignite	Lignite	Lignite	Gas	Gas	Gas
.1 Flow quantities, M lb/hr		840					768		925
Air at Airheater inlet		840					768		925
Air at Airheater outlet **		840					768		925
Air at windbox inlet									
Excess air at Economizer outlet, per cent		27.5					15.0		13.0
Fuel burned (M cu ft/hr for gas)		100.0					1030		1240
Gas at Furnace outlet									
Gas at Primary Superheater outlet*		1222					1215		1217
Gas at Secondary Superheater outlet									
Gas at Reheater outlet*		1222					1215		1217
Gas at Airheater outlet		1222					1215		1217
Steam at Reheater inlet		552					552		705
.2 Steam and water pressure PSIG									
Drum operating		1594					1594		1625
Drop, Drum to Secondary Superheater Outlet		44					44		75
Secondary Superheater Outlet		1550					1550		1550
Reheater Inlet		282.0					282.0		391
Reheater Outlet		267.0					267.0		361
Drop through Reheater		15					15		30
Drop through Economizer		16					16		25

* Varies depending on setting of proportioning dampers.

** Based on zero tempering.

WAD00084

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EXPECTED PERFORMANCE

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Limit of

Limit of
Temperature
Control

Operation At

Maximum Load

Temperature
Control

Maximum Load

Temperature
Control

Continuous steam output at Secondary Superheater outlet,
M lb/hr

Top extraction feed water heater

Fuel

.3 Temperature, F

a) Steam and water

Secondary Superheater Outlet

Reheater Inlet

Reheater Outlet

Economizer Inlet

Economizer Outlet

b) Flue gases

Furnace Outlet

Secondary Superheater Inlet

Secondary Superheater Outlet

Primary Superheater Inlet

*Primary Superheater Outlet

Reheater Inlet

*Reheater Outlet

Economizer Outlet, Mixed

*1) Superheater section

2) Reheater section

Airheater Outlet, Corrected

Maximum Load

Temperature Control

Maximum Load

WAD00085

*Temperature depends on setting of proportioning dampers.

SPECIFICATION BASCO
STEAM-GENERATING UNIT AND ACCESSORIES
EXPECTED PERFORMANCE

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Limit of
Temperature
Control

Temperature
Limit of
Control

Operation At

Maximum Load

Control

Maximum Load

Continuous steam output at Secondary Superheater outlet,
M lb/hr

Top extraction feed water heater

Fuel

Lignite

Lignite

Lignite

Gas

Gas

c) Air

Airheater Inlet

Airheater Outlet

.4 Air resistances in H₂O
Burners and windbox

Ducts, dampers & orifice

Airheater

Total drop air side

.5 Air pressure required at Forced Draft Fan Outlet

.6 Draft losses, in H₂O
Furnace

Boiler, superheater and reheater

Economizer

Airheater

Ducts, flues and dampers

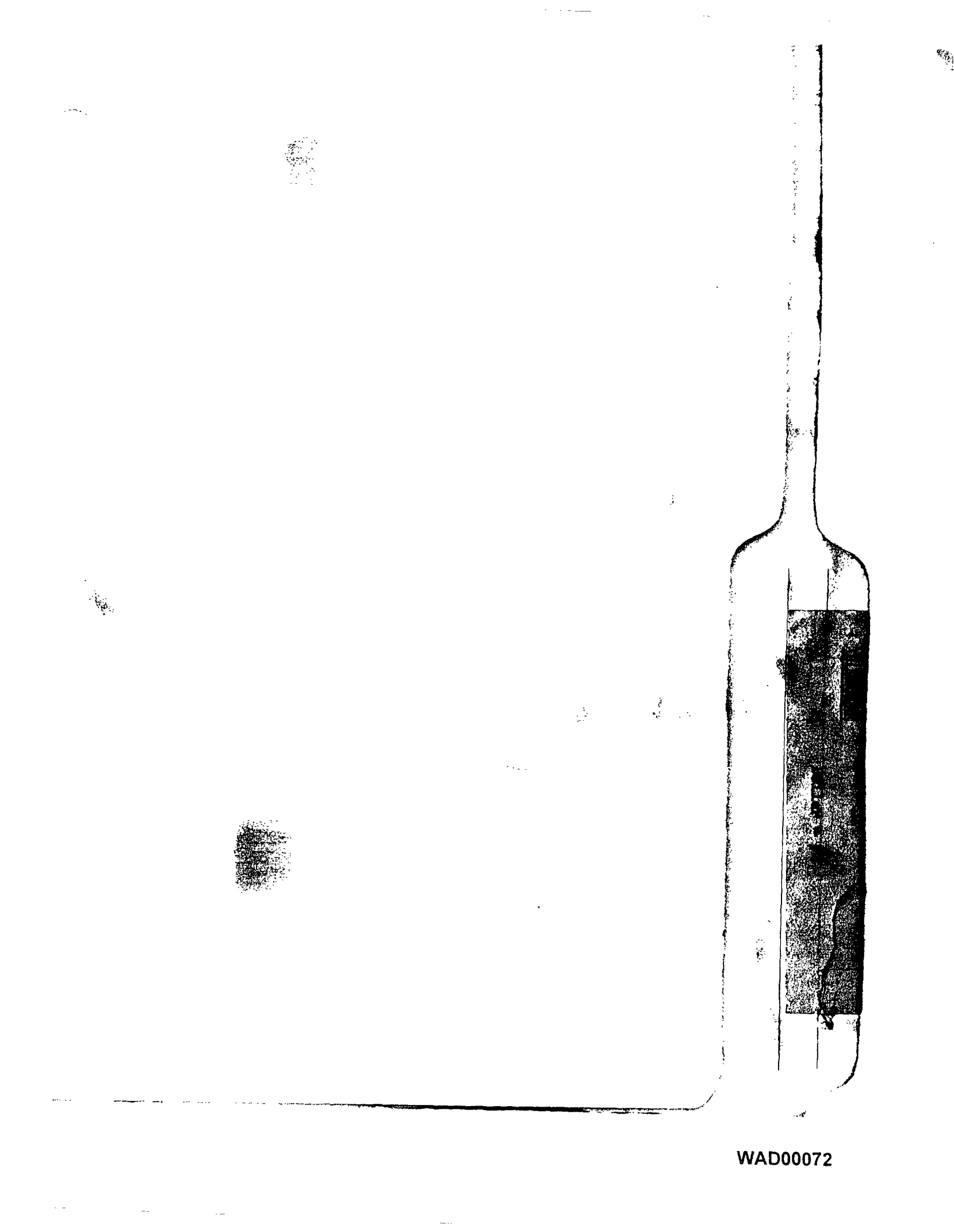
Present dust collector (mechanical)

Future dust collector (electrical) (assumed)

Total loss gas side

.7 Draft required at Induced Draft Fan Inlet

650	852	650	852
In Out	In Out	In Out	In Out
Lignite Lignite Lignite	Lignite Lignite Lignite	Lignite Lignite Lignite	Lignite Lignite Lignite
80	80	80	80
575	570	625	595
2.60	4.00	2.60	3.20
1.8	2.8	1.6	2.3
3.80	5.80	3.30	4.70
8.20	12.60	7.5	10.2
8.20	12.60	7.5	10.2
0.90	0.90	0.90	0.90
4.28	4.50	4.20	4.40
1.00	1.12	1.00	1.10
2.90	2.98	2.88	2.95
0.50	0.50	0.50	0.50
2.90	3.00	2.88	2.95
12.48	13.00	12.36	12.80
12.48	13.00	12.36	12.80



WAD00072