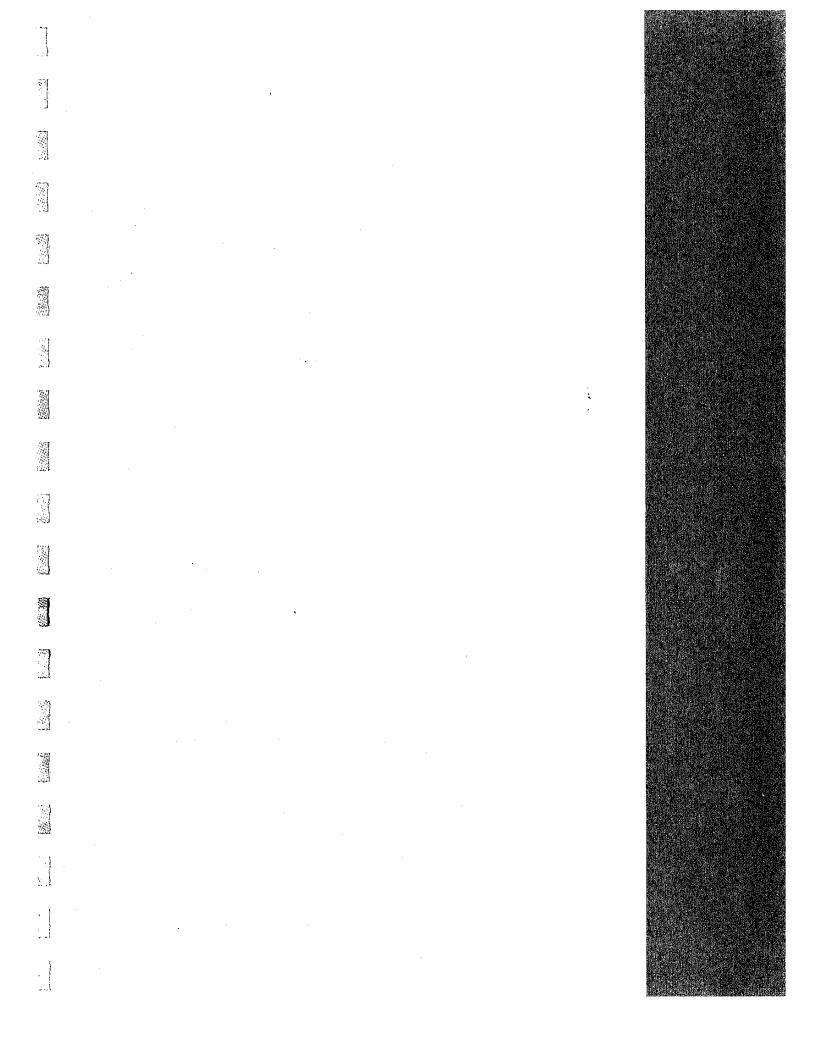
APPENDIX F

SUMMARY OF CONSUMABLES AND RELATIVE OPERATING COST ESTIMATES

F-1:	CONSUMABLE COMPONENTS & COSTS
F-2:	IRONMAKING PROCESS CONSUMPTIONS & RELATIVE OPERATING COSTS
F-3:	IRONMAKING PROCESS SUMMARIES
F-4:	IRONMAKING PROCESS RELATIVE OPERATING COSTS (OPEX)
F-5:	IRONMAKING PROCESS RELATIVE CAPITAL COSTS (CAPEX)
F-6:	RANKINGS OF PROCESSES



APPENDIX F-1 CONSUMABLE COMPONENTS & COSTS

Appendix F: Summary of Consumables and Relative Cost Estimates

F-1: Consumable Components & Costs

The approaches followed in developing the operating costs for the various Ironmaking Processes were to build up the operating cost (OPEX) from the individual components. These bases for these costs include:

- Consumable components as defined by the mass and fuel balances (Appendix B).
- Electrical power consumptions from experience or Process Vendor data.
- Labor estimates were factored from man-hour/mt data supplied by Process Vendors and experience with similar processes.
- Costs and/or fuel costs for transport of materials.
- Allowances for maintenance materials and supplies based on Vendor factors.
- As appropriate, allowances for G&A were added.
- Each process component cost was built up using the above factors for each unit operation involved in producing and delivering the consumable to the ironmaking process.

In the following tables, the Consumable component costs are defined and summarized for:

- F1.1 Bentonite Binder
- F1.2 Coal (lump delivered to use)
- F1.3 Burnt Lime/Dolomite
- F1.4 Lump Iron Ore
- F1.5 Fine Iron Ore
- F1.6 Iron Ore Concentrate
- F1.7 Iron Ore Pellets
- F1.8 Co-Product Coke Production
- F1.9 Non-Recovery Coke/with Co-Generation
- F1.10 Steel Scrap Composite Price Basis

ABIND

SUMMARY CONSUMABLES BENTONITE BINDER PREPARATION

Rev. 2

12-June-2000

BASIS:

1.0000 MM MT/YEAR PELLETIZING BINDER (BENTONITE)

SUMMARY:

2.1053 MM MT/YEAR AS-MINED BENTONITE RESOURCE

1.0527 MM MT/YEAR MINE WASTE ROCK

1.0527 MM MT/YEAR BENTONITE ROCK TO PREP. PLANT

1.0000 MM MT/YEAR NET BENTONITE TO SHIPPING

ASSUMPTIONS: (1)

5.8464 TOTAL FUEL MINING (kg/mt ROCK)

2.4992 BENTONITE MINE ELECTRICAL POWER REQ'D (kWhr/mt ROCK)

14.1809 PREP PLANT ELECTRICAL POWER REQ'D (kWhr/mt ORE)
10.0922 FUEL REQUIREMENT BENTONITE TRANS. TRUCK 30 mt - (kg/mt)
\$1.30 FUEL COST - (\$/gal)

3.1412 FUEL DENSITY - (kg/gal)

\$413.85 FUEL COST - (\$/mt)

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$0.033	ELECTRIC POVVER COSTS - (\$7KVVNT)			
PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
BINDER MINING	G:		76	
	AS-MINED CLAY/ROCK	2.1053	0.0632	2.1685
	WASTE ROCK	1.0527	0.0316	1.0842
	BENTONITE ROCK TO PREP PLANT	1.0527	0.0316	1.0842
	DIESEL FUEL (MINING ETC.)		0.0062	
	MINE ELECTRICAL POWER REQ'D (MM kWhr/yr)	5.2615		
PREPARATION	PLANT:			
	FUEL-ROCK TRANS. TO PREP PLANT		0.0005	, , , , , , , , , , , , , , , , , , ,
	NET PREPPED BENTONITE TO PELLET PLANT	1.0000	0.0300	1.0300
	REJECT TAILINGS TO DISPOSAL	0.0526	0.0016	0.0542
1	PREP. P ELECTRICAL POWER REQ'D (MM kWhr/yr)	14.9275		
	NET PREPPED BENTONITE TO PELLET PLANT	1.0000	0.0300	1.0300
TRANSPORT T	O PELLETIZING:	<u> </u>		
	DIESEL FUEL - BENTONITE TRANS.		0.0050	
COSTS:		\$/YEAR	\$/T	
0.0117	TOTAL FUEL - MM mt/yr	\$4,835,993	\$4.84	
20.1891	TOTAL ELECTRIC POWER - (MM kWhr/yr)	\$666,239	\$0.67	
\$1.201	PREP. PLANT LABOR COSTS - \$/mt PRODUCT	\$1,201,200	\$1.20	
\$0.137	LABOR OPERATING COSTS \$/mt - SHOVELS (1)	\$287,980	\$0.29	
\$0.547	LABOR OPERATING COSTS \$/mt - LOADERS (2)	\$1,151,920	\$1.15	
\$2.189	OPERATING HOURS/mt - MINE HAUL TRUCKS (4)	\$4,607,680	\$4.61	
\$10.267	TRANSPORT HAUL TRUCK LABOR - \$/mt	\$10,266,667	\$10.27	
\$20.000	EQUIPMENT COST AMORTIZATION - \$/mt	\$20,000,000	\$20.00	
\$4.500	EQUIPMENT MAINTENANCE & PARTS - \$/mt	\$4,500,000	\$4.50	
\$42.500	RAW MATERIAL VALUE ADDED - \$/mt	\$42,500,000	\$42.50	
	TOTAL:	\$90,017,678	\$90.02	

ACOAL

SUMMARY CONSUMABLES COAL ONLY - DELIVERED TO USE

12-June-2000 Rev. 2

BASIS:

1.000 MM MT/YR COAL DELIVERED

SUMMARY:

1.5038 MM MT/YEAR AS-MINED COAL RESOURCE 0.4511 MM MT/YEAR MINE WASTE ROCK 1.0527 MM MT/YEAR COAL TO PREP. PLANT 1.0000 MM MT/YEAR NET COAL TO SHIPPING

ASSUMPTIONS:

11.459 TOTAL FUEL MINING (kg/mt ROCK)

0.29 COAL MINE ELECTRICAL POWER REQ'D (kWhr/mt ROCK)

1.62 PREP PLANT ELECTRICAL POWER REQ'D (kWhr/mt COAL)

6.728 FUEL REQUIREMENT COAL TRANS. - (kg/mt)

\$1.30 FUEL COST - (\$/gal)

3.1412 FUEL DENSITY - (kg/gal) \$413.85 FUEL COST - (\$/mt) \$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	_(MM T/YR)
COAL MINING:				
]	AS-MINED COAL/ROCK	1.504	0.045	1.549
	WASTE ROCK	0.451	0.014	0.465
	RAW COAL TO PREP PLANT	1.053	0.032	1.084
	DIESEL FUEL (MINING ETC.)		0.0121	
	MINE ELECTRICAL POWER REQ'D - (MM kWhr/yr)	0.430		
PREPARATION	PLANT:		 	·
	AS-MINED RAW TRANS. TO PREP PLANT		0.00004	
	NET PREPPED COAL TO USE	1.000	0.030	1.030
	REJECT TAILINGS TO DISPOSAL	0.053	0.002	0.054
	PREP. P ELECTRICAL POWER REQ'D - (MM kWhr/yr)	1.708		
	NET PREPPED COAL TO USE	1.000	0.030	1.030
TRANSPORTA	TION TO USE:			
	DIESEL FUEL - COAL TRANS.	******	0.0050	•
COSTS:		\$/YEAR	\$/T	
0.0171	TOTAL FUEL - MM mt/yr	\$7,079,265	\$7.08	
2.1379	TOTAL ELECTRIC POWER - (MM kWhr/yr)	\$70,549	\$0.07	
\$0.480	PREP. PLANT LABOR COSTS - \$/mt PRODUCT	\$480,480	\$0.48	
\$0.192	LABOR OPERATING COSTS \$/mt - SHOVELS (1)	\$201,586	\$0.20	
\$0.766	LABOR OPERATING COSTS \$/mt - LOADERS (2)	\$806,344	\$0.81	
\$3.064	OPERATING HOURS/mt - MINE HAUL TRUCKS (4)	\$3,225,376	\$3.23	
\$8.000	TRANSPORT HAUL TRUCK LABOR - \$/mt	\$8,000,000	\$8.00	
\$15.000	EQUIPMENT COST AMORTIZATION - \$/mt	\$15,000,000	\$15.00	
\$3.300	EQUIPMENT MAINTENANCE & PARTS - \$/mt	\$3,300,000	\$3.30	
\$20.000	RAW MATERIAL VALUE ADDED - \$/mt	\$20,000,000	\$20.00	
	TOTAL:	\$58,163,600	\$58.16	

ALIME

SUMMARY CONSUMABLES BURNT LIME/DOLOMITE

Page 1

BASIS:

1.0001 MM MT/YEAR BURNT LIME/DOLOMITE

SUMMARY:

13-June-2000

2.7800	MM MT/YEAR AS-MINED LIMESTONE/MGO ROCK
0.9267	MM MT/YEAR MINE WASTE ROCK
1.8533	MM MT/YEAR LIME ROCK TO PREP. PLANT

1.7607 MM MT/YEAR NET LIMESTONE TO CALCINATION

1.0001 MMM MT/YEAR TARGET CALCINED LIME

ASSL

UMPTIONS:	
7.3791	TOTAL FUEL (kg/mt LIME ROCK)
3.3537	LIMESTONE MINE ELECTRICAL POWER REQ'D (kWhr/mt ROCK)
19.0328	PREP PLANT ELECTRICAL POWER REQ'D (kWhr/mt ORE)
6.3076	FUEL REQUIREMENT LIME TRANS. TRUCK 30 mt - (kg/mt)
124.0519	FUEL REQUIREMENT - CALCINING (kg N.G./mt CALCINE)
26.4600	CALCINING PLANT ELEC. POWER REQ'D (kWhr/mt FEED)
\$1.30	FUEL COST - (\$/gal)
3.1412	FUEL DENSITY - (kg/gal)
\$413.85	FUEL COST - (\$/mt)
\$38.50	LABOR RATE - \$/MAN-HOUR BURDENED
\$2.50	N.G. COSTS - (\$/GJ)
49.78	N.G (GJ/mt)
\$124.45	N.G. COSTS - (\$/mt)
1,345.53	N.G. DENSITY - (Nm3/mt)
27.03	N.G. CONVERSION - (GJ/Nm3)
\$0.033	ELECTRIC POWER COSTS - (\$/kWhr)

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL.
		(MM T/YR)	(MM T/YR)	(MM T/YR)
LIME ROCK MIN				
	AS-MINED LIME ROCK	2.7800	0.0834	2.8634
	WASTE ROCK	0.9267	0.0278	0.9545
	LIME ROCK TO PREP PLANT	1.8533	0.0556	1.9089
	DIESEL FUEL (MINING ETC.)		0.0137	1.3009
	MINE ELECTRICAL POWER REQ'D - (MM kWhr/yr)	9.3234	0.0137	
LIME ROCK PRE	EP PLANT:	[
	NET PREPPED LIME ROCK TO CALC.	1.7607	0.0528	1.8135
	REJECT TAILINGS TO DISPOSAL	0.0927	0.0028	0.0954
	PREP. P ELECTRICAL POWER REQ'D - (MM kWhr/yr)	35.2743	0.0020	0.0354
LIME CALCINAT	ION:			
	NET PREPPED LIME ROCK TO CALC.	1.7607	0.0528	1.8135
	DIESEL FUEL - LIME ROCK TRANS.		0.0002	1.0100
	BURNT LIME/DOLOMITE	1.0001	0.0002	1 0004
	N.G. FUEL (DRYING, CALCINATION, ETC.)	1.0001		1.0001
	CALC, ELECTRICAL POWER REQ'D	40 5035	0.2184	
	NET LIME/MgO SHIPPED	46.5875	_	
		1.0001	0.0000	1.0001
	LIME TRANSPORT FUEL		0.0063	
	1944			

ALIME

13-June-2000 Page 2

SUMMARY CONSUMABLES BURNT LIME/DOLOMITE

COSTS: \$/YEAR \$/T 0.2184 TOTAL N.G. FUEL - (MM mt/yr) \$27,181,466 \$27.18 0.0202 TOTAL FUEL DIESEL - (MM mt/yr) \$8,362,424 \$8.36 TOTAL ELECTRICAL POWER - (MM kWhr/yr) 91.1852 \$3,009,111 \$3.01 \$1.201 PREP. PLANT LABOR COSTS - \$/mt PRODUCT \$1,201,200 \$1.20 \$0.104 LABOR OPERATING COSTS \$/mt - SHOVELS (1) \$258,975 \$0.26 \$0.414 LABOR OPERATING COSTS \$/mt - LOADERS (2) \$1,035,899 \$1.04 OPERATING HOURS/mt - MINE HAUL TRUCKS (4) \$1.657 \$4,143,597 \$4.14 \$5.133 TRANSPORT HAUL TRUCK LABOR - \$/mt \$5,133,332 \$5.13 \$12.000 EQUIPMENT COST AMORTIZATION - \$/mt \$12,000,000 \$12.00 EQUIPMENT MAINTENANCE & PARTS - \$/mt \$3.000 \$3,000,000 \$3.00 \$12.500 RAW MATERIAL VALUE ADDED - \$/mt \$12,500,000 \$12.50

TOTAL:

\$77,826,004

\$77.83

AORE

SUMMARY CONSUMABLES LUMP IRON ORE DELIVERED

13-June-2000 Rev. 2

BASIS:

1.0000 MM MT/YEAR LUMP ORE DELIVERED

SUMMARY:

3.1630 MM MT/YEAR AS-MINED ROCK 1.9127 MM MT/YEAR WASTE ROCK

1.2503 MM MT/YEAR ORE ROCK TO PREP PLANT

1.0003 MM MT/YEAR CRUSHED LUMP ORE

0.2501 MM MT/YEAR FINE ORE REJECTS

ASSUMPTIONS:

TOTAL FUEL (kg/mt ORE) 26.124

IRON ORE MINE ELECTRICAL POWER REQ'D (kWhr/mt ROCK) 6.53

PREP PLANT ELECTRICAL POWER REQ'D (kWhr/mt ORE) 9.26

0.028 PIPELINE ELECTRICAL POWER REQ'D (kWhr/mt ORE/km)

0.00449 FUEL REQUIREMENT - SHIPPING (kg/mt/km)

13.95 FUEL REQUIREMENT SHIPPING (kg/mt LUMP ORE)

FUEL COST - (\$/gal)

\$1.30 3.1412 FUEL DENSITY - (kg/gal)

\$413.85 FUEL COST - (\$/mt)

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$2.50 N.G. COSTS - (\$/GJ)

49.78 N.G. - (GJ/mt)

\$124.45 N.G. COSTS - (\$/mt)

1,345.53 N.G. DENSITY - (Nm3/mt)

27.03 N.G. CONVERSION - (GJ/Nm3)

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
LUMP ORE MIN	JING-	(MM T/YR)	(MM T/YR)	(MM T/YR)
COMP ORE WILL	AS-MINED ROCK			
	WASTE ROCK	3.1630	0.0949	3.2579
	IRON ORE TO PREP PLANT	1.9127	0.0574	1.9701
Ì	DIESEL FUEL REO'D	1.2503	0.0375	2.5645
Ì			0.0026	
	MINE ELECTRICAL POWER REQ'D - (MM kWhr/yr)	20.6657	ŀ	
ORE PREPARA	ITION:	<u>.</u>		
	CRUSHED LUMP ORE TO SHIPPING	1.0003	0.0300	1,0303
ŀ	FINE ORE TO DISPOSAL	0.2501	0.0075	0.2576
ļ	PREP. ELECTRICAL POWER REQ'D - (MM kWhr/yr)	11.5729		
	SHIPPING FUEL REQ'D		0.0140	
COSTS:		\$/YEAR	\$/T	
32.2386	PROCESS ELECTRIC POWER REQ'D - (MM kWhr/yr)	\$1,063,874	\$1.06	***
0.0261	TOTAL FUEL - MM mt/yr	\$10,811,414	\$10.81	
\$1.201	PREP. PLANT LABOR COSTS - \$/mt PRODUCT	\$1,201,200	\$1.20	
\$0.244	LABOR OPERATING COSTS \$/mt - SHOVELS (1)	\$767,988	\$0.77	
\$0.978	LABOR OPERATING COSTS \$/mt - LOADERS (2)	\$3,071,951	\$3.07	
\$1.546	OPERATING HOURS/mt - MINE HAUL TRUCKS (4)	\$4,857,333	\$4.86	
\$5.775	ORE TRANSPORT COSTS - \$/mt	\$5,775,000	\$5.78	
\$3.500	EQUIPMENT COST AMORTIZATION - \$/mt	\$3,500,000	\$3.50	
\$0.788	EQUIPMENT MAINTENANCE & PARTS - \$/mt	\$787,500	\$0.79	
\$6.000	RAW MATERIAL VALUE ADDED - \$/mt	\$6,000,000	\$6.00	
	TOTAL:		\$37.84	

AFINEORE

SUMMARY CONSUMABLES FINE IRON ORE DELIVERED

13-June-2000

Rev. 2 BASIS:

0.2501 MM MT/YEAR FINE ORE DELIVERED

SUMMARY:

3.1630 MM MT/YEAR AS-MINED ROCK 1.9127 MM MT/YEAR WASTE ROCK

1.2503 MM MT/YEAR ORE ROCK TO PREP PLANT

1.0003 MM MT/YEAR CRUSHED LUMP ORE

0.2501 MM MT/YEAR FINE ORE TO DELIVERY

ASSUMPTIONS:

26.124 TOTAL FUEL (kg/mt ORE)

6.53 IRON ORE MINE ELECTRICAL POWER REQ'D (kWhr/mt ROCK)

9.26 PREP PLANT ELECTRICAL POWER REQ'D (kWhr/mt ORE)

0.028 PIPELINE ELECTRICAL POWER REQ'D (kWhr/mt ORE/km)

13.95 FUEL REQUIREMENT SHIPPING (kg/mt LUMP ORE)

\$1.30 FUEL COST - (\$/gal)

3.1412 FUEL DENSITY - (kg/gal)

\$413.85 FUEL COST - (\$/mt)

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID	TOTAL
LUMP ORE MIN	IING:	(IVIIVI 1717K)	(MM T/YR)	(MM T/YR)
	AS-MINED ROCK	3,1630	0.0949	3.2579
	WASTE ROCK	1.9127	0.0574	1.9701
	IRON ORE TO PREP PLANT	1.2503	0.0375	2.5645
	DIESEL FUEL REQ'D	1.2000	0.0026	2.3043
	MINE ELECTRICAL POWER REQ'D - (MM kWhr/yr)	20.6657	0.0020	
ORE PREPARA				
	CRUSHED LUMP ORE TO SHIPPING	1.0003	0.0300	1.0303
	FINE ORE TO SHIPPING	0.2501	0.0075	0.2576
	PREP. ELECTRICAL POWER REQ'D - (MM kWhr/yr)	11.5729		
	SHIPPING FUEL REQ'D		0.0140	
COSTS - FINE	ORE PORTION ONLY:	\$/YEAR	\$/T	
7.91%	PERCENT FACTOR - FINE ORE/ORE MINED			
2.5488	PROCESS ELECTRIC POWER REQ'D - (MM kWhr/yr)	\$21,033	\$0.08	
0.0021	TOTAL FINE ORE FUEL - MM mt/yr	\$213,742	\$0.85	
\$0.095	PREP. PLANT LABOR COSTS - \$/mt PRODUCT	\$23,748	\$0.09	
\$0.019	LABOR OPERATING COSTS \$/mt - SHOVELS (1)	\$15,183	\$0.06	
\$0.077	LABOR OPERATING COSTS \$/mt - LOADERS (2)	\$60,732	\$0.24	
\$0.122	OPERATING HOURS/mt - MINE HAUL TRUCKS (4)	\$96,029	\$0.38	
\$5.775	FINE ORE TRANSPORT COSTS - \$/mt	\$1,444,125	\$5.78	
\$1.384	EQUIPMENT COST AMORTIZATION - \$/mt (F.O.)	\$345,975	\$1.38	
\$0.311	EQUIPMENT MAINTENANCE & PARTS - \$/mt (F.O.)	\$77,844	\$0.31	
\$12.000	RAW MATERIAL VALUE ADDED - \$/mt	\$3,000,779	\$12.00	
	TOTAL:	\$5,299,191	\$21.19	

AORECONC 13-June-2000

SUMMARY CONSUMABLES IRON ORE CONCENTRATOR

Rev. 2 BASIS:

2.5677 MM MT/YEAR ORE DELIVERED TO CONCENTRATOR
1.4670 MM MT/YEAR CONCENTRATE TO PIPELINE (DRY)

SUMMARY:

6.4963 MM MT/YEAR AS-MINED ROCK 3.9286 MM MT/YEAR WASTE ROCK

2.5677 MM MT/YEAR ORE ROCK TO CONCENTRATOR

1.4670 MM MT/YEAR CONCENTRATE (DRY)

ASSUMPTIONS:

32.700 TOTAL FUEL (kg/mt ORE)

31.50 IRON ORE MINE ELECTRICAL POWER REQ'D (kWhr/mt ROCK)
27.26 CONCENTRATOR ELECTRICAL POWER REQ'D (kWhr/mt ORE)

54.167 PIPELINE ELECTRICAL POWER REQ'D (kWhr/mt ORE)

\$1.30 FUEL COST - (\$/gal)

3.1412 FUEL DENSITY - (kg/gal)

\$413.85 FUEL COST - (\$/mt)

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$2.50 N.G. COSTS - (\$/GJ)

49.78 N.G. - (GJ/mt)

\$124.45 N.G. COSTS - (\$/mt)

1,345.53 N.G. DENSITY - (Nm3/mt)

27.03 N.G. CONVERSION - (GJ/Nm3)

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
ORE MINING:				
	AS-MINED ROCK	6.3014	0.1949	6.4963
	WASTE ROCK	3.8107	0.1179	3.9286
	IRON ORE TO CONCENTRATOR	2.4907	0.0770	2.5677
	DIESEL FUEL REQ'D		0.0327	
	MINE ELECTRICAL POWER REQ'D - (MM kWhr/yr)	31.5022		
ORE CONCENT	RATION:			
	CONCENTRATE TO PIPELINE TRANSPORT	1.4670	0.7899	2.2569
	FINE ORE TO DISPOSAL	1.0237	1.9011	2,9248
	CONC. ELECTRICAL POWER REQ'D - (MM kWhr/yr)	69.9937		
	PIPELINE ELECT. POWER REQ'D - (MM kWhr/yr)	122.2500		
COSTS:		\$/YEAR	\$/T CONC.	
223.7459	PROCESS ELECTRIC POWER REQ'D - (MM kWhr/yr)	\$7,383,615	\$5.03	
0.0327	TOTAL FUEL - MM mt/yr	\$13,533,037	\$9.22	
\$1.682	CONC. LABOR COSTS - \$/mt CONC. PRODUCT	\$2,467,025	\$1.68	
\$0.980	OTHER CONC. COSTS - \$/mt CONC. PRODUCT	\$1,437,660	\$0.98	
\$1.450	LABOR OPERATING COSTS \$/mt - MINING TOTAL	\$9,419,635	\$6.42	
\$0.520	OTHER OPERATING COSTS \$/mt - MINING TOTAL	\$3,378,076	\$2.30	
\$10.000	EQUIPMENT COST AMORTIZATION - \$/mt CONC.	\$14,670,000	\$10.00	
\$2.250	EQUIPMENT MAINTENANCE & PARTS - \$/mt CONC.	\$3,300,750	\$2.25	
\$6.000	RAW MATERIAL VALUE ADDED - \$/mt CONC.	\$8,802,000	\$6.00	
	TOTAL:	\$64,391,797	\$43.89	

APELLETS 13-June-2000 SUMMARY CONSUMABLES IRON ORE PELLETS DELIVERED

BASIS:

1.0000 MM MT/YEAR INDURATED PELLETS DELIVERED

SUMMARY:

3.5343 MM MT/YEAR AS-MINED ROCK

2.1373 MM MT/YEAR WASTE ROCK

1.3969 MM MT/YEAR ORE ROCK TO CONCENTRATOR

0.8228 MM MT/YEAR CONCENTRATE TO PIPELINE

0.1404 MM MT/YEAR FINE ORE TO DELIVERY

ASSUMPTIONS:

26.124 TOTAL FUEL (kg/mt ORE)

6.534 IRON ORE MINE ELECTRICAL POWER REQ'D (kWhr/mt ROCK)

9.256 PREP PLANT ELECTRICAL POWER REQ'D (kWhr/mt ORE)

0.028 PIPELINE ELECTRICAL POWER REQ'D (kWhr/mt ORE/km)

0.014 FUEL REQUIREMENT SHIPPING (kg/mt PELLETS)

\$1.30 FUEL COST - (\$/gal)

3.1412 FUEL DENSITY - (kg/gal)

\$413.85 FUEL COST - (\$/mt)

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$0.033 ELECTRIC POWER COSTS - (\$/kWhr)

\$2.50 N.G. COSTS - (\$/GJ)

49.78 N.G. - (GJ/mt)

\$124.45 N.G. COSTS - (\$/mt)

1,345.53 N.G. DENSITY - (Nm3/mt) 27.03 N.G. CONVERSION - (GJ/Nm3)

STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
	(MM T/YR)	(MM T/YR)	(MM T/YR)
AS-MINED ROCK	3.5343	0.1093	3.6436
WASTE ROCK	2.1373	0.0661	2.2034
DIESEL FUEL (MINING ETC.)		0.0183	
MINE ELECTRICAL POWER REQ'D (MM kWhr/yr)	17.6774		
RATION:			
IRON ORE TO CONCENTRATOR	1.3969	0.0432	1.4401
CONCENTRATE TO PIPELINE FEED	0.8228	0.4430	1.2658
DEWATERED TAILINGS TO DISPOSAL	0.5741	1.0663	1.6404
CONC. ELECTRICAL POWER REQ'D (MM kWhr/yr)	39.2770		
CONC. SLURRY PIPELINE POWER (MM kWhr/yr)	68.5665		
	1.1059	0.0970	1.2029
BINDER TO PELLETIZING	0.0066	0.0000	0.0066
DOLOMITE TO PELLETIZING	0.0226	0.0000	0.0226
TOTAL OTHER FEED TO PELLETIZING	0.2831	i	
NET PELLETS, ETC. TO SHIPMENT	1.0000	i	
N.G. FUEL (DRYING, INDURATION, ETC.)		0.0288	
PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr)	71.8837		
UGH PELLET DELIVERY:	\$/YEAR	\$/T	
TOTAL ELECTRIC POWER REQ'D - (MM kWhr/yr)	\$6,514,353	\$6.51	
TOTAL FUEL OIL THROUGH PELLET - MM mt/yr	\$7,591,173	\$7.59	
TOTAL N.G. FUEL THROUGH PELLET - MM mt/yr	\$3,589,842	\$3.59	
CONC. PLANT LABOR COSTS - \$/mt PRODUCT	\$1,201,000	\$1.20	
ORE MINING LABOR COSTS - (\$/mt ORE)	\$4,324,123	\$4.32	
PELLET PLANT LABOR COSTS - (\$/mt PELLET)	\$1,100,000	\$1.10	
PELLET PLANT CONSUM. COSTS - (\$/mt PELLET)	\$3,660,000	\$3.66	
FINE ORE PIPELINE TRANSPORT COSTS - \$/mt	\$3,850,000	\$3.85	
EQUIPMENT COST AMORTIZATION - \$/mt (PEL.)	\$5,000,000	\$5.00	
EQUIPMENT MAINTENANCE & PARTS - \$/mt (PEL.)	\$1,125,000	\$1.13	
RAW MATERIAL VALUE ADDED - \$/mt	\$10,000,000	\$10.00	
TOTAL:	\$47,955,491	\$47.96	
	AS-MINED ROCK WASTE ROCK DIESEL FUEL (MINING ETC.) MINE ELECTRICAL POWER REQ'D (MM kWhr/yr) RATION: IRON ORE TO CONCENTRATOR CONCENTRATE TO PIPELINE FEED DEWATERED TAILINGS TO DISPOSAL CONC. ELECTRICAL POWER REQ'D (MM kWhr/yr) CONC. SLURRY PIPELINE POWER (MM kWhr/yr) NET OXIDE FEED TO PELLETIZING BINDER TO PELLETIZING DOLOMITE TO PELLETIZING TOTAL OTHER FEED TO PELLETIZING NET PELLETS, ETC. TO SHIPMENT N.G. FUEL (DRYING, INDURATION, ETC.) PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr) JGH PELLET DELIVERY: TOTAL ELECTRIC POWER REQ'D - (MM kWhr/yr) TOTAL FUEL OIL THROUGH PELLET - MM mt/yr TOTAL N.G. FUEL THROUGH PELLET - MM mt/yr CONC. PLANT LABOR COSTS - \$/mt PRODUCT ORE MINING LABOR COSTS - (\$/mt ORE) PELLET PLANT LABOR COSTS - (\$/mt PELLET) FINE ORE PIPELINE TRANSPORT COSTS - \$/mt EQUIPMENT COST AMORTIZATION - \$/mt (PEL.) EQUIPMENT MAINTENANCE & PARTS - \$/mt (PEL.) RAW MATERIAL VALUE ADDED - \$/mt	AS-MINED ROCK WASTE ROCK DIESEL FUEL (MINING ETC.) MINE ELECTRICAL POWER REQ'D (MM kWhr/yr) IRON ORE TO CONCENTRATOR CONCENTRATE TO PIPELINE FEED DEWATERED TAILINGS TO DISPOSAL CONC. ELECTRICAL POWER REQ'D (MM kWhr/yr) CONC. SLURRY PIPELINE POWER (MM kWhr/yr) NET OXIDE FEED TO PELLETIZING BINDER TO PELLETIZING DOLOMITE TO PELLETIZING DOLOMITE TO PELLETIZING NET PELLETS, ETC. TO SHIPMENT N.G. FUEL (DRYING, INDURATION, ETC.) PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr) JGH PELLET DELIVERY: TOTAL ELECTRIC POWER REQ'D (MM kWhr/yr) TOTAL N.G. FUEL THROUGH PELLET - MM mt/yr CONC. PLANT LABOR COSTS - (\$/mt PELLET) PELLET PLANT CONSUM. COSTS - (\$/mt PELLET) FINE ORE PIPELINE TRANSPORT COSTS - \$/mt EQUIPMENT COST AMORTIZATION - \$/mt (PEL.) EQUIPMENT MAINTENANCE & PARTS - \$/mt (PEL.) RAW MATERIAL VALUE ADDED - \$/mt \$10,000,000	AS-MINED ROCK WASTE ROCK DIESEL FUEL (MINING ETC.) MINE ELECTRICAL POWER REQ'D (MM kWhr/yr) RATION: IRON ORE TO CONCENTRATOR CONCENTRATE TO PIPELINE FEED DEWATERED TAILINGS TO DISPOSAL CONC. ELECTRICAL POWER REQ'D (MM kWhr/yr) CONC. SLURRY PIPELINE POWER (MM kWhr/yr) NET OXIDE FEED TO PELLETIZING DOLOMITE TO PELLETIZING DOLOMITE TO PELLETIZING DOLOMITE TO PELLETIZING NET PELLETS, ETC. TO SHIPMENT N.G. FUEL (DRYING, INDURATION, ETC.) PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr) TOTAL OTHER FEED TO PELLETIZING NET PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr) TOTAL OTHER FEED TO PELLETIZING NET PELLET S, ETC. TO SHIPMENT N.G. FUEL (DRYING, INDURATION, ETC.) PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr) TOTAL FUEL OIL THROUGH PELLET - MM mt/yr TOTAL FUEL OIL THROUGH PELLET - MM mt/yr TOTAL N.G. FUEL THROUGH PELLET - MM mt

DRY COLUDE LIQUID TOTAL

ACPCOK

18-June-2000

SUMMARY CONSUMABLES COPRODUCT COKE PRODUCTION

Rev. 2

BASIS:

1.000 MM MT/YR COPRODUCT COKE DELIVERED (TARGET)
1.111 MM MT/YR COPRODUCT COKE DELIVERED (CALCULATED)

SUMMARY:

1.5873 MM MT/YEAR BITUMINOUS COAL FEED
1.1111 MM MT/YEAR TOTAL COKE PRODUCT
0.000 MM MT/YEAR FINE COKE BREEZE

1.111 MM MT/YEAR SIZED COKE PRODUCT TO USE

ASSUMPTIONS: (R

5.000 FUEL REQUIREMENT COKE TRANS. - (kg/mt)
500 TRANSPORT DISTANCE, ONE WAY - (km)
24.50 COKE PLANT ELECTRICAL POWER REQ'D (kWhr/mt COKE)
\$1.30 FUEL COST - (\$/gal)
\$413.85 FUEL COST - (\$/mt)
\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED
\$2.50 N.G. COSTS - (\$/GJ)
49.78 N.G. - (GJ/mt)
\$124.45 N.G. COSTS - (\$/mt)
1,345.53 N.G. DENSITY - (Nm3/mt)
0.0007432 N.G. DENSITY - (mt/Nm3)

\$0.033 ELECTRIC POWER COSTS - (\$/kWhr)

\$72.70 COKING COAL ONLY

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL.
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
	COAL FEED	1.587	0.000	1.587
	COKE PRODUCT GROSS	1.111	0.000	1.111
	COKE BREEZE (FINES)	0.111	0.000	0.111
	COKE PRODUCED (NET TO SHIPMENT)	1.000	0.000	1.000
	TOTAL ELEC. POWER FOR COKE:	30.6157		
	TRANS. OF COKE (FUEL)		0.0056	
COSTS:		\$/YEAR	\$/T	
1.587	COAL FEED - MM mt/yr	\$115,396,710	\$115.40	
0.0056	TOTAL TRANSPORT FUEL - MM mt/yr	\$2,299,164	\$2.30	
30.6157	TOTAL ELECTRIC POWER - (MM kWhr/yr)	\$1,010,317	\$1.01	
\$10.66	TRANSPORT LABOR - (MN-HR/mt)	\$10,660,000	\$10.66	
\$3.134	COKE PLANT LABOR COSTS - \$/mt PROD	\$3,133,809	\$3.13	·
\$7.500	COKE PLANT OTHER - (\$/mt)	\$7,500,000	\$7.50	
	TOTAL:	\$140,000,000	\$140.00	

ANRCOK

SUMMARY CONSUMABLES NON-RECOVERY COKE/CO-GENERATION

18-June-2000 Rev. 2 BASIS:

1.000 MM MT/YR NON-RECOVERY COKE DELIVERED (TARGET)
1.000 MM MT/YR NON-RECOVERY COKE DELIVERED (CALCULATED)

SUMMARY:

4.2045	MM MT/YEAR FINE COAL SLURRY RECLAIMED FROM WASTE POND
0.0334	MM MT/YEAR COARSE REJECT SLURRY
4.1711	NET FEED TO COAL CLEANING/CONCENTRATION
1.2551	CLEANED COAL TO DRYER
0.9413	MM MT/YEAR BITUMINOUS COAL FEED TO CHARRING (DRY BASIS)
0.8256	MM MT/YEAR NET CHAR PRODUCT

1.1541 MM MT/YEAR TOTAL COKE PRODUCT 0.1541 MM MT/YEAR FINE COKE BREEZE

1.0000 MM MT/YEAR SIZED COKE PRODUCT TO USE

ASSUMPTIONS:

	5.50	ELECTRIC POWER CONSUMMED IN RECLAIM (kWhr/MT FEED)
	7.50	ELECTRIC POWER CONSUMMED IN CLEANING (kWhr/MT COAL FD.)
•	11.00	ELECTRIC POWER CONSUMMED IN CHARRING (kWhr/MT CHAR)
	12.00	ELECTRIC POWER CONSUMMED IN BRIQUET. (kWhr/MT BRIQ. FD.)
42	25.67	(kWhr/MT CHAR) ELECTRIC POWER GENERATED
5	15.50	(kWhr/MT COKE) ELECTRIC POWER GENERATED
\$	10.00	FINE COAL RECLAIMED - VALUE ADDED (\$/mt CONC.)

Ψ10.00	THE GOVE NEOD-TIMED - TALOE ADDED (DAIL GOTTO)	• /		
\$38.50	LABOR COSTS - (\$/MN-HR INCLUDING BURDEN)			
PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
CHAR PRODU	CT PRODUCTION:			
	FINE COAL SLURRY RECLAIMED	1.261	2.943	4.204
	ELECTRIC POWER IN COAL RECLAIM	6.937		
1	FINE COAL TO CLEANING	1.236	2.935	4.171
	ELECTRICAL POWER IN CLEANING	9.272		
Ì	CLEANED COAL TO DRYER	0.941	0.314	1.255
	DRIED COAL TO CHARRING FURNACE	0.941	0.060	1.001
	CHAR PRODUCT TO BRIQUETTING	0.826	0.000	0.826
1	ELECTRICAL POWER IN CHARRING	10.355		
1	TOTAL ELEC. THROUGH CHARRING	26.564		
	CO-GENERATED ELECTRIC POWER - CHAR	(351.444)	1	,
	NET ELECTRICAL POWER GENERATED - CHAR	(324.880)		
BRIQUETTING	OPERATION:			
	CHAR FEED TO BRIQUETTING	0.826	0.000	0.826
	COAL FEED TO BRIQUETTING	0.247	0.000	0.247
-	RECYCLE BREEZE FEED TO BRIQUET.	0.154	0.000	0.154
	PITCH FEED TO BRIQUETTING	0.160	0.000	0.160
	ELECTRIC POWER IN BRIQUETTING	16.641		
NON-RECOVE	RY COKING:			
	COKE PRODUCT GROSS	1.154	0.000	1.154
	COKE BREEZE (FINES)	0.154	0.000	0.154
	COKE PRODUCED (NET TO SHIPMENT)	1.000	0.000	1.000
	COKING ELECTRICAL POWER REQ'D	16.152		
	COKE ELECT. POWER CO-GENERATED	(515.493)	·	
	TOTAL ELECT. POWER REQUIRED COKE	32.793		
	NET ELECT. POWER PRODUCED COKE	(482.700)		
	TRANS. OF COKE		0.0058	

ANRCOK 18-June-2000

Rev. 2

SUMMARY CONSUMABLES NON-RECOVERY COKE/CO-GENERATION

COSTS:		\$/YEAR	\$/T - PROD	\$/T - COKE
	CHAR PRODUCT PRODUCTION:	···		· · · · · · · · · · · · · · · · · · ·
\$10.00	FINE COAL SLURRY RECLAIMED - (\$/mt DRY)	\$12,613,402	\$15.28	\$12.61
0.826	CHAR PRODUCT TO BRIQUETTING	-		
\$0.033	TOTAL ELEC. THROUGH CHARRING	\$876,619	\$1.06	\$0.88
\$0.033	CO-GENERATED ELECTRIC POWER - CHAR	(\$11,597,647)	(\$14.05)	(\$11.60)
\$0.033	NET ELECTRICAL POWER GENERATED - CHAR	(\$10,721,028)		
\$0.250	LABOR IN CHAR PRODUCT PROD (MN-HR/mt)	\$9,060,230	\$10.97	\$9.06
\$15.00	OTHER THROUGH CHARRING - (\$/mt CHAR)	<u>\$12,384,511</u>	<u>\$15.00</u>	<u>\$12.38</u>
	SUB-TOTAL CHAR FROM FINES:	\$23,337,115	\$28.27	\$23.34
	BRIQUETTING OPERATION:			
0.826	CHAR FEED TO BRIQUETTING	0.826		
	COAL FEED TO BRIQUETTING	\$14,357,645	\$14.36	\$14.36
\$150.00	PITCH FEED TO BRIQUETTING	\$9,315,662	\$9.32	\$9.32
\$0.033	ELECTRIC POWER IN BRIQUETTING	\$549,155	\$0.55	\$0.55
\$0.100	LABOR IN BRIQUETTING - (MN-HR/mt)	\$4,443,164	\$4.44	\$4.44
\$7.50	OTHER THROUGH CHARRING - (\$/mt CHAR)	<u>\$8,655,515</u>	<u>\$8.66</u>	<u>\$8.66</u>
	SUB-TOTAL BRIQUETTING:	\$37,321,141	\$37.32	\$37.32
	NON-RECOVERY COKING:			
	COKE PRODUCT GROSS	1.154		
	COKE PRODUCED (NET TO SHIPMENT)	1.000		
\$0.033	COKING ELECTRICAL POWER REQ'D - (kWhr/mt COKE)	\$533,026	\$0.53	\$0.53
\$0.033	COKE ELECT. POWER CO-GENERATED - (kWhr/mt COK	(\$17,011,276)	(\$17.01)	(\$17.01)
	NET ELECT. POWER PRODUCED COKE	(\$16,478,250)		
\$413.85	TRANS. OF COKE (FUEL \$/mt)	\$2,388,056	\$2.39	\$2.39
\$10.66	TRANSPORT LABOR - (MN-HR/MT COKE)	\$10,659,836	\$10.66	\$10.66
\$0.300	LABOR IN BRIQUETTING - (MN-HR/mt)	\$13,329,493	\$13.33	\$13.33
\$7.50	OTHER THROUGH CHARRING - (\$/mt CHAR)	<u>\$7,499,885</u>	<u>\$7.50</u>	<u>\$7.50</u>
	SUB-TOTAL COKING:	\$17,399,022	\$16.87	\$16.87
	TOTAL NON-RECOVERY COKE WITH CO-GENERATION:	\$78,057,278	\$82.45	\$77.53

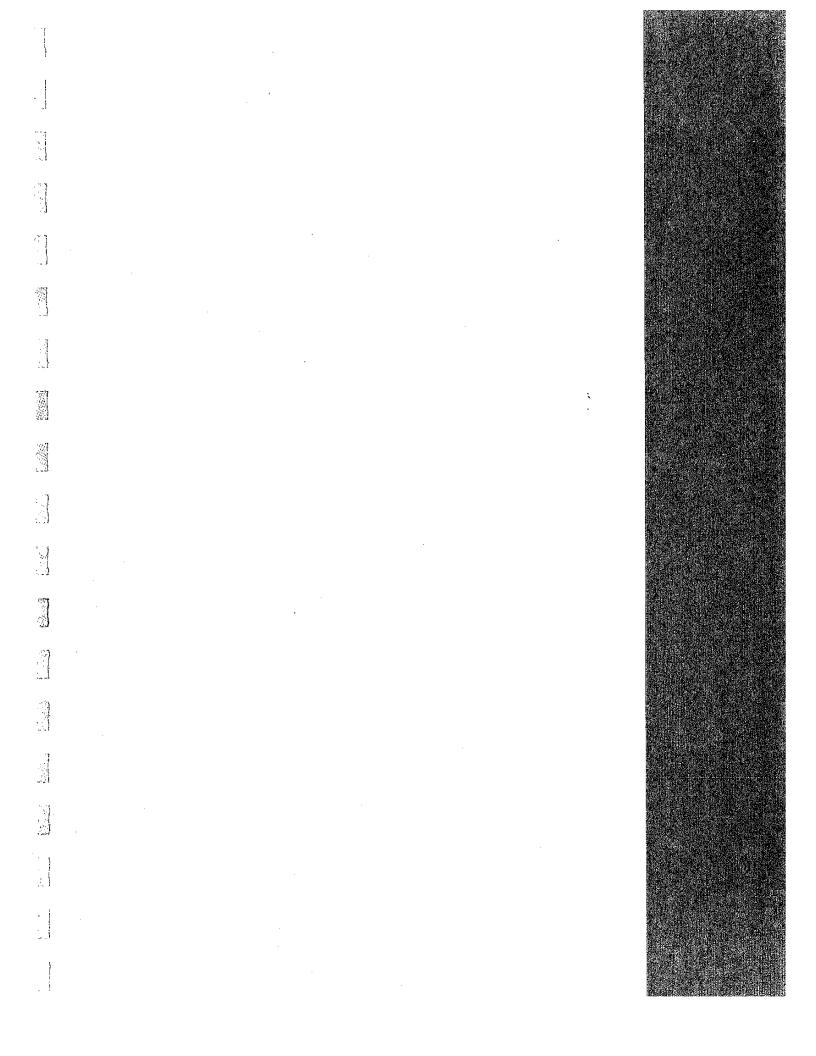
WEEKLY STEEL SCRAP PRICE COMPOSITE - \$/TON AND \$/mt

(From American Metal Market)

	(From American Metal Market)						
MONTH	WEEK		\$/TON			\$/mt	
		1998	1999	2000	1998	1999	2000
JANUARY	1	\$138.70	\$77.00	\$122.00	\$152.92	\$84.89	\$134.51
	2	\$138.70	\$79.00	\$122.00	\$152.92	\$87.10	\$134.51
]	3	\$138.50	\$82.00	\$122.00	\$152.70	\$90.41	\$134.51
	4	\$138.50	\$85.00	\$121.00	\$152.70	\$93.71	\$133.40
FEBRUARY	5	\$133.00	\$86.00	\$119.00	\$146.63	\$94.82	\$131.20
l i	6	\$131.50	\$90.00	\$115.00	\$144.98	\$99.23	\$126.79
	7	\$131.50	\$92.50	\$110.50	\$144.98	\$101.98	\$121.83
	8	\$128.00	\$95.00	\$110.50	\$141.12	\$104.74	\$121.83
MARCH	9	\$127.00	\$95.00	\$110.50	\$140.02	\$104.74	\$121.83
	10	\$125.00	\$87.00	\$110.50	\$137.81	\$95.92	\$121.83
	11	\$125.00	\$84.50	\$110.50	\$137.81	\$93.16	\$121.83
	12	\$125.00	\$84.50	\$110.50	\$137.81	\$93.16	\$121.83
	13	\$124.00	\$84.50	\$110.50	\$136.71	\$93.16	\$121.83
APRIL	14	\$124.00	\$84.50	\$110.50	\$136.71	\$93.16	\$121.83
	15	\$124.00	\$84.50	\$110.50	\$136.71	\$93.16	\$121.83
	16	\$124.00	\$84.50	\$103.00	\$136.71	\$93.16	\$113.56
	17	\$124.50	\$88.00	\$103.00	\$137.26	\$97.02	\$113.56
MAY	18	\$125.00	\$91.50	\$103.00	\$137.81	\$100.88	\$113.56
	19	\$125.00	\$91.50	\$102.00	\$137.81	\$100.88	\$112.46
	20	\$125.00	\$91.50	\$102.00	\$137.81	\$100.88	\$112.46
1	21	\$125.00	\$94.00	\$98.00	\$137.81	\$103.64	\$108.05
	22	\$123.00	\$95.00	\$98.00	\$135.61	\$104.74	\$108.05
JUNE	23	\$122.00	\$95.00	\$98.00	\$134.51	\$104.74	\$108.05
	24	\$122.00	\$95.00	\$98.00	\$134.51	\$104.74	\$108.05
1	25	\$122.00	\$95.00	\$95.00	\$134.51	\$104.74	\$104.74
	26	\$122.00	\$93.50	\$94.00	\$134.51	\$103.08	\$103.64
JULY	27	\$120.00	\$93.50	\$93.50	\$132.30	\$103.08	\$103.08
1	28	\$119.50	\$93.50	\$93.50	\$131.75	\$103.08	\$103.08
	29	\$119.50	\$97.50	\$94.00	\$131.75	\$107.49	\$103.64
	30	\$119.50	\$100.00	\$94.00	\$131.75	\$110.25	\$103.64
	31	\$119.50	\$100.00		\$131.75	\$110.25	
AUGUST	32	\$112.00	\$100.00		\$123.48	\$110.25	
	33	\$109.00	\$100.00		\$120.17	\$110.25	
	34	\$108.00	\$100.00		\$119.07	\$110.25	
	45	\$108.00	\$100.00		\$119.07	\$110.25	
	46	\$103.00	\$100.00		\$113.56	\$110.25	
SEPTEMBER		\$101.00	\$100.00		\$111.35	\$110.25	
İ	38	\$98.00	\$100.00		\$108.05	\$110.25	
1	39	\$98.00	\$100.00	-	\$108.05	\$110.25	
	40	\$95.50	\$100.00		\$105.29	\$110.25	
OCTOBER	41	\$89.00	\$100.00		\$98.12 \$92.61	\$110.25	
	42	\$84.00	\$100.00		1	\$110.25	
	43	\$81.50	\$105.00 \$108.00		\$89.85	\$115.76	
NOVEMBER	44 45		\$108.00		\$89.85 \$86.00	\$119.07 \$119.62	
NOVEMBER	L	\$78.00	\$108.50		I .		
	46 47	1	\$100.00		\$81.59 \$81.03	\$119.62 \$121.28	
	48	i .	\$116.50		\$81.03	\$128.44	
DECEMBER	49		\$117.00		\$79.38	\$128.99	
DESCIMBLE	50	1 '	\$117.00]	\$79.38	\$128.99	
	51	\$71.50	\$120.00]	\$78.83	\$132.30	
	52	i i	\$122.00		\$82.69	\$134.51	
<u> </u>	1	¥10.00	1 4.22.00	E .		¥.04.01	
1			MEDIAN P	RICE (1998-	2000):	\$115.00	

160 140 120 ----SCRAP COMP. -+- MEDIAN PRICE 100 WEEKLY FROM JAN. 1998 80 9 4 20 \$180.00 \$60.00 \$40.00 \$20.00 \$0.00 \$160.00 \$140.00 \$120.00 \$100.00 \$80.00 COMPOSITE SCRAP PRICE - \$/mt

STEEL SCRAP PRICE COMPOSITE (\$/mt WEEKLY FROM JANUARY 1998)



APPENDIX F-2

IRONMAKING PROCESS CONSUMPTIONS & RELATIVE OPERATING COSTS

SHAFT FURNACE DRI PROCESSES

HOT METAL VARIATIONS

ROTARY HEARTH DRI FURNACES

FLUID BED DRI/HBI PROCESSES

OTHER PROCESSES

F-2 Ironmaking Process Consumptions & Relative Operating Costs

The Ironmaking Process Consumptions and their Relative Operating Costs are built up from the costs of the various consumable materials in a similar manner.

- Consumable components as defined by the mass and fuel balances for the Ironmaking Processes (Appendices C & D).
- Electrical power consumptions from experience or Process Vendor data.
- Labor estimates were factored from man-hour/mt data supplied by Process Vendors and experience with similar processes.
- Costs for transport of materials included in material costs.
- Allowances for maintenance materials and supplies based on Vendor factors.
- Other consumable cost assumptions, e.g. composite steel scrap, overall labor cost per man-hour, natural gas, electrical power, and other delivered materials are based on an upper mid-West U.S.A. location. These were derived from negotiated commodity costs achieved for a recent large-scale project in that region.
- As appropriate, allowances for G&A and/or Vendor fees were added.
- Each Ironmaking Process Cost was derived from the summation of the individual costs of each unit operation involved in producing the Iron Units and subsequent production of EAF/LRF Refined Steel Product.

The Process Operating Costs, (OPEX), developed in the above fashion are believed to be relatively precise as a basis for comparing the various processes on an equalized footing. By normalizing all processes through the production of the Refined Liquid Steel product, all types of iron units produced by the Ironmaking Processes can be compared. The relative accuracy of each of the components of the OPEX based on closure of the mass balances should produce a fair overall cost for each process that can be compared accurately to each other. Thus the ranking exercise and other comparisons between processes should be relatively accurate.

It is also believed that the absolute accuracy of these OPEX costs are also relatively precise. Spot checks of the estimated costs and comparisons with recent detailed feasibility studies using Vendor data of these and similar processes have verified the accuracy of the built up operating cost calculation procedure. The Ironmaking Process Operating Costs are provided for:

SHAFT FURNACE DRI PROCESSES

- F2.1 Base Process Shaft Furnace (i.e. Midrex), 100% DRI charge to EAF, 1.0 wt.% DRI Carbon (Appendix C-1)
- F2.2 Base Process Shaft Furnace (i.e. Midrex), 100% DRI charge to EAF, 2.5 wt.% DRI Carbon (for reference, Appendix C-2)
- F2.3 Electric Arc Furnace Steelmaking, 100% Steel Scrap Charge (for reference, Appendix C-3)
- F2.4 Base Process Shaft Furnace (i.e. Midrex), 30% DRI/70% Steel Scrap charge to EAF (a common industry practice), 1.0 wt.% DRI Carbon (Appendix C-4)
- F2.5 Base Process Shaft Furnace (i.e. Midrex), 30 % DRI/70% Steel Scrap charge to EAF (for reference, Appendix C-5)
- F2.6 HYLSA IVM Shaft Furnace without reformer, 100% hot DRI charge to EAF, (Appendix C-6)

HOT METAL VARIATIONS

- F2.7 Blast Furnace Hot Metal (30% H.M./70% Steel Scrap charge to EAF), Conventional Co-Product Coke (Appendix C-7)
- F2.8 Mini Blast Furnace Comparison (30% H.M./70% Steel Scrap charge to EAF), Co-Product Coke
- F2.9 Blast Furnace Hot Metal (30% H.M./70% Steel Scrap charge to EAF), Non-Recovery Coking process with Co-Generation (for comparison, Appendix C-8)
- F2.10 Cold Pig Iron (30% P.I./70% Steel Scrap charge to EAF), Conventional Co-Product Coke (Appendix C-9)
- F2.11 Tecnored Hot Metal (30% H.M./70% Steel Scrap charge to EAF) with integral Co-Generation of Electrical Power (Appendix C-10)
- F2.12 Tecnored Hot Metal (30% H.M./70% Steel Scrap charge to EAF) without Co-Generation of Electrical Power (Appendix C-11)
- F2.13 Corex (VAI)/Midrex Shaft Furnace combination process, 60% H.M./40% DRI charge to EAF (Appendix C-12)
- F2.14 HiSmelt Enriched Oxygen Reactor Process, 32.7% H.M. feed to EAF (Appendix C-13)

ROTARY HEARTH DRI FURNACES

- F2.15 REDSMELT (Mannessmann) process to produce RHF DRI, Hot Metal utilizing a SAF, recycle scrap only charge to EAF (Appendix C-14)
- F2.16 MauMee Research & Engineering Briquette DRI charge (100% with only recycle scrap charge to EAF) (Appendix C-15)
- F2.17 ITMK3 (Midrex RHF) process producing reduced shot iron pellets charge to Melter/EAF (100% with only recycle scrap charge to EAF) (Appendix C-16)
- Note: Other Rotary Hearth Processes, e.g. Inmetco, Iron Dynamics, FastMet/FastMelt, etc. are so generically similar to those above, that they were not individually considered.

FLUID-BED DRI/HBI

- F2.18 Circored (Lurgi) natural gas based circulating fluid bed/bubbling bed fine ore process with 100% HBI charge to EAF (Appendix C-17)
- F2.19 Circofer (Lurgi) fine coal and fine ore circulating fluid bed/bubbling bed with HBI charge to SAF and low-carbon, low-Si H.M. charge to EAF (Appendix C-18)
- F2.20 Finmet (VAI) multi-stage fluidized bed fine ore process, natural gas based, 100% HBI charge to EAF (Appendix C-19)
- F2.21 Generic Iron Carbide Process (to represent all process variations and/or configurations) with 100% IC charge to EAF (Appendix C-20)
- F2.22 Generic Iron Carbide Process with 40% IC/60% Scrap charge to EAF (considered to be a practical limit for charging iron carbide to the EAF)

OTHER PROCESSES

F2.23 SL/RN (Stelco-Lurgi) Rotary Kiln reduction process to produce 100% sponge iron charge to EAF with only recycle Scrap (Appendix C-21)

SHAFT FURNACE DRI PROCESSES

ABASE

SUMMARY CONSUMABLES

18-June-2000

BASE PROCESS SHAFT FURNACE DRI/EAF

Rev. 2

100% DRI CHARGE - 1.0 wt.% CARBON

BASIS:

1.0000 MM MT/YEAR LIQUID STEEL PRODUCT 0.9768 MM MT/YEAR NET SLAB PRODUCT

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
ORE MINING:	, , , , , , , , , , , , , , , , , , ,	((1	(1.11.)
	AS-MINED ROCK	6.2935	0.1946	6.4882
	WASTE ROCK	3.8060	0.1177	3.9237
	DIESEL FUEL (MINING ETC.)	3.0200	0.0327	0.0201
	MINE ELECTRICAL POWER REQ'D (MM kWhr/yr)	31.4785	0.0027	
		01.4700		
ORE CONCENT	RATION:	<u> </u>		****
	IRON ORE TO CONCENTRATOR	2.4876	0.0769	2.5645
	CONCENTRATE TO PIPELINE FEED	1.4652	0.7889	2.2541
	DEWATERED TAILINGS TO DISPOSAL	1.0224	1.8987	2.9211
	CONC. ELECTRICAL POWER REQ'D (MM kWhr/yr)	69,9415		2.0211
	CONC. SLURRY PIPELINE POWER (MM kWhr/vr)	122.0979		
	,			
PELLETIZING:		- 		
	NET OXIDE FEED TO PELLETIZING	1.9693	0.1727	2.1420
	BINDER TO PELLETIZING	0.0118	0.0000	0.0118
	DOLOMITE TO PELLETIZING	0.0402	0.0000	0.0402
	TOTAL OTHER FEED TO PELLETIZING	0.5041		
	FUEL (DRYING, INDURATION, ETC.)		0.0514	
	PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr)	128.0051	5.55.1	
SHAFT FURNA	CE DIRECT REDUCTION:			
	NET PELLETS, ETC. TO SHAFT FCE.	1.7807	0.0000	1.7807
	DRI TO EAF (1.0% C)	1.0450	0.0000	1.0450
	FUEL TO DRI	1	0.2555	
	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	141.5137		
EAF STEELMA	(MC·	<u>l.,. </u>		
EAF STEELMA	TOTAL STEEL SCRAP (100% DRI)	0.0648	0.0000	0.0040
	MISC. ADDITIVES	0.0070	0.0000	0.0648
	STEEL C (CHARGE+SLAG INJ)		0.0000	0.0070
	EAF ELECTRODES	0.0120	0.0000	0.0120
	LIME CHARGED	0.0038	0.0000	0.0038
	O2 GAS TO EAF (MM Nm3/YR)	0.0124	0.0000	0.0124
	AUX. FUEL TO EAF		11.0000	
			0.0023	
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	736.0266		
LADLE REFININ	IG:	l	<u> </u>	
	LIQ. EAF STEEL TO LRF	0.0000	1.0549	1.0549
	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
	SLAGWIRE DESULFURIZER TO LRF	0.0004	0.0000	0.0003
	ARGON GAS TO LRF (MM Nm3/YR)	0.0004	0.0633	0.0004
	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8973	0.0633	
	REFINED STEEL TO CASTING	1	4 0000	4 0000
	NET STEEL SLAB PRODUCED	0.0000	1.0000	1.0000
	HET GILLE GLAD FRODUCED	0.9768	0.0000	0.9768

ABASE

SUMMARY CONSUMABLES BASE PROCESS SHAFT FURNACE DRI/EAF

18-June-2000 Rev. 2

100% DRI CHARGE - 1.0 wt.% CARBON

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED \$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt \$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT		(10111111111111111111111111111111111111	Ψ Ε	Ψ//// 2.5.	ψ/mc ONT
	ORE:				***************************************
\$43.89	IRON ORE CONC. DELIVERED - (\$/mt DRY)	1.4652	\$64,306,540	\$64.31	\$43.89
	PELLETIZING:		<u></u>		V /0.00
	NET PELLETS, ETC. TO SHAFT FCE.	1.7807			
0.0742	PELLETIZATION LABOR - (MN-HR/mt PELLETS)	1.7807	\$5,090,195	\$5.09	\$2.86
\$90.02	BINDER TO PELLETIZING - (\$/mt BINDER)	0.0118	\$1,063,663	\$1.06	\$0.60
\$77.83	DOLOMITE TO PELLET (\$/mt LIME/DOL.)	0.0402	\$3,127,985	\$3.13	\$1.76
\$2.36	PELLET OTHER - (\$/mt PELLETS)	1.7807	\$4,202,507	\$4.20	\$2.36
\$0.033	PELLET ELECTRICAL - (MM kWhr/yr)	128.0051	\$4,224,167	\$4.22	\$2.37
\$124.45	PELLET N.G. FUEL - (\$/mt)	0.0514	\$6,392,588	\$6.39	\$3.59
	SUB-TOTAL PELLETIZING:		\$24,101,105	\$24.10	\$13.53
	DIRECT REDUCTION IN SHAFT FURNACE:			·	, , , , , , , , , , , , , , , , , , , ,
1	DRI TO EAF (1.0% C)	1.0450		1	• • •
0.0401	DRI LABOR - (MN-HR/mt DRI)	1.0450	\$1,611,721	\$1.61	\$1.54
11.39	DRI OTHER - (\$/mt DRI)	1.0450	\$11,902,822	\$11.90	\$11.39
\$0.033	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	141.5137	\$4,669,951	\$4.67	\$4.47
\$124.45	N.G. FUEL TO DRI - (\$/mt)	0.2555	\$31,802,440	\$31.80	\$30.43
	SUB-TOTAL DRI PRODUCTION:		\$49,986,934	\$49.99	\$47.83
	EAF STEELMAKING:		· · · · · · · · · · · · · · · · · · ·	,	
	REFINED STEEL TO LRF	1.0549			
\$10.00	TOTAL STEEL SCRAP (100% DRI, REVERT ONLY)	0.0648	\$647,911	\$0.65	\$0.61
\$1,076.24	MISC. ADDITIVES - (AVG. \$/mt)	0.0070	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0120	\$698,201	\$0.70	\$0.66
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,939,447	\$3.94	\$3.73
\$77.10	LIME CHARGED	0.0124	\$952,588	\$0.95	\$0.90
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	11.0000	\$462,000	\$0.46	\$0.44
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.25
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$15.95
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	736.0266	\$24,288,878	\$24.29	\$23.02
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,65 <u>6</u>	<u>\$0.29</u>	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$60,172,682	\$60.17	\$57.04
	LADLE REFINING:				
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$892,991	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,303	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,182	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8973	<u>\$1,151,610</u>	<u>\$1.15</u>	<u>\$1.15</u>
	SUB-TOTAL LRF:		\$6,815,685	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$205,382,946	\$205.38	

18-June-2000

SUMMARY CONSUMABLES BASE PROCESS SHAFT FURNACE DRI/EAF 100% DRI CHARGE - 2.5% C

Rev. 2

BASIS:

1.0000 MM MT/YEAR LIQUID STEEL PRODUCT 0.9774 MM MT/YEAR NET SLAB PRODUCT

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
ORE MINING:				
0112 11111111111	AS-MINED ROCK	6.3014	0.1949	6.4963
	WASTE ROCK	3.8107	0.1179	3.9286
	DIESEL FUEL (MINING ETC.)	1	0.0327	
	MINE ELECTRICAL POWER REQ'D (MM kWhr/yr)	31.5022		
	WHITE ELECTRONIC STREET, COMMISSION,			
ORE CONCEN	RATION:		0.0770	2.5677
	IRON ORE TO CONCENTRATOR	2.4907	0.0770	
	CONCENTRATE TO PIPELINE FEED	1.4670	0.7899	2.2569
	DEWATERED TAILINGS TO DISPOSAL	1.0237	1.9011	2.9247
	CONC. ELECTRICAL POWER REQ'D (MM kWhr/yr)	69.9937		
	CONC. SLURRY PIPELINE POWER (MM kWhr/yr)	122.2500		
DELL ETIZOLO				
PELLETIZING:	NET OXIDE FEED TO PELLETIZING	1.9714	0.1729	2.1443
	BINDER TO PELLETIZING	0.0118	0.0000	0,0118
		0.0402	0.0000	0.0402
	DOLOMITE TO PELLETIZING	0.5044	0.0000	0.0.10
	TOTAL OTHER FEED TO PELLETIZING	0.5044	0.0514	i
	FUEL (DRYING, INDURATION, ETC.)	400 4440	0.0514	
	PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr)	128.1416		
SHAFT FURNA	ACE DIRECT REDUCTION:	_ !		
	NET PELLETS, ETC. TO SHAFT FCE.	1.7826	0.0000	1.7826
	DRI TO EAF (2.5% C)	1.0624	0.0000	1.0624
	FUEL TO DRI		0.2598	
1	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	143.8703		
EAF STEELM	AKING:	0.0648	0.0000	0.0648
	TOTAL STEEL SCRAP (100% DRI)	0.0072	0.0000	0.0072
	MISC. ADDITIVES	1	0.0000	0.0099
	STEEL C (CHARGE+SLAG INJ)	0.0099		0.0099
	EAF ELECTRODES	0.0045	0.0000	
	LIME CHARGED	0.0126	0.0000	0.0126
	O2 GAS TO EAF (MM Nm3/YR)		19.2500	
Ì	AUX. FUEL TO EAF	l	0.0023	
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	736.4717		Ĭ.
LADLE REFIN	UNIC:	1	<u></u>	<u> </u>
LAULE KEFIN	LIQ. EAF STEEL TO LRF	0.0000	1.0549	1.0549
	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
1	SLAGWIRE DESULFURIZER TO LRF	0.0004	0.0000	1
		0.0004	0.0633	1
	ARGON GAS TO LRF (MM Nm3/YR)	24.0404	1 0.0033	
	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9184	4 0000	1 000
1	REFINED STEEL TO CASTING	0.0000	1.0000	l .
1	NET STEEL SLAB PRODUCED	0.9774	0.0000	0.9774

18-June-2000

SUMMARY CONSUMABLES BASE PROCESS SHAFT FURNACE DRI/EAF

Rev. 2

100% DRI CHARGE - 2.5% C

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt \$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT	ORE:				
\$43.89	IRON ORE CONC. DELIVERED - (\$/mt DRY)	1.4670	\$64,386,622	\$64.39	\$43.89
	PELLETIZING:				
	NET PELLETS, ETC. TO SHAFT FCE.	1.7826			
0.0742	PELLETIZATION LABOR - (MN-HR/mt PELLETS)	1.7826	\$5,095,625	\$5.10	\$2.86
\$90.02	BINDER TO PELLETIZING - (\$/mt BINDER)	0.0118	\$1,064,798	\$1.06	\$0.60
\$77.83	DOLOMITE TO PELLET (\$/mt LIME/DOL.)	0.0402	\$3,131,322	\$3.13	\$1.76
\$2.36	PELLET OTHER - (\$/mt PELLETS)	1.7826	\$4,206,990	\$4.21	\$2.36
\$0.033	PELLET ELECTRICAL - (MM kWhr/yr)	128.1416	\$4,228,673	\$4.23	\$2.3
\$124,45	PELLET N.G. FUEL - (\$/mt)	0.0514	\$6,399,407	\$6.40	\$3.59
	SUB-TOTAL PELLETIZING:		\$24,126,816	\$24.13	\$13.5
_	DIRECT REDUCTION IN SHAFT FURNACE:				
	DRI TO EAF (1.0% C)	1.0450			
0.0401	DRI LABOR - (MN-HR/mt DRI)	1.0450	\$1,611,721	\$1.61	\$1.5
11.39	DRI OTHER - (\$/mt DRI)	1.0450	\$11,902,822	\$11.90	\$11.3
\$0.033	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	141.5137	\$4,669,951	\$4.67	\$4.4
\$124.45	N.G. FUEL TO DRI - (\$/mt)	0.2555	\$31,802,440	\$31.80	\$30.4
1	SUB-TOTAL DRI PRODUCTION:		\$49,986,934	\$49.99	\$47.8
	EAF STEELMAKING:				,
	REFINED STEEL TO LRF	1.0549			
\$10.00	TOTAL STEEL SCRAP (100% DRI, REVERT ONLY)	0.0648	\$648,303	\$0.65	\$0.6
\$1,058.61	MISC. ADDITIVES - (AVG. \$/mt)	0.0072	\$7,580,000	\$7.58	\$7.1
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0099	\$576,293	\$0.58	\$0.5
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0045	\$4,605,810	\$4.61	\$4.3
\$77.10	LIME CHARGED	0.0126	\$968,452	\$0.97	\$0.9
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	19.2500	\$808,500	\$0.81	\$0.7
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.2
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$15.9
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	736.4717	\$24,303,567	\$24.30	\$23.0
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,831	\$0.29	\$0.2
1	SUB-TOTAL EAF STEELMAKING:		\$61,094,755	\$61.09	\$57.9
	LADLE REFINING:		1	******	
	LIQ. EAF STEEL TO CASTING	1.0000			·
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$893,531	\$0.89	\$0.8
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,459	\$0.26	\$0.2
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,191	\$0.02	\$0.0
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.5
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9184	\$1,152,306	\$1.15	\$1.1
	SUB-TOTAL LRF:		\$6,817,087	\$6.82	\$6.8
	TOTAL THROUGH LIQUID STEEL:		\$206,412,215	\$206.41	40.0

ASC100 SUMMARY CONSUMABLES

19-June-2000 ELECTRIC ARC FURNACE WITH SCRAP CHARGE ONLY

Rev. 2 100% STEEL SCRAP CHARGE TO EAF

BASIS:

1.000 MM MT/YEAR LIQUID STEEL PRODUCT 0.977 MM MT/YEAR NET SLAB PRODUCT

SUMMARY:

1.028 MM MT/YEAR PURCHASED SCRAP FEED TO EAF 0.050 MM MT/YEAR REVERT SCRAP FEED TO EAF

0.000 MM MT/YEAR NET DRI TO EAF

0.000	MINIMITYEAR NET DRITO EAF			
PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
EAF STEELMAKING:				
1	REVERT SCRAP CHARGE TO EAF	0.0496	0.0000	0.0496
1	PURCHASED SCRAP CHARGE TO EAF	1.0280	0.0000	1.0280
	TOTAL STEEL SCRAP (100%)	1.0776	0.0000	1.0776
1	MISC. ADDITIVES	0.0070	0.0000	0.0070
	STEEL C (CHARGE+SLAG INJ)	0.0119	0.0000	0.0119
	EAF ELECTRODES	0.0038	0.0000	0.0038
	LIME CHARGED	0.0122	0.0000	0.0122
	O2 GAS TO EAF (MM Nm3/YR)		11.91	
	LIQ. EAF STEEL TO LRF	0.0000	1.0543	1.0543
	AUX. N.G. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (kWhr/yr)	726.931		
LADLE REFIN	ING FURNACE:			
***************************************	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
	SLAG/WIRE DESULFURIZER TO LRF	0.0004	0.0000	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)		0.0633	
	LRF ELECTRICAL POWER REQ'D	34.8964		
	REFINED STEEL TO CASTING	0.0000	1.0521	1.0521
	NET STEEL SLAB PRODUCED	0.9768	0.0000	0.9768

ASC100

SUMMARY CONSUMABLES

19-June-2000

ELECTRIC ARC FURNACE WITH SCRAP CHARGE ONLY

Rev. 2

100% STEEL SCRAP CHARGE TO EAF

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

\$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT		,	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	7	4
	EAF STEELMAKING:		,		
	REFINED STEEL TO LRF	1.0543		7	T
\$10.00	STEEL SCRAP (REVERT)	0.0496	\$495,681	\$0.50	\$0.47
\$140.00	PURCHASED STEEL SCRAP	1.0280	\$143,920,000	\$143.92	\$136.51
\$1,087.23	MISC. ADDITIVES - (AVG. \$/mt)	0.0070	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0119	\$691,146	\$0.69	\$0.66
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,899,645	\$3.90	\$3.70
\$77.10	LIME CHARGED	0.0122	\$942,964	\$0.94	\$0.89
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	11.9131	\$500,350	\$0.50	\$0.47
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4,49	\$4.25
\$24.83	EAF OTHER, INCL. OSBL - (\$/mt L.S.)	1.0000	\$24,830,000	\$24.83	\$23.55
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	726.9314	\$23,988,736	\$23.99	\$22.75
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,649	\$0.29	\$0.27
<u></u>	SUB-TOTAL EAF STEELMAKING:		\$211,622,171	\$211.13	\$200.26
	LADLE REFINING:		,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		
	LIQ. EAF STEEL TO CASTING	1.0521	1		
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$892,969	\$0.89	\$0.85
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,297	\$0.26	\$0.25
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,182	\$0.02	\$0.01
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.27
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8964	\$1,151,582	\$1.15	\$1.09
	SUB-TOTAL LRF:		\$6,815,629	\$6.82	\$6.48
			, , , , , , , , , , , , , , , , , , , ,		00710
	TOTAL THROUGH LIQUID STEEL:		\$218,437,800	\$217.94	
			. ,,	, 2	

SUMMARY CONSUMABLES

18-June-2000

BASE PROCESS SHAFT FURNACE DRI/EAF 30% DRI CHARGE - 1.0 WT.% CARBON

Rev. 2 BASIS:

1.0000 MM MT/YEAR LIQUID STEEL PRODUCT 0.9767 MM MT/YEAR NET SLAB PRODUCT

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
ORE MINING:		(11111)	(17113)	(MINI LYTEX)
,	AS-MINED ROCK	2.0874	0.0646	2,1520
ļ	WASTE ROCK	1,2623	0.0390	1.3014
	DIESEL FUEL (MINING ETC.)	1.2025	0.0099	1.5014
1	MINE ELECTRICAL POWER REQ'D (MM kWhr/yr)	16.1883	0.0099	
	MANUEL ELECTRICAL POWER (NEW KWINNY)	10,1003	i	
ORE CONCENT	FRATION:		<u></u>	· · · · · · · · · · · · · · · · · · ·
	IRON ORE TO CONCENTRATOR	0.8251	0.0255	0.8506
	CONCENTRATE TO PIPELINE FEED	0.4860	0.2617	0.7476
	DEWATERED TAILINGS TO DISPOSAL	0.3391	0.6298	0.9689
	CONC. ELECTRICAL POWER REQ'D (MM kWhr/yr)	36.0713	0.0250	0.9009
	CONC. SLURRY PIPELINE POWER (MM kWhr/vr)	40.4968		
•	OOMO. OLOMAN T. II. ELEMET OWNER (MANY ROVINING)	40.4300		
PELLETIZING:		<u> </u>		
	NET OXIDE FEED TO PELLETIZING	0.8419	0.0738	0.9157
1	BINDER TO PELLETIZING	0.0051	0.0000	0.0051
	DOLOMITE TO PELLETIZING	0.0172	0.0000	0.0172
	TOTAL OTHER FEED TO PELLETIZING	0.3559	0.0000	0.0172
ļ	FUEL (DRYING, INDURATION, ETC.)	0.5559	0 0000	
	PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr)	E4 7000	0.0220	
	TELLET ELECTRICAL FOWER REQ D (WWW RVVIII/YI)	54.7208		
SHAFT FURNA	CE DIRECT REDUCTION:	<u></u>	I	
	NET PELLETS, ETC. TO SHAFT FCE.	0.7612	0.0000	0.7612
[DRI TO EAF (1.0% C)	0.3527	0.0000	0.3527
	FUEL TO DRI	3.002.	0.0863	0.5521
	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	47.7673	0.0003	
	The second of th	47.1075]	
EAF STEELMA	KING:			
	TOTAL STEEL SCRAP (30% DRI)	0.7364	0.0000	0.7364
	MISC. ADDITIVES	0.0071	0.0000	0.0071
	STEEL C (CHARGE+SLAG INJ)	0.0122	0.0000	0.0122
	EAF ELECTRODES	0.0039	0.0000	0.0039
	LIME CHARGED	0.0125	0.0000	0.0039
	O2 GAS TO EAF (MM Nm3/YR)	0.0123	11.8117	0.0125
	AUX. FUEL TO EAF			
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	707.0040	0.0023	
	EAF ELECTRICAL FOWER REQ D (WIN KWINTYF)	737.2919		
LADLE REFINI	NG:	<u> </u>		
	LIQ. EAF STEEL TO LRF	0.0000	1.0541	1.0541
	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
	SLAG/WIRE DESULFURIZER TO LRF	0.0004	0.0000	0.0003
	ARGON GAS TO LRF (MM Nm3/YR)	0.0004	0.0632	0.0004
	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8913	0.0032	
	REFINED STEEL TO CASTING		4 0000	
	NET STEEL SLAB PRODUCED	0.0000	1.0000	1.0000
L	MET STEEL SLAD FRODUCED	0.9767	0.0000	0.9767

18-June-2000

SUMMARY CONSUMABLES BASE PROCESS SHAFT FURNACE DRI/EAF 30% DRI CHARGE - 1.0 WT.% CARBON

Rev. 2

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION \$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

\$413.85 DIESEL FUEL COSTS - \$/mt \$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
FERONII	ORE:	<u> </u>			
\$43.89	IRON ORE CONC. DELIVERED - (\$/mt DRY)	0.4860	\$21,328,869	\$21.33	\$43.89
V.0.00	PELLETIZING:	0.4000	Ψ21,320,009	<u> Φ</u> 21.33 [\$43.09
	NET PELLETS, ETC. TO SHAFT FCE.	0.7612	- 		
0.0742	PELLETIZATION LABOR - (MN-HR/mt PELLETS)	0.7612	\$2,176,003	\$2.18	\$2.86
\$90.02	BINDER TO PELLETIZING - (\$/mt BINDER)	0.0051	\$454,704	\$0.45	\$0.60
\$77.83	DOLOMITE TO PELLET (\$/mt LIME/DOL.)	0.0172	\$1,337,180	\$0.45 \$1.34	\$0.00 \$1.76
\$2.36	PELLET OTHER - (\$/mt PELLETS)	0.7612	\$1,796,526	\$1.80	\$2.36
\$0.033	PELLET ELECTRICAL - (MM kWhr/yr)	54.7208	\$1,805,785	\$1.80 \$1.81	\$2.30
\$124.45	PELLET N.G. FUEL - (\$/mt)	0.0220	\$2,732,762	\$2.73	\$3.59
	SUB-TOTAL PELLETIZING:	0.0220	\$10,302,960	\$10.30	\$13.53
<u>. </u>	DIRECT REDUCTION IN SHAFT FURNACE:		\$10,002,000 T	ψ10.50 <u> </u>	φ15,55
	DRI TO EAF (1.0% C)	0.3527			
0.0401	DRI LABOR - (MN-HR/mt DRI)	0.3527	\$544,029	\$0.54	\$1.54
11.39	DRI OTHER - (\$/mt DRI)	0.3527	\$4,017,744	\$4.02	\$11.39
\$0.033	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	47.7673	\$1,576,321	\$1.58	\$4.47
\$124.45	N.G. FUEL TO DRI - (\$/mt)	0.0863	\$10,734,770	\$10.73	\$30.43
,	SUB-TOTAL DRI PRODUCTION:	0.0000	\$16,872,863	\$16.87	\$47.83
·	EAF STEELMAKING:	V- 4-A	φ10,012,000 <u> </u>	ψ10.07	Ψ1.00
	REFINED STEEL TO LRF	1.0541		*****	*****
\$140.00	TOTAL STEEL SCRAP (30% DRI, REVERT & BUNDLE		\$103,092,630	\$103.09	\$97.80
\$1,061.37	MISC. ADDITIVES - (AVG. \$/mt)	0.0071	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0122	\$707,982	\$0.71	\$0.67
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0039	\$3,994,636	\$3.99	\$3.79
\$77.10	LIME CHARGED	0.0125	\$965,933	\$0.97	\$0.92
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	11.8117	\$496,093	\$0.50	\$0.47
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.25
\$16.83	EAF OTHER - (\$/mt L.S.)	1,0000	\$16,830,000	\$16.83	\$15.97
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	737,2919	\$24,330,632	\$24.33	\$23.08
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,607	\$0.29	\$0.27
i	SUB-TOTAL EAF STEELMAKING:		\$162,771,513	\$162.77	\$154.41
,	LADLE REFINING:	·	****	+	
	LIQ. EAF STEEL TO CASTING	1.0000	1		
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$892,837	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,259	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0632	\$15,179	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8913	\$1,151,412	\$1.1 <u>5</u>	\$1.15
	SUB-TOTAL LRF:		\$6,815,288	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$218,091,493	\$218.09	

SUMMARY CONSUMABLES BASE PROCESS SHAFT FURNACE DRI/EAF

Rev. 2

18-June-2000

30% DRI CHARGE - 2.5% C

BASIS:

1.0000 MM MT/YEAR LIQUID STEEL PRODUCT 0.9767 MM MT/YEAR NET SLAB PRODUCT

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
ORE MINING:		(101101 17774)	(IVIIVI 1711K)	(MINITAL)
	AS-MINED ROCK	2.0888	0.0646	2.1534
	WASTE ROCK	1.2632		
	DIESEL FUEL (MINING ETC.)	1.2032	0.0391	1.3023
	MINE ELECTRICAL POWER REQ'D (MM kWhr/yr)	40.4040	0.0099	
	WINE ELECTRICAL FOWER REQ D (WIM RVVIII/YI)	16.1948	į	
ORE CONCENT			*-	· · · · · · · · · · · · · · · · · · ·
	IRON ORE TO CONCENTRATOR	0.8256	0.0255	0.8511
	CONCENTRATE TO PIPELINE FEED	0.4863	0.2618	0.7481
	DEWATERED TAILINGS TO DISPOSAL	0.3393	0.6302	0.9695
	CONC. ELECTRICAL POWER REQ'D (MM kWhr/yr)	36.0857	0.0002	0.5055
	CONC. SLURRY PIPELINE POWER (MM kWhr/yr)	40.5237	i	
DELL ETITLE				
PELLETIZING:	NET OXIDE FEED TO PELLETIZING	0.0400	0.000.1	
	BINDER TO PELLETIZING	0.8422	0.0739	0.9161
		0.0051	0.0000	0.0051
	DOLOMITE TO PELLETIZING	0.0172	0.0000	0.0172
	TOTAL OTHER FEED TO PELLETIZING	0.3559		
ļ	FUEL (DRYING, INDURATION, ETC.)	1	0.0220	
	PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr)	54.7449		
SHAFT FURNA	CE DIRECT REDUCTION:	<u> </u>		
	NET PELLETS, ETC. TO SHAFT FCE.	0.7616	0.0000	0.7616
	DRI TO EAF (2.5% C)	0.3584		
	FUEL TO DRI	0.3504	0.0000	0.3584
			0.0876	
	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	48.5357		
EAF STEELMA				7.114
	TOTAL STEEL SCRAP (30% DRI)	0.7364	0.0000	0.7364
	MISC. ADDITIVES	0.0072	0.0000	0.0072
	STEEL C (CHARGE+SLAG INJ)	0.0099	0.0000	0.0099
	EAF ELECTRODES	0.0045	0.0000	0.0045
	LIME CHARGED	0.0126	0.0000	0.0126
	O2 GAS TO EAF (MM Nm3/YR)	0.0120		0.0126
	AUX. FUEL TO EAF		25.0833	
			0.0023	
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	737.3320		
LADLE REFININ	lG:			
	LIQ. EAF STEEL TO LRF	0.0000	1.0542	1.0542
	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
	SLAG/WIRE DESULFURIZER TO LRF	0.0004	0.0000	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)	3.3357	0.0633	0.0004
	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	24 9022	0.0033	
	REFINED STEEL TO CASTING	34.8932		
		0.0000	1.0000	1.0000
~	NET STEEL SLAB PRODUCED	0.9767	0.0000	0.9767

SUMMARY CONSUMABLES BASE PROCESS SHAFT FURNACE DRI/EAF

Rev. 2

18-June-2000

30% DRI CHARGE - 2.5% C

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt

\$413.85 DIESEL FUEL COSTS - \$/mt

\$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
12/(0111	ORE:				
\$43.89	IRON ORE CONC. DELIVERED - (\$/mt DRY)	0.4863	\$21,343,027	\$24.24	£42.00
,	PELLETIZING:	0.4005	ΨZ1,343,0Z1	\$21.34	\$43.89
	NET PELLETS, ETC. TO SHAFT FCE.	0.7616		<u></u>	
0.0742	PELLETIZATION LABOR - (MN-HR/mt PELLETS)	0.7616	\$2,176,963	\$2.18	\$2.86
\$90.02	BINDER TO PELLETIZING - (\$/mt BINDER)	0.0051	\$454,905	\$0.45	\$2.60 \$0.60
\$77.83	DOLOMITE TO PELLET (\$/mt LIME/DOL.)	0.0172	\$1,337,770	\$1.34	\$0.60 \$1.76
\$2.36	PELLET OTHER - (\$/mt PELLETS)	0.7616	\$1,797,318	\$1.80	\$1.76 \$2.36
\$0.033	PELLET ELECTRICAL - (MM kWhr/yr)	54.7449	\$1,806,582	\$1.80	\$2.30 \$2.37
\$124.45	PELLET N.G. FUEL - (\$/mt)	0.0220	\$2,733,967	\$2.73	\$3.59
	SUB-TOTAL PELLETIZING:	0.0220	\$10,307,505	\$10.31	\$13.53
	DIRECT REDUCTION IN SHAFT FURNACE:		Ψ10,307,303 [\$10.31	φ (3.55
	DRI TO EAF (1.0% C)	0.3584	· · ·		
0.0401	DRI LABOR - (MN-HR/mt DRI)	0.3584	\$552,781	\$0.55	\$1.54
11.39	DRI OTHER - (\$/mt DRI)	0.3584	\$4,082,375	\$4.08	\$1.34 \$11.39
\$0.033	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	48.5357	\$1,601,678	\$1.60	\$4.47
\$124.45	N.G. FUEL TO DRI - (\$/mt)	0.0876	\$10,907,454	\$1.00 \$10.91	\$30.43
	SUB-TOTAL DRI PRODUCTION:	0.0070	\$17,144,288	\$17.14	
	EAF STEELMAKING:		\$17,144,200	\$17.14	\$47.83
	REFINED STEEL TO LRF	1.0542	······································		
\$140.00	TOTAL STEEL SCRAP (30% DRI, REVERT & BUNDLE	0.7364	\$103,098,237	\$103.10	\$97.80
\$1,055.68	MISC. ADDITIVES - (AVG. \$/mt)	0.0072	\$7,580,000	\$7.58	\$7.00 \$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0099	\$577,893	\$0.58	\$0.55
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0045	\$4,618,598	\$4.62	\$4.38
\$77.10	LIME CHARGED	0.0126	\$971,141	\$0.97	\$0.92
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	25.0833	\$1,053,498	\$1.05	\$1.00
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.25
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$15.97
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	737.3320	\$24,331,955	\$24.33	\$23.08
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,623	\$0.29	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$163,834,945	\$163.83	\$155.42
	LADLE REFINING:	 -	+100,001,010	ψ100.00 j	Ψ100.4Z
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$892,886	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,273	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,180	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8932	\$1,151,475	\$1.15	\$1.15
	SUB-TOTAL LRF:		\$6,815,414	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$219,445,179	\$219.45	

SUMMARY CONSUMABLES AHYLIV

HYLSA IVM PROCESS SHAFT FURNACE DRI/EAF 19-June-2000

100% DRI CHARGE - 4.0 wt.% CARBON Rev. 2

BASIS:

1.000 MM MT/YEAR LIQUID STEEL PRODUCT 0.977 MM MT/YEAR NET SLAB PRODUCT

SUMMARY:

6.294 MM MT/YEAR AS-MINED ROCK

3.806 MM MT/YEAR WASTE ROCK

2.488 MM MT/YEAR ORE ROCK TO CONCENTRATOR

1.465 MM MT/YEAR CONCENTRATE

1.940 MM MT/YEAR NET GREENBALL PELLETS

1.836 MM MT/YEAR NET INDURATED PELLETS

1,781 MM MT/YEAR PELLET FEED TO DRI

1.089 MM MT/YEAR NET DRI TO EAF

ASSUMPTIONS:

5.00 IRON ORE MINE ELECTRICAL POWER REQ'D (kWhr/mt ROCK)

28.12 CONCENTRATOR ELECTRICAL POWER REQ'D (kWhr/mt ORE)
0.333 PIPELINE ELECTRICAL POWER REQ'D (kWhr/mt ORE/km)
1.30 FUEL REQUIREMENT - PELLET PLANT (GJ/mt PEL)

26.08 FUEL REQUIREMENT - PELLET PLANT (kg N.G./mt PEL)

65.0 PELLET PLANT ELEC. POWER REQ'D (kWhr/mt FEED)

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
ORE MINING:				
	AS-MINED ROCK	6.294	0.195	6.488
	WASTE ROCK	3.806	0.118	3.924
	DIESEL FUEL (MINING ETC.)		0.0327	
	MINE ELECTRICAL POWER REQ'D - (kWhr/yr)	31.479		
ORE CONCENT			!	
	IRON ORE TO CONCENTRATOR	2.488	0.077	2.564
	CONCENTRATE TO PIPELINE FEED	1.465	0.789	2.254
	DEWATERED TAILINGS TO DISPOSAL	1.022	1.899	2.921
	CONC. ELECTRICAL POWER REQ'D - (kWhr/yr)	69.941		
	CONC. SLURRY PIPELINE POWER - (kWhr/yr)	122.098		
PELLETIZING:				
	NET OXIDE FEED TO PELLETIZING	1.969	0.173	2.142
	BINDER TO PELLETIZING	0.012	0.000	0.012
	DOLOMITE TO PELLETIZING	0.040	0.000	0.040
	TOTAL OTHER FEED TO PELLETIZING	0.504		
	FUEL (DRYING, INDURATION, ETC.)		0.0514	
	PELLET ELECTRICAL POWER REQ'D - (kWhr/yr)	128.005		
SHAFT FURNA	CE DIRECT REDUCTION:	· · · · · · · · · · · · · · · · · · ·		
	NET PELLETS, ETC. TO SHAFT FCE.	1.781	0.000	1.781
Ì	DRI TO EAF (1.0% C, >450°C)	1.045	0.000	1.045
1	FUEL TO DRI		0.2062	
	DRI ELECTRICAL POWER REQ'D - (kWhr/yr)	108.857		

AHYLIV

SUMMARY CONSUMABLES

19-June-2000

HYLSA IVM PROCESS SHAFT FURNACE DRI/EAF

Rev. 2

100% DRI CHARGE - 4.0 wt.% CARBON

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
EAF STEELMA	KING:	· · · · · · · · · · · · · · · · · · ·	· · · · · · · · · · · · · · · · · · ·	<u> </u>
	TOTAL STEEL SCRAP (100% DRI, REVERT ONLY)	0.0648	0.0000	0.0648
	MISC. ADDITIVES	0.0070	0.0000	0.0070
	STEEL C (CHARGE+SLAG INJ)	0.0084	0.0000	0.0084
	EAF ELECTRODES	0.0038	0.0000	0.0038
	LIME CHARGED	0.0124	0.0000	0.0124
	O2 GAS TO EAF (MM Nm3/YR)	1	44.00	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (kWhr/yr)	639.221		
LADLE REFININ	IG:	L		
	LIQ. EAF STEEL TO LRF	0.0000	1.0543	1.0543
	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
	SLAG/WIRE DESULFURIZER TO LRF	0.0004	0.0000	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)	1	0.0633	
ŀ	LRF ELECTRICAL POWER REQ'D - (kWhr/yr)	34.8973		
	REFINED STEEL TO CASTING	0.0000	1.0521	1.0521
	NET STEEL SLAB PRODUCED	0.9768	0.0000	0.9768

AHYLIV

SUMMARY CONSUMABLES

19-June-2000

HYLSA IVM PROCESS SHAFT FURNACE DRI/EAF

Rev. 2

100% DRI CHARGE - 4.0 wt.% CARBON

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED \$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt \$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
	ORE:				
\$43.89	IRON ORE CONC. DELIVERED - (\$/mt DRY)	1.4652	\$64.306.540	\$64.31	\$43.8
	PELLETIZING:	1.4002	ΨΟΨ,ΟΟΟ,ΟΨΟ	Ψ04.51	φ43.0
	NET PELLETS, ETC. TO SHAFT FCE.	1.7807		·	
0.0742	PELLETIZATION LABOR - (MN-HR/mt PELLETS)	1.7807	\$5,090,195	\$5.09	\$2.8
\$90.02	BINDER TO PELLETIZING - (\$/mt BINDER)	0.0118	\$1,063,663	\$1.06	\$0.6
\$77.83	DOLOMITE TO PELLET (\$/mt LIME/DOL.)	0.0402	\$3,127,985	\$3.13	\$1.7
\$2.36	PELLET OTHER - (\$/mt PELLETS)	1.7807	\$4,202,507	\$4.20	\$2.3
\$0.033	PELLET ELECTRICAL - (MM kWhr/yr)	128.0051	\$4,224,167	\$4.22	\$2.3
\$124.45	PELLET N.G. FUEL - (\$/mt)	0.0514	\$6,392,588	\$6.39	\$3.5
	SUB-TOTAL PELLETIZING:		\$24,101,105	\$24.10	\$13.5
	DIRECT REDUCTION IN SHAFT FURNACE:		+= 1,101,100	<u> </u>	Ψ10.0
	DRI TO EAF (1.0% C)	1.0450			
0.0401	DRI LABOR - (MN-HR/mt DRI)	1.0450	\$1,611,721	\$1.61	\$1.5
11.39	DRI OTHER - (\$/mt DRI)	1.0450	\$11,902,822	\$11.90	\$11.3
\$0.033	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	108.8567	\$3,592,270	\$3.59	\$3.4
\$124.45	N.G. FUEL TO DRI - (\$/mt)	0.2062	\$25,656,170	\$25.66	\$24.5
	SUB-TOTAL DRI PRODUCTION:		\$42,762,983	\$42.76	\$40.9
	EAF STEELMAKING:			+ 12	V.0.0
	REFINED STEEL TO LRF	1.0543		**	
\$10.00	TOTAL STEEL SCRAP (100% DRI, REVERT ONLY)	0.0648	\$647,911	\$0.65	\$0.6
\$1,076.24	MISC. ADDITIVES - (AVG. \$/mt)	0.0070	\$7,580,000	\$7.58	\$7.1
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0084	\$489,310	\$0.49	\$0.4
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,939,447	\$3.94	\$3.7
\$77.10	LIME CHARGED	0.0124	\$952,588	\$0.95	\$0.9
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	44.0000	\$1,848,000	\$1.85	\$1.7
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.2
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830.000	\$16.83	\$15.9
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	639.2210	\$21,094,291	\$21.09	\$20.0
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,656	\$0.29	\$0.2
	SUB-TOTAL EAF STEELMAKING:		\$58,155,205	\$58.16	\$55.1
	LADLE REFINING:	······································	***************************************	<u></u>	·····
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$892,991	\$0.89	\$0.8
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,303	\$0.26	\$0.2
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,182	\$0.02	\$0.0
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.5
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8973	\$1,151,610	\$1.1 <u>5</u>	\$1.1
	SUB-TOTAL LRF:		\$6,815,685	\$6.82	\$6.8
	TOTAL THROUGH LIQUID STEEL:		\$196,141,518	\$196.14	

HOT METAL VARIATIONS

ABF

SUMMARY CONSUMABLES

18-June-2000

BLAST FURNACE HOT METAL/EAF

Rev. 2

30% BF HOT METAL CHARGE - CO-PRODUCT COKE

BASIS:

28' DIA BLAST FURNACE (REF. MST OF STEEL, 9th EDITION)

0.6882 MM MT/YEAR PURCHASED SCRAP CHARGED TO EAF

0.3580 MM MT/YEAR LIQUID HOT METAL (TARGET)

0.3584 MM MT/YEAR LIQUID HOT METAL (CALC.)

1.0000 MM MT/YEAR LIQUID STEEL (TARGET)

0.9770 MM MT/YEAR HOT BAND EQUIVALENT (CALC.)

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
BLAST FURNAC				
	LUMP IRON ORE FEED	0.1054	0.0000	0.1054
	IRON PELLET FEED	0.2097	0.0000	0.2097
	IRON SINTER FEED	0.2097	0.0000	0.2097
•	IRON SCRAP FEED	0.0337	0.0000	0.0337
	LIMESTONE FEED	0.0026	0.0000	0.0026
†	GRAVEL FEED	0.0026	0.0000	0.0026
1	COKE FEED	0.1753	0.0000	0.1753
	AIR TO FURNACE	0.0000	0.5873	0.5873
	MOISTURE TO FURNACE	0.0000	0.0057	0.0057
	N.G. FUEL TO FURNACE	0.0000	0.0073	0.0055
	BF ELECTRICAL POWER REQ'D (MM kWhr/yr)	30.8336		
	BF HOT METAL FROM FURNACE TO EAF	0.3584	0.0000	0.3584
EAF STEELMAK				
	TOTAL STEEL SCRAP (100% DRI)	0.7366	0.0000	0.7366
	MISC. ADDITIVES	0.0071	0.0000	0.0071
1	STEEL C (CHARGE+SLAG INJ)	0.0060	0.0000	0.0060
	EAF ELECTRODES	0.0038	0.0000	0.0038
	LIME CHARGED	0.0124	0.0000	0.0124
	O2 GAS TO EAF (MM Nm3/YR)		38.9907	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	542.1070		
LADLE REFININ	G:	_! <u></u>		
	LIQ. EAF STEEL TO LRF	0.0000	1.0000	1.0000
	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
	SLAG/WIRE DESULFURIZER TO LRF	0.0004	0.0000	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)		0.0633	
	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9032		ļ
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9770	0,0000	0.9770

ABF

SUMMARY CONSUMABLES BLAST FURNACE HOT METAL/EAF

Rev. 2

18-June-2000

30% BF HOT METAL CHARGE - CO-PRODUCT COKE

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT		,	4	V	ψ/IIIC ORIT
	BLAST FURNACE:				
	BF HOT METAL FROM FURNACE TO EAF	0.3584	T		
\$37.84	LUMP IRON ORE FEED	0.1054	\$3,987,425	\$3.99	\$11.13
\$47.96	IRON PELLET FEED	0.2097	\$10,058,433	\$10.06	\$28.06
\$40.00	IRON SINTER FEED	0.2097	\$8,389,019	\$8.39	\$23.41
\$10.00	IRON SCRAP FEED (INTERNAL RECYCLE)	0.0337	\$336,998	\$0.34	\$0.94
\$65.00	LIMESTONE FEED	0.0026	\$166,788	\$0.17	\$0.47
\$50.00	GRAVEL FEED	0.0026	\$128,299	\$0.13	\$0.36
\$140.00	COKE FEED	0.1753	\$24,547,801	\$24.55	\$68.49
INCL. ELEC.	AIR TO FURNACE	0.5873	\$0	\$0.00	\$0.00
INCL. ELEC.	MOISTURE TO FURNACE	0.0057	\$0	\$0.00	\$0.00
\$124.45	N.G. FUEL TO FURNACE	0.0073	\$914,401	\$0.91	\$2.55
\$0.033	BF ELECTRICAL POWER REQ'D (MM kWhr/yr)	30.8336	\$1,017,507	\$1.02	\$2.84
\$0.75	LABOR IN BF - (\$/mt)	0.3584	\$268,812	\$0.27	\$0.75
\$15.00	OTHER IN BF - (\$/mt)	0.3584	\$5,376,249	\$5.38	\$15.00
	SUB-TOTAL BF HOT METAL:		\$55,191,732	\$55.19	\$153.99
	EAF STEELMAKING:		<u> </u>		
	REFINED STEEL TO LRF	1.0000		T	
\$140.00	TOTAL STEEL SCRAP (REVERT & PURCHASED)	0.7366	\$103,127,846	\$103.13	\$103.13
\$1,070.09	MISC. ADDITIVES - (AVG. \$/mt)	0.0071	\$7,580,000	\$7.58	\$7.58
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0060	\$351,108	\$0.35	\$0.35
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,962,106	\$3.96	\$3.96
\$77.10	LIME CHARGED	0.0124	\$958,067	\$0.96	\$0.96
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	38.9907	\$1,637,608	\$1.64	\$1.64
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.49
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$16.83
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	542.1070	\$17,889,533	\$17.89	\$17.89
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,705	\$0.29	\$0.29
	SUB-TOTAL EAF STEELMAKING:		\$157,109,974	\$157,11	\$157.11
	LADLE REFINING:				
	LIQ. EAF STEEL TO CASTING	1.0000	·	· · ·	
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$893,142	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,347	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9032	\$1,151,806	\$1.15	\$1.15
	SUB-TOTAL LRF:	1	\$6,816,080	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$219,117,786	\$219.12	

ABFNRC

SUMMARY CONSUMABLES

18-June-2000

BLAST FURNACE HOT METAL/EAF

Rev. 2

30% BF HOT METAL CHARGE

NON-RECOVERY PROCESS COKE

BASIS:

28' DIA BLAST FURNACE (REF. MST OF STEEL, 9th EDITION)

0.6882 MM MT/YEAR PURCHASED SCRAP CHARGED TO EAF

0.3580 MM MT/YEAR LIQUID HOT METAL (TARGET)

0.3584 MM MT/YEAR LIQUID HOT METAL (CALC.) 1.0000 MM MT/YEAR LIQUID STEEL (TARGET)

0.9770 MM MT/YEAR HOT BAND EQUIVALENT (CALC.)

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
BLAST FURNA	CE:			
	LUMP IRON ORE FEED	0.1076	0.0000	0.1076
	IRON PELLET FEED	0.2145	0.0000	0.2145
Ì	IRON SINTER FEED	0.2145	0.0000	0.2145
İ	IRON SCRAP FEED	0.0345	0.0000	0.0345
	LIMESTONE FEED	0.0026	0.0000	0.0026
	GRAVEL FEED	0.0026	0.0000	0.0026
	N.R. COKE FEED	0.1627	0.0000	0.1627
	AIR TO FURNACE	0.0000	0.5873	0.5873
İ	MOISTURE TO FURNACE	0.0000	0.0057	0.0057
	N.G. FUEL TO FURNACE	0.0000	0.0073	0.0055
	BF ELECTRICAL POWER REQ'D (MM kWhr/yr)	30.8336		
	BF HOT METAL FROM FURNACE TO EAF	0.3584	0.0000	0.3584
1			AS N.G.	
EAF STEELMA	KING:			
	TOTAL STEEL SCRAP (100% DRI)	0.7366	0.0000	0.7366
1	MISC. ADDITIVES	0.0071	0.0000	0.0071
	STEEL C (CHARGE+SLAG INJ)	0.0060	0.0000	0.0060
	EAF ELECTRODES	0.0038	0.0000	0.0038
	LIME CHARGED	0.0124	0.0000	0.0124
i	O2 GAS TO EAF (MM Nm3/YR)		38.9907	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	542.1070		
LADLE REFIN	NG:	1		
LAULE KELIN	LIQ. EAF STEEL TO LRF	0.0000	1.0545	1.0545
	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
	SLAGWIRE DESULFURIZER TO LRF	0.0003	0.0000	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)	0.0004	0.0633	0.0004
	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9032	0.0000	
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770
<u> </u>	NET STEEL STAD PRODUCED	0.9770	0.0000	1 0.5770

ABFNRC

18-June-2000

BLAST FURNACE HOT METAL/EAF 30% BF HOT METAL CHARGE NON-RECOVERY PROCESS COKE

Rev. 2

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT				,	***************************************
	BLAST FURNACE:				
ŀ	BF HOT METAL FROM FURNACE TO EAF	0.3584			
\$37.84	LUMP IRON ORE FEED	0.1076	\$4,071,272	\$4.07	\$11.36
\$47.96	IRON PELLET FEED	0.2145	\$10,286,640	\$10.29	\$28.70
\$40.00	IRON SINTER FEED	0.2145	\$8,579,349	\$8.58	\$23.94
\$10.00	IRON SCRAP FEED (INTERNAL RECYCLE)	0.0345	\$344,644	\$0.34	\$0.96
\$65.00	LIMESTONE FEED	0.0026	\$166,788	\$0.17	\$0.47
\$50.00	GRAVEL FEED	0.0026	\$128,299	\$0.13	\$0.36
\$77.53	N.R. COKE FEED	0.1627	\$12,616,306	\$12,62	\$35.20
INCL. ELEC.	AIR TO FURNACE	0.5873	\$0	\$0.00	\$0.00
INCL. ELEC.	MOISTURE TO FURNACE	0.0057	\$0	\$0.00	\$0.00
\$124.45	N.G. FUEL TO FURNACE	0.0073	\$914,401	\$0.91	\$2.55
\$0.033	BF ELECTRICAL POWER REQ'D (MM kWhr/yr)	30.8336	\$1,017,507	\$1.02	\$2.84
\$0.75	LABOR IN BF - (\$/mt)	0.3584	\$268,812	\$0.27	\$0.75
\$15.00	OTHER IN BF - (\$/mt)	0.3584	\$5,376,249	\$5.38	\$15.00
	SUB-TOTAL BF HOT METAL:		\$43,770,267	\$43.77	\$122.12
	EAF STEELMAKING:	J.	+ 10[170]	V 10.11	Ψ,22.12
	REFINED STEEL TO LRF	1.0545			
\$140.00	TOTAL STEEL SCRAP (REVERT & PURCHASED)	0.7366	\$103,127,846	\$103.13	\$97.80
\$1,070.09	MISC. ADDITIVES - (AVG. \$/mt)	0.0071	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0060	\$351,108	\$0.35	\$0.33
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,962,106	\$3.96	\$3.76
\$77.10	LIME CHARGED	0.0124	\$958,067	\$0.96	\$0.91
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	38.9907	\$1,637,608	\$1.64	\$1.55
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.25
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$15.96
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	542.1070	\$17,889,533	\$17.89	\$16.97
\$124.45	N.G. AUX, FUEL TO EAF	0.0023	\$288,705	\$0.29	\$10.97 \$0.27
ĺ	SUB-TOTAL EAF STEELMAKING:	5.5020	\$157,109,974	\$157.11	\$148.99
	LADLE REFINING:		Ψ107,100,074 <u> </u>	Ψ107.11	\$140.55
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$893,142	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,347	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.20
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$0.02 \$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9032	\$1,151,806	\$1.15	\$4.50 \$1.15
ļ	SUB-TOTAL LRF:	31.0002	\$6,816,080	\$6.82	\$6.82
		<u>.</u>	Ψ0,010,000	Ψ0.02	ψ0.02
	TOTAL THROUGH LIQUID STEEL:		\$207,696,321	\$207.70	
			V=01,000,021	Ψ201.10	

APIG SUMMARY CONSUMABLES

19-June-2000 BLAST FURNACE PRODUCING PIG IRON AS CHARGE TO EAF

Rev. 2 30% COLD BLAST FURNACE PIG IRON CHARGE

BASIS: 28' DIA BLAST FURNACE (REF. MST OF STEEL, 9th EDITION)

0.688 MM MT/YEAR PURCHASED SCRAP CHARGED TO EAF

0.358 MM MT/YEAR LIQUID HOT METAL (TARGET)
0.358 MM MT/YEAR LIQUID HOT METAL (CALC.)

1.000 MM MT/YEAR LIQUID STEEL (TARGET)

0.977 MM MT/YEAR HOT BAND EQUIVALENT (CALC.)

OPERATION	PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
BLAST FURNACE:	1	STREAM LABLE			· - · · · · ·
LUMP IRON ORE FEED		CE:	(IAIIA: 1/11Z)	(MIN TELEV)	(INITAL IT IK)
IRON PELLET FEED			0.1054	0.000	0.105
IRON SINTER FEED		IRON PELLET FEED			
IRON SCRAP FEED		IRON SINTER FEED			
LIMESTONE FEED		IRON SCRAP FEED			
GRAVEL FEED	1	LIMESTONE FEED	0.0026		
COKE FEED		GRAVEL FEED	1 1		
MOISTURE TO FURNACE (AS GAS) 0.0000 0.006 0.006 N.G. FUEL TO FURNACE (AS GAS) 0.0000 0.007 0.005 0.006 BF ELECTRICAL POWER REQ'D - (kWhr/yr) 36.0066 BF HOT METAL FROM FURNACE 0.3584 0.000 0.358 PIGGING OPERATION:		COKE FEED	0.1753	0.000	
N.G. FUEL TO FURNACE (ÀS GAS) 0.0000 0.007 0.005 BF ELECTRICAL POWER REQ'D - (kWhr/yr) 36.0066 BF HOT METAL FROM FURNACE 0.3584 0.000 0.358 PIGGING OPERATION:		AIR TO FURNACE (AS GAS)	0.0000	0.587	0.587
N.G. FUEL TO FURNACE (AS GAS) 0.0000 0.007 0.005 BF ELECTRICAL POWER REQ'D - (kWhr/yr) 36.0066 BF HOT METAL FROM FURNACE 0.3584 0.000 0.358 PIGGING OPERATION:	İ	MOISTURE TO FURNACE (AS GAS)	0.0000	0.006	0.006
BF HOT METAL FROM FURNACE 0.3584 0.000 0.358		N.G. FUEL TO FURNACE (AS GAS)	0.0000	0.007	
PIGGING OPERATION: BF COLD PIG IRON		BF ELECTRICAL POWER REQ'D - (kWhr/yr)	36.0066		
BF COLD PIG IRON 0.3584 0.000 0.358 BF SCRAP FROM FCE 0.0022 0.000 0.0022 PIGGING ELECTRICAL POWER REQ'D - (kWhr/yr) 0.0022 0.000 0.0022 EAF STEELMAKING:		BF HOT METAL FROM FURNACE	0.3584	0.000	0.358
BF COLD PIG IRON 0.3584 0.000 0.358 BF SCRAP FROM FCE 0.0022 0.000 0.0022 PIGGING ELECTRICAL POWER REQ'D - (kWhr/yr) 0.0022 0.000 0.0022 EAF STEELMAKING:					
BF SCRAP FROM FCE PIGGING ELECTRICAL POWER REQ'D - (kWhr/yr) EAF STEELMAKING: COLD PIG IRON CHARGE TO EAF TOTAL STEEL SCRAP (PURCHASED & REVERT) MISC. ADDITIVES NISC. ADDITION NISC.	PIGGING OPE				
PIGGING ELECTRICAL POWER REQ'D - (kWhr/yr)		BF COLD PIG IRON	0.3584	0.000	0.358
EAF STEELMAKING: COLD PIG IRON CHARGE TO EAF 0.3584 0.000 0.358 TOTAL STEEL SCRAP (PURCHASED & REVERT) 0.7366 0.0000 0.7366 MISC. ADDITIVES 0.0071 0.0000 0.0071 STEEL C (CHARGE+SLAG INJ) 0.0060 0.0000 0.0060 EAF ELECTRODES 0.0050 0.0000 0.0050 LIME CHARGED 0.0124 0.0000 0.0124 O2 GAS TO EAF (MM Nm3/YR) 38.99 AUX. FUEL TO EAF 0.0023 EAF ELECTRICAL POWER REQ'D - (kWhr/yr) 736.1518 LADLE REFINING: 0.0000 1.0545 1.0545 LIQ. EAF STEEL TO LRF 0.0003 0.0000 0.0053 SLAG/WIRE DESULFURIZER TO LRF 0.0004 0.000 0.0005 LRF ELECTRICAL POWER REQ'D - (kWhr/yr) 34.9032 REFINED STEEL TO CASTING 1.000 0.0000 1.000		BF SCRAP FROM FCE	0.0022	0.000	0.0022
COLD PIG IRON CHARGE TO EAF TOTAL STEEL SCRAP (PURCHASED & REVERT) MISC. ADDITIVES MISC. ADDITICATION OF MISC. ADDITIVES MISC. ADDITICATION OF		PIGGING ELECTRICAL POWER REQ'D - (kWhr/yr)			
COLD PIG IRON CHARGE TO EAF TOTAL STEEL SCRAP (PURCHASED & REVERT) MISC. ADDITIVES MISC. ADDITICATION OF MISC. ADDITIVES MISC. ADDITICATION OF					
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1.000		· · · · · · · · · · · · · · · · · · ·		0.0000	1 000
1 NELSTEELSTAB PRODUCED I 0.9770 0.000 0.0770		NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

APIG

SUMMARY CONSUMABLES

19-June-2000

BLAST FURNACE PRODUCING PIG IRON AS CHARGE TO EAF 30% COLD BLAST FURNACE PIG IRON CHARGE

Rev. 2

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt

\$413.85 DIESEL FUEL COSTS - \$/mt \$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT	BLAST FURNACE:				
	BF HOT METAL TO PIGGING	0.050			
\$37.84	· · · -	0.3584			
\$37.6 4 \$47.96	LUMP IRON ORE FEED	0.1054	\$3,987,425	\$3.99	\$11.13
, ,,,,,	IRON PELLET FEED	0.2097	\$10,058,433	\$10.06	\$28.06
\$40.00	IRON SINTER FEED	0.2097	\$8,389,019	\$8.39	\$23.41
\$10.00	IRON SCRAP FEED (INTERNAL RECYCLE)	0.0337	\$336,998	\$0.34	\$0.94
\$65.00	LIMESTONE FEED	0.0026	\$166,788	\$0.17	\$0.47
\$50.00	GRAVEL FEED	0.0026	\$128,299	\$0.13	\$0.36
\$140.00	COKE FEED	0.1753	\$24,547,801	\$24.55	\$68.49
INCL. ELEC.	AIR TO FURNACE	0.5873	\$0	\$0.00	\$0.00
INCL, ELEC.	MOISTURE TO FURNACE	0.0057	\$0	\$0.00	\$0.00
\$124.45	N.G. FUEL TO FURNACE	0.0073	\$914,401	\$0.91	\$2.55
\$0.033	BF ELECTRICAL POWER REQ'D (MM kWhr/yr)	30.8336	\$1,017,507	\$1.02	\$2.84
\$0.75	LABOR IN BF - (\$/mt)	0.3584	\$268,812	\$0.27	\$0.75
\$15.00	OTHER IN BF - (\$/mt)	0.3584	\$5,376,249	\$5.38	\$15.00
	SUB-TOTAL BF HOT METAL:		\$55,191,732	\$55.19	\$153.99
	PIGGING OPERATION:		, , ,	+++++	
	BF PIG IRON TO EAF	0.3584		<u> </u>	***
\$2.25	PIGGING OPERATION (ALL-IN)	0.3584	<u>\$806,437</u>	\$0.81	\$2.25
	SUB-TOTAL BF PIG IRON:		\$806,437	\$0.81	\$2.25
	EAF STEELMAKING:		7		VI.L 0
	REFINED STEEL TO LRF	1.0545			
\$140.00	TOTAL STEEL SCRAP (REVERT & PURCHASED)	0.7366	\$103,127,846	\$103.13	\$97.80
\$1,070.09	MISC. ADDITIVES - (AVG. \$/mt)	0.0071	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0060	\$351,108	\$0.35	\$0.33
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0050	\$5,150,738	\$5.15	\$4.88
\$77.10	LIME CHARGED	0.0124	\$958,067	\$0.96	\$0.91
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	38.9907	\$1,637,608	\$1.64	\$1.55
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.25
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$4.25 \$15.96
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	736.1518	\$24,293,010	\$24.29	\$23.04
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,705	\$0.29	
,	SUB-TOTAL EAF STEELMAKING:	0.0025	\$164,702,084	\$164.70	\$0.27 \$156.10
	LADLE REFINING:		Ψ104,702,004	\$104.70	\$156.19
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$893,142	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,347	\$0.89	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$256,347 \$15,184	\$0.26	\$0.26 \$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600		
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9032	\$4,497,600 \$1,151,806	\$4.50 \$1.15	\$4.50
72.230	SUB-TOTAL LRF:	34.5032	\$6,816,080	<u>\$1.15</u>	\$1.15
	COB-TOTAL ERF.		\$0,010,080	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$226,709,895	\$226.71	

ATECN SUMMARY CONSUMABLES

19-June-2000 TECNORED PROCESS THROUGH EAF PROD. OF LIQ. STEEL 30% HOT METAL CHARGE - WITH CO-GEN. OF ELEC. PWR.

BASIS:

0.688 MM MT/YEAR PURCHASED SCRAP CHARGED
0.358 MM MT/YEAR LIQUID HOT METAL (TARGET)
0.358 MM MT/YEAR LIQUID HOT METAL (CALC.)
1.000 MM MT/YEAR LIQUID STEEL (TARGET)
0.977 MM MT/YEAR HOT BAND EQUIVALENT (CALC.)

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
GREEN-BALL	PELLET PREPARATION:			
	IRON ORE FINES TO PELLET	0.5080	0,0000	0.5080
	EAF SLAG TO PELLET	0.0610	0.0000	0.0610
	CHARCOAL TO PELLET	0.0762	0.0000	0.0762
	BINDER C TO PELLET	0.0051	0.0000	0.0051
	BINDER TO PELLET	0.0130	0.0000	0.0130
	FINES RECYCLE TO PELLET	0.0062	0.0000	0.0062
ŀ	WATER TO PELLET	0.0000	0.0656	0.0656
	GREEN PELLET PRODUCT	0.6565	0.0000	0.6565
	NET PELLET PRODUCT TO FURNACE	0.6377	0.0000	0.6377
	HEAT FOR DRYING (N.G. EQUIV.)		0.0013	
	PELLET ELECTRICAL POWER REQ'D - (MM kWhr/yr)	21.6632		
TECNORED EL	JRNACE OPERATION:			
LONGICED FC	EAF SLAG TO FURNACE	0.0371	0.0000	0.0371
	CHINA COKE TO FURNACE	0.1490	0.0000	0.1490
	PELLETS TO FURNACE	0.6377	0.0000	0.6377
	BURNT LIME TO SCRUBBER	0.0022	0.0000	0.0022
	AUXILLARY N.G. FUEL REQUIREMENT	0.0022	0.0638	0.0022
	ELEC. POWER - CONSUMED FCE - (MM kWhr/yr)	25.0740	GENERATED	378.1112
	HOT METAL PRODUCED	0.0000	0.3582	570.1112
	TIOT METICET RODGED	0.0000	0.0002	
EAF FURNACE		l		
	TOTAL STEEL SCRAP (PURCHASED)	0.7366	0.0000	0.7366
	MISC. ADDITIVES	0.0071	0.0000	0.0071
	STEEL C (CHARGE+SLAG INJ)	0.0060	0.0000	0.0060
	EAF ELECTRODES	0.0038	0.0000	0.0038
	LIME CHARGED	0.0124	0.0000	0.0124
1	O2 GAS TO EAF (MM Nm3/YR)		36.8404	
	LIQ. EAF STEEL TO LRF	0.0000	1.0545	1.0545
	AUX. FUEL TO EAF	1	0.0023	
	EAF ELECTRICAL POWER REQ'D - (kWhr/mt)	486.4149		
LADLE REFIN	NG:	L		
LADLE REPIN	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
	SLAG/WIRE DESULFURIZER TO LRF	0.0033	0.0000	0.0003
1	ARGON GAS TO LRF (MM Nm3/YR)	0.0004	0.0000	0.0004
	LRF ELECTRICAL POWER REQ'D - (kWhr/mt)	34.9032	0.0000	
	REFINED STEEL TO CASTING	0.0000	1.0523	1.0523
	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770
	NET STEEL SLAB PRODUCED	0.9770	บ.บบบับ	0.9770

ATECN

SUMMARY CONSUMABLES

19-June-2000 TECNORED PROCESS THROUGH EAF PROD. OF LIQ. STEEL

Rev. 2 30% HOT METAL CHARGE - WITH CO-GEN. OF ELEC. PWR.

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

\$21.19 \$30.00 \$27.00 \$58.16 \$75.00 \$3.00 \$0.75 \	GREEN BALL PELLETIZING: IRON ORE FINES TO PELLET EAF SLAG TO PELLET CHARCOAL TO PELLET	0.5080	040 704 500		
\$21.19 \$30.00 \$27.00 \$58.16 \$75.00 \$3.00 \$0.75 \	IRON ORE FINES TO PELLET EAF SLAG TO PELLET	0.5080	040 TO4 500 I		
\$30.00 18 18 18 18 18 18 18	EAF SLAG TO PELLET	0.5080	040 704 500		
\$27.00 0 \$58.16 E \$75.00 E \$3.00 E \$0.75 \			\$10,764,520	\$10.76	\$16.88
\$58.16 E \$75.00 E \$3.00 E \$0.75 \	CHARCOAL TO DELLET	0.0610	\$1,828,800	\$1.83	\$2.87
\$75.00 E \$3.00 E \$0.75 \		0.0762	\$2,057,400	\$2.06	\$3.23
\$3.00 E \$0.75 \	BINDER C TO PELLET	0.0051	\$295,453	\$0.30	\$0.46
\$0.75 \	BINDER TO PELLET	0.0130	\$975,000	\$0.98	\$1.53
	FINES RECYCLE TO PELLET	0.0062	\$18,659	\$0.02	\$0.03
	WATER TO PELLET	0.0656	\$49,234	\$0.05	\$0.08
	GREEN PELLET PRODUCT	0.6565			•
	NET PELLET PRODUCT TO FURNACE	0.6377			
	HEAT FOR DRYING (N.G. EQUIV.)	0.0013	\$160,084	\$0.16	\$0.25
\$0.033 F	PELLET ELECTRICAL POWER REQ'D - (MM kWhr/yr)	21.6632	\$714,885	\$0.71	\$1.12
0.0826 L	LABOR FOR PELLETIZING - (MH-HR/mt PELLET)	0.6377	\$2,029,161	\$2.03	\$3.18
	OTHER COSTS IN PELLETIZING -(\$/mt)	0.6377	\$2,391,385	\$2.39	\$3.75
	SUB-TOTAL GREEN-BALL PELLETIZING:		\$21,284,581	\$21,28	\$33.38
·····	TECNORED FURNACE:		7-1,201,001	Ψ21,20	ψ00.00
	TENORED HOT METAL TO EAF	0.3584	· · ·		· · · · · · · · · · · · · · · · · · ·
\$30.00	EAF SLAG TO FURNACE	0.0371	\$1,111,584	\$1.11	\$3.10
\$90.00	CHINA COKE TO FURNAÇE	0.1490	\$13,411,471	\$13.41	\$37.42
\$77.83	BURNT LIME TO SCRUBBER	0.0022	\$174,016	\$0.17	\$0.49
	IRON PELLET FEED	0.2097	\$10,058,433	\$10.06	\$28.06
	N.G. FUEL TO FURNACE	0.0638	\$7,936,208	\$7.94	\$20.00
	NET ELECTRICAL POWER REQ'D (MM kWhr/yr)	(378.1)	(\$12,477,670)	(\$12.48)	(\$34.81
	LABOR IN TECNO - (\$/mt)	0.3584	\$66,651	\$0.07	• • • • • • • • • • • • • • • • • • • •
	OTHER IN TECNO - (\$/mt)	0.3584	i i		\$0.19
V10.00	SUB-TOTAL BF HOT METAL:	0.5564	\$3,584,166 \$23,864,860	\$3.58	\$10.00
<u>' </u>	EAF STEELMAKING:	l	\$25,004,000	\$23.86	\$66.58
	REFINED STEEL TO LRF	1.0523			· ····
I	TOTAL STEEL SCRAP (REVERT & PURCHASED)	0.7366	\$103,127,846	\$103.13	600.00
	MISC. ADDITIVES - (AVG. \$/mt)	0.0071	\$7,580,000		\$98.00
	STEEL C (CHARGE+SLAG INJ)	0.0060	\$351,108	\$7.58	\$7.20
	EAF ELECTRODES - (\$/mt)	0.0038		\$0.35	\$0.33
	LIME CHARGED	0.0038	\$3,962,106	\$3.96	\$3.77
' 1	O2 GAS TO EAF (MM Nm3/YR)		\$958,067	\$0.96	\$0.91
· ·	EAF LABOR - (MN-HR/mt L.S.)	36.8404	\$1,547,299	\$1.55	\$1.47
,	EAF OTHER - (\$/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.26
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	1.0000	\$16,830,000	\$16.83	\$15.99
		486.4149	\$16,051,693	\$16.05	\$15.25
\$124,40	N.G. AUX. FUEL TO EAF	0.0023	\$288,705	\$0.29	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$155,181,824	\$155.18	\$147.47
	LIQ. EAF STEEL TO CASTING	4 0000 I	<u> </u>		
	PULV. LIME TO LADLE REF. FCE (\$/mt)	1.0000	6002 440	00.00	00.00
	· · · · · · · · · · · · · · · · · · ·	0.0053	\$893,142	\$0.89	\$0.89
	SLAGWIRE DESULFURIZER TO LRF	0.0004	\$258,347	\$0.26	\$0.26
	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9032	<u>\$1,151,806</u>	<u>\$1.15</u>	\$1.15
	SUB-TOTAL LRF:		\$6,816,080	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$185,862,764	\$207.15	
			\$ 100,002,104	\$207.15	

ATECN2

SUMMARY CONSUMABLES

19-June-2000

TECNORED PROCESS THROUGH EAF PROD. OF LIQ. STEEL

Rev. 2

30% HOT METAL CHARGE - WITHOUT CO-GEN. OF ELEC. PWR.

BASIS:

0.688 MM MT/YEAR PURCHASED SCRAP CHARGED
0.358 MM MT/YEAR LIQUID HOT METAL (TARGET)
0.358 MM MT/YEAR LIQUID HOT METAL (CALC.)
1.000 MM MT/YEAR LIQUID STEEL (TARGET)
0.977 MM MT/YEAR HOT BAND EQUIVALENT (CALC.)

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION	= == !!! 	(MM T/YR)	(MM T/YR)	(MM T/YR)
GREEN-BALL	PELLET PREPARATION:	(17114)	(11111)	(1/11/7)
	IRON ORE FINES TO PELLET	0.5080	0.0000	0.5080
	EAF SLAG TO PELLET	0.0610	0.0000	0.0610
	CHARCOAL TO PELLET	0.0762	0.0000	0.0762
	BINDER C TO PELLET	0.0051	0.0000	0.0051
	BINDER TO PELLET	0.0130	0.0000	0.0130
	FINES RECYCLE TO PELLET	0.0062	0.0000	0.0062
	WATER TO PELLET	0.0000	0.0656	0.0656
	GREEN PELLET PRODUCT	0.6565	0.0000	0.6565
	NET PELLET PRODUCT TO FURNACE	0.6377	0.0000	0.6377
	HEAT FOR DRYING (N.G. EQUIV.)		0.0013	0.0077
	PELLET ELECTRICAL POWER REQ'D - (MM kWhr/yr)	21.6632	3,40,10	
TECNORED FU	RNACE OPERATION:			
	EAF SLAG TO FURNACE	0.0371	0.0000	0.0371
	CHINA COKE TO FURNACE	0.1490	0.0000	0.1490
	PELLETS TO FURNACE	0.6377	0.0000	0.6377
	BURNT LIME TO SCRUBBER	0.0022	0.0000	0.0022
	AUXILLARY N.G. FUEL REQUIREMENT		0.0638	0.0022
	ELEC. POWER - CONSUMED FCE - (MM kWhr/yr)	25.0740		
	HOT METAL PRODUCED	0.0000	0.3582	
EAF FURNACE	:		<u> </u>	
	TOTAL STEEL SCRAP (PURCHASED)	0.7366	0.0000	0.7366
	MISC. ADDITIVES	0.0071	0.0000	0.0071
	STEEL C (CHARGE+SLAG INJ)	0.0060	0.0000	0.0060
	EAF ELECTRODES	0.0038	0.0000	0.0038
	LIME CHARGED	0.0124	0.0000	0.0124
	O2 GAS TO EAF (MM Nm3/YR)	ľ	36.8404	
	LIQ. EAF STEEL TO LRF	0.0000	1.0545	1.0545
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (kWhr/mt)	486.4149		
LADLE REFINI				
	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
	SLAG/WIRE DESULFURIZER TO LRF	0.0004	0.0000	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)		0.0633	
	LRF ELECTRICAL POWER REQ'D - (kWhr/mt)	34.9032		1
	REFINED STEEL TO CASTING	0.0000	1.0523	1.0523
<u> </u>	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

ATECN2

SUMMARY CONSUMABLES

TECNORED PROCESS THROUGH EAF PROD. OF LIQ. STEEL 19-June-2000

Rev. 2 30% HOT METAL CHARGE - WITHOUT CO-GEN. OF ELEC. PWR.

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED \$124.45 N.G. FUEL COSTS - \$/mt

\$413.85 DIESEL FUEL COSTS - \$/mt

\$0.033	ELECTRICAL POWER RATE - (\$/kWhr)				
COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT					
	GREEN BALL PELLETIZING:				
\$21.19	IRON ORE FINES TO PELLET	0.5080	\$10,764,520	\$10.76	\$16.88
\$30.00	EAF SLAG TO PELLET	0.0610	\$1,828,800	\$1.83	\$2.87
\$27.00	CHARCOAL TO PELLET	0.0762	\$2,057,400	\$2.06	\$3.23
\$58.16	BINDER C TO PELLET	0.0051	\$295,453	\$0.30	\$0.46
\$75.00	BINDER TO PELLET	0.0130	\$975,000	\$0.98	\$1.53
\$3.00	FINES RECYCLE TO PELLET	0.0062	\$18,659	\$0.02	\$0.03
\$0.75	WATER TO PELLET	0.0656	\$49,234	\$0.05	\$0.08
	GREEN PELLET PRODUCT	0.6565	` '		•
1	NET PELLET PRODUCT TO FURNACE	0.6377			
\$124.45	HEAT FOR DRYING (N.G. EQUIV.)	0.0013	\$160,084	\$0.16	\$0.25
\$0.033	PELLET ELECTRICAL POWER REQ'D - (MM kWhr/yr)	21,6632	\$714,885	\$0.71	\$1.12
0.0826	LABOR FOR PELLETIZING - (MH-HR/mt PELLET)	0.6377	\$2,029,161	\$2.03	\$3.18
\$3.75	OTHER COSTS IN PELLETIZING -(\$/mt)	0.6377	\$2,391,385	\$2,39	\$3.75
	SUB-TOTAL GREEN-BALL PELLETIZING:	0.00.1	\$21,284,581	\$21.28	\$33.38
	TECNORED FURNACE:		ΨΕ1,204,001	Ψ21.20	Ψ00.00
	TENORED HOT METAL TO EAF	0.3584	1		
\$30.00	EAF SLAG TO FURNACE	0.0371	\$1,111,584	\$1.11	\$3.10
\$90.00	CHINA COKE TO FURNACE	0.1490	\$13,411,471	\$13.41	\$37.42
\$77.83	BURNT LIME TO SCRUBBER	0.0022	\$174,016	\$0.17	\$0.49
\$47.96	IRON PELLET FEED	0.2097	\$10,058,433	\$10.06	\$28.06
\$124.45	N.G. FUEL TO FURNACE	0.0638	\$7,936,208	\$7.94	\$28.00
\$0.033	NET ELECTRICAL POWER REQ'D (MM kWhr/yr)	25.1	\$827,443	\$0.83	\$2.14
0.1860	LABOR IN TECNO - (\$/mt)	0.3584	· ·		
\$10.00	OTHER IN TECNO - (\$/mt)	0.3584	\$66,651	\$0.07	\$0.19
\$10.00	SUB-TOTAL BF HOT METAL:	0.3564	\$3,584,166	<u>\$3.58</u>	\$10.00
	EAF STEELMAKING:		\$37,169,973	\$37.17	\$103.71
	REFINED STEEL TO LRF	1.0523		···	
\$140.00	TOTAL STEEL SCRAP (REVERT & PURCHASED)	0.7366	\$400 407 046	6400.40	600.00
\$1,070.09	MISC. ADDITIVES - (AVG. \$/mt)		\$103,127,846	\$103.13	\$98.00
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0071	\$7,580,000	\$7.58	\$7.20
	,	0.0060	\$351,108	\$0.35	\$0.33
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,962,106	\$3.96	\$3.77
\$77.10	LIME CHARGED	0.0124	\$958,067	\$0.96	\$0.91
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	36.8404	\$1,547,299	\$1.55	\$1.47
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.26
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$15.99
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	486.4149	\$16,051,693	\$16.05	\$15.25
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	<u>\$288,705</u>	<u>\$0.29</u>	<u>\$0.27</u>
	SUB-TOTAL EAF STEELMAKING:		\$155,181,824	\$155.18	\$147.47
	LADLE REFINING:				
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$893,142	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,347	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9032	<u>\$1,151,806</u>	<u>\$1.15</u>	<u>\$1.18</u>
	SUB-TOTAL LRF:		\$6,816,080	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$199,167,877	\$220.45	

ACOREX

SUMMARY CONSUMABLES COREX HOT METAL/EAF

04-Aug-2000

Rev. 3

60% COREX HOT METAL CHARGE - 40%MIDREX DRI

BASIS:

0.418	MM MT/YEAR MIDREX DRI CHARGED TO EAF
0.628	MM MT/YEAR LIQUID HOT METAL (TARGET)
0.624	MM MT/YEAR LIQUID HOT METAL (CALC.)
1.000	MM MT/YEAR LIQUID STEEL (TARGET)
0.977	MM MT/YEAR HOT BAND EQUIVALENT (CALC.)

SUMMARY:

0.431	MM MT/YEAR LUMP IRON ORE
0.431	MM MT/YEAR IRON ORE PELLETS FEED
0.118	MM MT/YEAR FLUXED IRON SINTER
0.000	MM MT/YEAR IRON SCRAP
0.138	MM MT/YEAR LIMESTONE
0.138	MM MT/YEAR SIO2/GRAVEL
0.741	MM MT/YEAR COAL

1.958 MMT MT/YEAR TOTAL SOLID COREX FEED (ASSUMPTION)

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
COREX FURNA	CE:			
	LUMP IRON ORE FEED	0.4313	0.000	0.431
	IRON PELLET FEED	0.4313	0.000	0.431
	IRON SINTER FEED	0.1181	0.000	0.118
	IRON SCRAP FEED	0.0000	0.000	0.000
	LIMESTONE FEED	0.1382	0.000	0.138
	GRAVEL FEED	0.1382	0.000	0.138
	COAL FEED	0.7413	0.000	0.741
	OXYGEN TO FURNACE (AS GAS)		0.009	
	MOISTURE TO FURNACE (AS GAS)	0.0000	0.010	0.010
	NET SOLID FEED TO FURNACE	1.9985	0.000	1.999
	N.G. FUEL TO FURNACE - (MM mt/yr)	0.0000	0.009	0.009
	COREX ELECTRICAL POWER REQ'D -	40.1390		
	BLAST GAS FROM FURNACE (AS GAS)		1.1226	
	HOT METAL FROM COREX FURNACE	0.6237	0.000	0.624
MIDREX DRI SH	AFT FURNACE:			
	NET PELLETS TO SHAFT FCE - MIDREX	0.7124	0.000	0.7124
	SUPPLIMENTAL FUEL TO DRI (AS N.G.)		0.020	
	MIDREX ELECTRIC POWER REQ'D - (MM kWhr/yr)	82.4296		

ACOREX

SUMMARY CONSUMABLES COREX HOT METAL/EAF

04-Aug-2000 Rev. 2

60% COREX HOT METAL CHARGE - 40%MIDREX DRI

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID	TOTAL
EAF STEELMA	KING:	(191191 17 175)	(MM T/YR)	(MM T/YR)
	MIDREX DRI (40.13% DRI)	0.4180	0.0000	0.4400
	HOT METAL FROM COREX FURNACE	0.6237		0.4180
	MISC. ADDITIVES	0.0237	0.0000	0.6237
	STEEL C (CHARGE+SLAG INJ)	0.0060	0.0000	0.0071
	EAF ELECTRODES		0.0000	0.0060
	LIME CHARGED	0.0038	0.0000	0.0038
		0.0124	0.0000	0.0124
	O2 GAS TO EAF (MM Nm3/YR)		38.99	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (kWhr/yr)	406.2297	_	
LADLE REFININ				
	LIQ. EAF STEEL TO LRF	0.0000	1.0545	1.0545
	LIME TO LADLE REF. FCE.	0.0053	0.000	0.0053
	SLAG/WIRE DESULFURIZER TO LRF	0.0004	0.000	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)		0.063	
	LRF ELECTRICAL POWER REQ'D - (kWhr/yr)	34.9032		
	REFINED STEEL TO CASTING	1.000	0.0000	1.000
	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

ACOREX 04-Aug-2000

SUMMARY CONSUMABLES COREX HOT METAL/EAF

Rev. 3

60% COREX HOT METAL CHARGE - 40%MIDREX DRI

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PERONI	COREX:		. ,		
\$37.84	IRON ORE LUMP. DELIVERED - (\$/mt DRY)	0.4042	040,000,400		
\$47.96	IRON ORE PELLETS DELIVERED - (\$/mt)	0.4313	\$16,322,186	\$16.32	\$26.17
\$40.00	IRON SINTER FEED	0.4313	\$20,687,421	\$20.69	\$33.17
\$10.00	IRON SCRAP FEED	0.1181	\$4,722,696	\$4.72	\$7.57
\$65.00		0.0000	\$0	\$0.00	\$0.00
\$50.00	LIMESTONE FEED GRAVEL FEED	0.1382	\$8,985,262	\$8.99	\$14.41
\$58.16		0.1382	\$6,911,740	\$6.91	\$11.08
	COAL FEED	0.7413	\$43,113,938	\$43.11	\$69.13
\$0.042	OXYGEN TO FURNACE (\$/Nm3 AS GAS)	11.7481	\$493,420	\$0.49	\$0.79
\$124.45	N.G. FUEL TO FURNACE - (MM mt/yr)	0.0095	\$1,181,064	\$1.18	\$1.89
\$0.033	COREX ELECTRICAL POWER REQ'D -	40.1390	\$1,324,587	\$1.32	\$2.12
0.2925	LABOR FOR COREX & FACILITY - (MN-HR/mt HM)		\$7,023,145	\$7.02	\$11.26
\$10.00	COREX & GENERAL OTHER - (\$/mt HM)		<u>\$6,236,559</u>	<u>\$6.24</u>	\$10.00
	HOT METAL FROM COREX FURNACE	0.6237			
	SUB-TOTAL COREX H.M.:		\$117,002,018	\$117.00	\$187.61
	MIDREX SHAFT FURNACE DRI:				
	MIDREX DRI (40.13% DRI)	0.4180			
\$47.96	NET PELLETS, ETC. TO SHAFT FCE.	0.7124	\$34,166,704	\$34.17	\$81.74
\$0.04	DRI LABOR - (MN-HR/mt DRI)	0.4180	\$644,674	\$0.64	\$1.54
\$11.39	DRI OTHER - (\$/mt DRI)	0.4180	\$4,761,020	\$4.76	\$11.39
\$0.033	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	82.4296	\$2,720,177	\$2.72	\$6.51
\$124.45	N.G. FUEL TO DRI - (\$/mt)	0.0204	\$2,543,758	\$2.54	\$6.09
	SUB-TOTAL DRI PRODUCTION:		\$44,836,332	\$44.84	\$107.26
	EAF STEELMAKING:	÷		<u> </u>	0101.20
	REFINED STEEL TO LRF	1.0545			
	MIDREX DRI (40.13% DRI)	0.4180		ŀ	
	HOT METAL FROM COREX FURNACE	0.6237		İ	
\$0.00	TOTAL STEEL SCRAP (REVERT ONLY)	0.0000	so l	\$0.00	\$0.00
\$1,070.09	MISC. ADDITIVES - (AVG. \$/mt)	0.0071	\$7,580,000	\$7.58	\$7.19
\$58.16	STEEL C (CHARGE+SLAG INJ)	0.0060	\$351,169	\$0.35	\$0.33
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,962,106	\$3.96	\$3.76
\$77.83	LIME CHARGED	0.0124	\$967,138	\$0.97	
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	38.9907	\$1,637,608		\$0.92
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000		\$1.64	\$1.55
\$16.83	EAF OTHER - (\$/mt L.S.)	E	\$4,485,000	\$4.49	\$4.25
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	1.0000	\$16,830,000	\$16.83	\$15.96
\$124.45	N.G. AUX, FUEL TO EAF	406.2297	\$13,405,579	\$13.41	\$12.71
9124.40		0.0023	<u>\$288,705</u>	\$0.29	\$0.27
<u></u>	SUB-TOTAL EAF STEELMAKING: LADLE REFINING:		\$49,507,306	\$49.51	\$46.95
	LIQ. EAF STEEL TO CASTING	4.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	1.0000	#200 440		
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0053	\$893,142	\$0.89	\$0.89
t t		0.0004	\$258,347	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9032	<u>\$1,151,806</u>	<u>\$1.15</u>	<u>\$1.15</u>
	SUB-TOTAL LRF:		\$6,816,080	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$218,161,736	\$218.16	

AHISMT SUMMARY CONSUMABLES

21-June-2000 HISMELT PROCESS TO PRODUCE HOT METAL

Rev. 2 32.7% HOT METAL CHARGE TO EAF

BASIS:

0.6882 MM MT/YEAR PURCHASED SCRAP CHARGED
0.3585 MM MT/YEAR LIQUID HOT METAL (TARGET)
0.3585 MM MT/YEAR LIQUID HOT METAL (CALC.)
1.0000 MM MT/YEAR LIQUID STEEL (TARGET)
0.9770 MM MT/YEAR HOT BAND EQUIVALENT (CALC.)

SUMMARY:

0.534 MMM MT/YEAR FINE ORE FEED

454.376 MMM Nm3/YEAR AIR

61.452 MMM Nm3/YEAR OXYGEN

16.760 MMM Nm3/YEAR NATURAL GAS

0.204 MMM MT/YEAR FINE COAL

0.061 MMM MT/YEAR LIME/DOLOMITE FLUX ADDED

0.125 MMM MT/YEAR NET SLAG PRODUCED

316.573 MMM Nm3/YEAR WASTE FLUE GASES

ASSUMPTIONS:

1.621	ORE/HM RATIO - (MT/mt HM)
0.620	COAL TO HM RATIO - (MT/mt HM)
2.200	NATURAL GAS - (GJ/mt HM)
50.847	NATURAL GAS - (Nm3/mt HM)
1,378.531	TOTAL AIR TO SRV - (Nm3/mt HM)
186.441	OXYGEN TO SRV - (Nm3/mt HM)
80.00%	PERCENT C IN COAL
174.81	SRV PLANT ELEC. POWER REQ'D, W/O O2 PLANT - (kWhr/mt HM)
0.3953	TOTAL ORE/TOTAL MINED ROCK RATIO - (MT/mt)

AHISMT

21-June-2000

SUMMARY CONSUMABLES HISMELT PROCESS TO PRODUCE HOT METAL

Rev. 2

32.7% HOT METAL CHARGE TO EAF

PROCESS	STREAM LABLE	I DDV OOL (DO		
OPERATION	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
SRV REACTOR	SVSTEM.	(MM T/YR)	(MM T/YR)	(MM T/YR)
SIN KEACTOI	IRON ORE FINES FEED	0.5045		
	COAL FINES TO FEED	0.5345	0.0000	0.5345
	OXYGEN GAS TO SRV - (MM Nm3/yr)	0.2045	0.0000	0.2045
	FLUX CHARGED TO SRV (LIME)	61.4524	0.0000	61.4524
	NATURAL GAS TO SRV (LIME)	0.0615	0.0000	0.0615
	HOT METAL LEAVING SRV TO EAF	16.7598	0.0125	16.7598
	• • •	0.3585	0.0000	0.3585
	ELECT. POWER CONSUMMED IN SRV - (MM kWhī/yr)	62.6727		
EAF STEELMA	KING:	<u> </u>		
	HOT METAL LEAVING SRV TO EAF	0.3585	0.0000	0.3585
1	TOTAL STEEL SCRAP (32.7% HM TO EAF)	0.7366	0.0000	0.7366
	MISC. ADDITIVES	0.0071	0.0000	0.0071
	STEEL C (CHARGE+SLAG INJ)	0.0060	0.0000	0.0060
	EAF ELECTRODES	0.0038	0.0000	0.0038
	LIME CHARGED	0.0124	0.0000	0.0038
	O2 GAS TO EAF (MM Nm3/YR)	0.0724	36.8404	0.0124
	LIQ. EAF STEEL TO LRF	0.0000	1.0545	1.0545
	AUX. FUEL TO EAF] 0.0000	0.0023	1.0545
	EAF ELECTRICAL POWER REQ'D - (MM kWhr/vr)	486.4149	0.0023	
	,	'33,1116		
LADLE REFINI	NG:	!		
1	LIQ. EAF STEEL TO LRF	0.0000	1.0545	1.0545
	LIME TO LADLE REF. FCE.	0.0053	0.0000	0.0053
	SLAG/WIRE DESULFURIZER TO LRF	0.0025	0.0000	0.0025
	ARGON GAS TO LRF (MM Nm3/YR)		0.0633	
	LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	34.9032		
	REFINED STEEL TO CASTING	0.0000	1,0000	1.0000
	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

AHISMT

SUMMARY CONSUMABLES

21-June-2000

HISMELT PROCESS TO PRODUCE HOT METAL

Rev. 2

32.7% HOT METAL CHARGE TO EAF

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT		<u></u>			
	ORE:				
\$43.89	IRON ORE CONC. DELIVERED - (\$/mt DRY)	0.5345	\$23,457,011	\$23.46	\$65.43
	DIRECT REDUCTION IN SHAFT FURNACE:				
\$40.71	COAL FINES TO FEED	0.2045	\$8,324,343	\$8.32	\$23.22
\$0.042	OXYGEN GAS TO SRV - (MM Nm3/yr)	61.4524	\$2,581,002	\$2.58	\$7.20
\$77.83	FLUX CHARGED TO SRV (LIME)	0.0615	\$4,782,843	\$4.78	\$13.34
\$124.45	N.G. FUEL TO SRV - (\$/mt)	0.0125	\$1,550,131	\$1.55	\$4.32
	HOT METAL LEAVING SRV TO EAF	0.3585			
\$0.033	ELECT. POWER CONSUMMED IN SRV - (MM kWhr/yr)	62.6727	\$2,068,198	\$2.07	\$5.77
0.1860	SRV LABOR - (MN-HR/mt HM)	0.3585	\$2,567,418	\$2.57	\$7.16
11.39	SRV OTHER - (\$/mt HM)	0.3585	\$4,083,632	\$4.08	<u>\$11.39</u>
	SUB-TOTAL DRI PRODUCTION:		\$25,957,567	\$25.96	\$72.40
	EAF STEELMAKING:			<u></u>	*** **********************************
	REFINED STEEL TO LRF	1.0545			
\$140.00	TOTAL STEEL SCRAP (PURCHASED, REVERT)	0.7366	\$103,127,846	\$103.13	\$97.80
\$1,070.09	MISC. ADDITIVES - (AVG. \$/mt)	0.0071	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0060	\$351,108	\$0.35	\$0.33
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,962,106	\$3.96	\$3.76
\$77.10	LIME CHARGED	0.0124	\$958,067	\$0.96	\$0.91
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	36.8404	\$1,547,299	\$1.55	\$1.47
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.25
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$15.96
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	486.4149	\$16,051,693	\$16.05	\$15.22
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,705	\$0.29	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$155,181,824	\$155.18	\$147.16
	LADLE REFINING:				
	LIQ. EAF STEEL TO CASTING	1.0000			, ,
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$893,142	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0025	\$1,750,000	\$1.75	\$1.75
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9032	\$1,151,806	<u>\$1.15</u>	\$1.15
	SUB-TOTAL LRF:		\$8,307,733	\$8.31	\$8.31
	TOTAL THROUGH LIQUID STEEL:		\$212,904,134	\$212.90	

ROTARY HEARTH DRI FURNACES

AREDSM	SUMMARY CONSUMABLES
21-June-2000	ROTARY HEARTH DIRECT REDUCTION/SAF/EAF PROCESS
Rev. 2	(E.G. REDSMELT, IRON DYNAMICS, FASTMELT, ETC.)
BASIS:	MAXIMUM HOT METAL CHARGED - 85.5%
0.1181	MM MT/YEAR PURCHASED SCRAP CHARGED
0.0363	MM MT/YEAR RECYCLED SCRAP CHARGED
1.0261	MM MT/YEAR DRI CHARGED
0.9112	MM MT/YEAR LIQUID HOT METAL (TARGET)
0.9112	MM MT/YEAR LIQUID HOT METAL (CALC.)
1.0000	MM MT/YEAR LIQUID STEEL (TARGET)
0.9770	MM MT/YEAR CAST SLAB EQUIVALENT (CALC.)
SUMMARY:	
1.454	MM MT/YEAR FINE ORE FEED
3,344.5	MM Nm3/YEAR AIR
13.9	MM Nm3/YEAR OXYGEN
54.9	MM Nm3/YEAR NATURAL GAS
0.350	MM MT/YEAR COAL (AS FINES)
0.052	MM MT/YEAR FLUX ADDED
2.014	MM MT/YEAR NET G.B. PELLETS PRODUCED
3,442.3	MM Nm3/YEAR WASTE FLUE GASES SAF
0.159	MM MT/YEAR NET SLAG PRODUCED
ASSUMPTIONS:	
48.48	ELECTRIC POWER CONSUMPTION IN RHF - (kWhr/mt DRI)
2.375	NATURAL GAS - (GJ/mt HM)
54.890	NATURAL GAS TO RHF- (Nm3/mt HM)
0.044.545	

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
GREEN BALL P	ELLETIZING:	1 ((7.1.4)	(dilli 1711t)	(141141 17114)
	IRON ORE FINES TO PELLETIZING	1.4535	0.0000	1.4535
i	COAL FINES TO PELLETIZING	0.3496	0.0018	0.3514
-	BINDER TO PELLETIZING	0.0203	0.0015	0.0218
	RECYCLE DUST TO PELLETIZING	0.2046	0.2046	0.4092
j	RECYCLE PELLETS TO PELLETIZING	0.0516	0.0070	0.0587
	GROSS GREEN-BALL PELLETS	2.0653	0.2816	2.3469
	ELECTRIC POWER IN G-B PELLET (MM kWhr/yr)	38.4560		
ROTARY HEAR	TH FURNACE:			
	GREEN-BALL PELLETS FEED TO RHF	2.0137	0.2746	2.2883
	NATURAL GAS FUEL TO RHF - (MM Nm3/yr)	54.8896	0.04074	
	COMBUSTION AIR TO RHF	3,344.5452	4.32383	
	DRI LEAVING RHF TO SAF	1.0261	0.000	1.0261
	ELECT. POWER CONSUM. IN RHF - (MM kWhr/yr)	49.7464		
SUBMERGED A	RC FURNACE MELTER:	1		
	NET DRI CHARGE TO SAF (>450 °C)	1.0261	0.0000	1.0261
	LIME FLUX TO SAF	0.0635		1.0201
	SILICA FLUX TO SAF	0.0334		
	ELECTRODES TO SAF	0.0018		
	SAF CHARGE CARBON (COAL)	0.0217		
	SLAG/WIRE DESULFURIZER TO LTF	0.0046		
	NET HOT METAL CHARGE TO EAF	0.9112		
	ELECTRIC POWER CONSUMP. SAF - (MM kWhr/yr)	265.1622		

3,344.545 TOTAL AIR TO RHF - (Nm3/mt HM)
13.500 OXYGEN TO RHF - (Nm3/mt HM)

0.9301 NET IRON RECOVERY IN SAF + LTF

18.6200 ELECTRIC POWER CONSUMMED IN G-B PELLET. - (kWhr/mt GB)

AREDSM

SUMMARY CONSUMABLES

21-June-2000

ROTARY HEARTH DIRECT REDUCTION/SAF/EAF PROCESS

Rev. 2

(E.G. REDSMELT, IRON DYNAMICS, FASTMELT, ETC.)

	(Ziericzenia ziniericzenia zin								
PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL					
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)					
EAF STEELMAI	KING:	····	- ' 	(**************************************					
	PURCHASED SCRAP TO EAF	0.1181	<u> </u>	0.1181					
	RECYCLE SCRAP (REVERT) TO EAF	0.0363		0.0363					
	MISC. ADDITIVES	0.0155		0.0155					
	STEEL C (CHARGE+SLAG INJ)	0.0130		0.0130					
	EAF ELECTRODES	0.0028		0.0005					
	LIME CHARGED	0,0243		0.0243					
	O2 GAS TO EAF (MM Nm3/YR)		52.60	0.02.10					
	AUX. FUEL TO EAF		0.0023	i					
	EAF ELECTRICAL POWER REQ'D	130.0000	5.0020						
LADLE REFININ	lG:								
	LIQ. EAF STEEL TO LRF	0.0000	1.0032	1.0032					
	LIME TO LADLE REF. FCE.	0.0053		0.0053					
	SLAG/WIRE DESULFURIZER TO LRF	0.0004		0.0004					
	ARGON GAS TO LRF (MM Nm3/YR)	<u> </u>	0.063						
ĺ	LRF ELECTRICAL POWER REQ'D	30.0950							
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000					
L	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770					

AREDSM

SUMMARY CONSUMABLES

21-June-2000

ROTARY HEARTH DIRECT REDUCTION/SAF/EAF PROCESS

Rev. 2

(E.G. REDSMELT, IRON DYNAMICS, FASTMELT, ETC.)

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED \$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt \$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS:	ELECTRICAL POWER RATE - (\$/KVVnr)	(8555 (0/5)	402-1-		
PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
T Z X ONT	ORE FINES:			<u></u>	
\$21.19	IRON ORE FINES TO PELLETIZING	4.4505	200 000 744		
Ψ21.13 [GREEN BALL PELLETIZING:	1.4535	\$30,800,714	\$30.80	\$15.30
\$40.71	COAL FINES TO PELLETIZING	2.0.100			
\$90.02	BINDER TO PELLETIZING	0.3496	\$14,233,112	\$14.23	\$7.07
390.02	RECYCLE DUST TO PELLETIZING	0.0203	\$1,828,958	\$1.83	\$0.91
	RECYCLE PELLETS TO PELLETIZING	0.2046			
	GROSS GREEN-BALL PELLETS	0.0516		ļ	
\$0.033		2.0653			
I	ELEC. POWER IN G-B PELLET (MM kWhr/yr)	38.4560	\$1,269,048	\$1.27	\$0.63
\$124.45	HEAT FOR DRYING (N.G. EQUIV.)	0.0407	\$5,070,656	\$5.07	\$2.52
0.0582	LABOR FOR PELLETIZING - (MH-HR/mt PELLET)	2.0653	\$4,630,911	\$4.63	\$2.30
\$2.30	OTHER COSTS IN G-B PELLETIZING -(\$/mt)	2.0653	<u>\$4,750,203</u>	<u>\$4.75</u>	<u>\$2.36</u>
	SUB-TOTAL GREEN-BALL PELLETIZING:		\$31,782,887	\$31.78	\$15.78
	ROTARY HEARTH FURNACE:	***			
	DRI LEAVING RHF TO SAF	1.0261			
	GREEN-BALL PELLETS FEED TO RHF	2.0137		1	
\$0.042	NATURAL GAS FUEL TO RHF - (MM Nm3/yr)	54.8896	\$2,305,362	\$2.31	\$2.25
\$0.033	ELECT. POWER CONSUM. IN RHF - (MM kWhr/yr)	49.7464	\$1,641,633	\$1.64	\$1.60
0.1098	LABOR IN RHF - (\$/mt)	1.0261	\$4,338,678	\$4.34	\$4.23
\$13.69	OTHER IN RHF - (\$/mt)	1.0261	\$14,047,624	\$14.05	\$13.69
	SUB-TOTAL SAF HOT METAL:		\$22,333,297	\$22.33	\$21.76
	IRONMAKING IN SAF FURNACE:				
	NET DRI CHARGE TO SAF (>450 °C)	1.0261			
	NET HOT METAL CHARGE TO EAF	0.9112		i	
\$77.83	LIME FLUX TO SAF	0.0635	\$4,939,235	\$4.94	\$5.42
\$50.00	SILICA FLUX TO SAF	0.0334	\$1,672,070	\$1,67	\$1.83
\$1,031.03	ELECTRODES TO SAF	0.0021	\$2,113,850	\$2.11	\$2.32
\$58.16	SAF CHARGE CARBON	0.0217	\$1,264,392	\$1.26	\$1.39
\$4.83	SLAG/WIRE DESULFURIZER TO LTF - (AVG.\$/MM mt)	0.9112	\$4,400,000	\$4.40	\$4.83
\$0.72	LADLE COSTS - (\$/mt)	0.9112	\$656,071	\$0.66	\$0.72
\$0.033	ELECTRIC POWER CONSUMP. SAF/LTF - (MM kWhr/y	318.9235	\$10,524,475	\$10,52	\$11.55
0.1019	SAF LABOR - (MN-HR/mt)	0.9112	\$3,574,026	\$3.57	\$3.92
10.46	SAF OTHER - (\$/mt)	0.9112	\$9,531,256	\$9.53	\$10.46
	SUB-TOTAL HM PRODUCTION IN SAF:	0.0112	\$38,675,376	\$38.68	\$10.46 \$42.44
		<u> </u>	400,010,010	\$30.00	⊅4∠.44

AREDSM

SUMMARY CONSUMABLES

21-June-2000

ROTARY HEARTH DIRECT REDUCTION/SAF/EAF PROCESS

Rev. 2

(E.G. REDSMELT, IRON DYNAMICS, FASTMELT, ETC.)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT					******
	EAF STEELMAKING:			·	
	REFINED STEEL TO LRF	1.0032		-	-117
	NET HOT METAL CHARGE TO EAF	0.9112			
\$140.00	PURCHASED SCRAP TO EAF	0.1181	\$16,530,376	\$16.53	\$16.48
\$10.00	REVERT STEEL SCRAP (REVERT ONLY)	0.0363	\$362,919	\$0.36	\$0.36
\$490.53	MISC. ADDITIVES - (AVG. \$/mt)	0.0155	\$7,580,000	\$7.58	\$7.56
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0130	\$753,636	\$0.75	\$0.75
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0028	\$2,886,897	\$2.89	\$2.88
\$77.10	LIME CHARGED	0.0243	\$1,872,407	\$1.87	\$1.87
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	52.5985	\$2,209,137	\$2.21	\$2.20
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.47
\$21.51	EAF OTHER - (\$/mt L.S.)	1.0000	\$21,510,000	\$21.51	\$21.44
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	130.0000	\$4,290,000	\$4.29	\$4.28
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,705	\$0.29	\$0.29
	SUB-TOTAL EAF STEELMAKING:		\$62,769,076	\$62.77	\$62.57
	LADLE REFINING:	1	<u> </u>	. , , , , , , , , , , , , , , , , , , ,	
	LIQ. EAF STEEL TO CASTING	1.0032			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$893,142	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,347	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0032	\$4,511,842	\$4.51	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	30.0950	\$993,135	\$0.99	\$0.99
	SUB-TOTAL LRF:		\$6,671,651	\$6.67	\$6.65
	TOTAL THROUGH LIQUID STEEL:	-	\$193,033,000	\$193.03	

AMAUMEE

SUMMARY CONSUMABLES

22-June-2000

MAUMEE ROTARY HEARTH FURNACE DRI WITH BRIQUETTES/EAF

Rev. 2

100% DRI CHARGE - 4.0 wt.% CARBON

BASIS:

1.0000 MM MT/YEAR LIQUID STEEL PRODUCT 0.9768 MM MT/YEAR NET SLAB PRODUCT

SUMMARY:

0.7868 MM MT/YEAR FINE ORE FEED (BY-PRODUCT OF LUMP)

0.3934 MILL SCALE TO BRIQUETTING

0.3934 RESIDUAL IRON UNITS TO BRIQUETTING

1.8983 MM MT/YEAR NET GREEN BRIQUETTE FEED TO RHF

1.1217 MM MT/YEAR NET DRI TO EAF

1.0106 MM MT/YEAR NET DRI IRON UNITS TO EAF

ASSUMPTIONS:

39.47% PERCENT IRON ORE FINES IN FEED - (IRON ORE/BRIQUETTE)

19.74% PERCENT MILL SCALE IN FEED - (SCALE/BRIQUETTE)

19.74% PERCENT RESIDUAL IRON UNITS IN FEED - (RIU/BRIQUETTE)

16.29% PERCENT COAL IN FEED - (COAL/BRIQUETTE)
4.76% PERCENT RECYCLE BRIQUETTE MATERIAL IN FEED - (% RECYCLE)

55.00 OXYGEN REQUIREMENT FOR EAF - (Nm2/mt HM)

OPERATION BRIQUETTING OF IRON UNITS:	PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
BRIQUETTING OF IRON UNITS: ORE FINES DELIVERED TO PLANT SITE 0.7868 0.7868 0.3248 0.3248 0.3248 0.3248 0.3248 0.3248 0.3248 0.3248 0.3934 0.3932 0.3932 0.3932 0.3932 0.3932 0.3932 0.3932 0.3932 0.3932 0.39333 0.3933 0.3933 0.3933 0.3933 0.3933 0.3933 0.39333 0.3933 0.3933 0.393333 0.39333 0.39333 0.39333 0.39333 0.39333 0.39333	OPERATION		(MM T/YR)	(MM T/YR)	
COAL TO BRIQUETTING 0.3248 0.3248 MILL SCALE TO BRIQUETTING 0.3934 0.3934 RESIDUAL IRON UNITS TO BRIQUETTING 0.3934 0.3934 RECYCLE BRIQUETTES TO FEED 0.0949 0.0949 TOTAL FEED TO BRIQUETTING 1.9932 1.9932 TOTAL BRIQUETTES TO RHF 1.8983 1.8983 BRIQUETTE ELEC. POWER REQ'D - (MM kWhr/yr) 39.8645 ROTARY HEARTH DRI PRODUCTION: NET REDUCED IRON BRIQUETTES TO EAF (4.0% C) 1.1217 AUXILARY FUEL TO DRI RHF DRI ELEC. POWER REQ'D - (MM kWhr/yr) 165.0916 EAF STEELMAKING: HBI FEED TO EAF 1.1217 0.0000 0.0567 STEEL C (CHARGE+SLAG INJ) 0.0648 0.0000 0.0648 MISC. ADDITIVES 0.0070 0.0000 0.0070 STEEL C (CHARGE+SLAG INJ) 0.0000 0.0000 0.0070 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.000	BRIQUETTING				,
MILL SCALE TO BRIQUETTING 0.3934 RESIDUAL IRON UNITS TO BRIQUETTING 0.3934 RECYCLE BRIQUETTES TO FEED 0.0949 0.0949 TOTAL FEED TO BRIQUETTING 1.9932 1.9932 TOTAL BRIQUETTES TO RHF 1.8983 1.8983 BRIQUETTE ELEC. POWER REQ'D - (MM kWhr/yr) 39.8645 ROTARY HEARTH DRI PRODUCTION: NET REDUCED IRON BRIQUETTES TO EAF (4.0% C) 1.1217 0.0567 RHF DRI ELEC. POWER REQ'D - (MM kWhr/yr) 165.0916 EAF STEELMAKING: HBI FEED TO EAF 1.1217 0.0567 TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) 0.0648 0.0000 0.00648 MISC. ADDITIVES 0.0070 0.0000 0.0070 STEEL C (CHARGE+SLAG INJ) 0.0000 0.0000 0.0000 EAF ELECTRODES 0.0038 0.0000 0.0038 LIME CHARGED 0.0124 0.0000 0.0038 LIME CHARGED 0.0124 0.0000 0.0124 O2 GAS TO EAF (MM Nm3/YR) 44,0000 AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D 597.4453 LADLE REFINING: LIQ. EAF STEEL TO LRF 0.0101 0.0000 0.0101 SLAGWIRE DESULFURIZER TO LRF 0.0101 0.0000 0.0025 ARGON GAS TO LRF (MM Nm3/YR) 1.0633 1.0543 REFINED STEEL TO CASTING 0.0005 1.0000 0.0025 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000 0.0025 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000 0.0025 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000 0.0025			0.7868		0.7868
RESIDUAL IRON UNITS TO BRIQUETTING 0.3934 RECYCLE BRIQUETTES TO FEED 0.0949 TOTAL FEED TO BRIQUETTING TOTAL BRIQUETTES TO RHF 1.9932 TOTAL BRIQUETTES TO RHF 1.8983 RIQUETTE ELEC. POWER REQ'D - (MM kWhr/yr) NET REDUCED IRON BRIQUETTES TO EAF (4.0% C) AUXILARY FUEL TO DRI RHF DRI ELEC. POWER REQ'D - (MM kWhr/yr) RET STEELMAKING: HBI FEED TO EAF TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) STEEL C (CHARGE+SLAG INJ) CAGAS TO EAF (4.0000 EAF ELECTRODES 0.0038 0.0000 0.0000 EAF ELECTRODES 0.0038 0.0000 0.0000 0.0000 EAF ELECTRODES 0.0038 0.0000 0.0038 LIME CHARGED 0.0124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00124 0.0000 0.00125 EAF ELECTRICAL POWER REQ'D LADLE REFINING: LIQ. EAF STEEL TO LRF 0.0101 0.0000 0.0025 0.0000 0.0025 0.0000 0.0025 0.0000 0.0025 0.0000 0.0025 0.0000 0.0025 0.0000 0.0025 0.0000 0.0025 0.0000 0.0025 0.0000 0.0025 0.0000 0.0025 0.0000 0.0			0.3248		0.3248
RECYCLE BRIQUETTES TO FEED 0.0949 0.0949 TOTAL FEED TO BRIQUETTING 1.9932 1.9932 TOTAL BRIQUETTES TO RHF 1.8983 1.8983 RRIQUETTE ELEC. POWER REQ'D - (MM kWhr/yr) 39.8645 ROTARY HEARTH DRI PRODUCTION: NET REDUCED IRON BRIQUETTES TO EAF (4.0% C) 1.1217 AUXILARY FUEL TO DRI RHF DRI ELEC. POWER REQ'D - (MM kWhr/yr) 165.0916 EAF STEELMAKING: HBI FEED TO EAF 1.1217 TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) 0.0648 0.0000 0.0648 MISC. ADDITIVES 0.0070 0.0000 0.0070 STEEL C (CHARGE+SLAG INJ) 0.0000 0.0000 0.0000 EAF ELECTRODES 0.0038 0.0000 0.0038 LIME CHARGED 0.0124 0.0000 0.0124 O2 GAS TO EAF (MM Nm3/YR) 44.0000 AUX. FUEL TO EAF 597.4453 LADLE REFINING: LIQ. EAF STEEL TO LRF 0.0101 0.0000 0.0101 SLAG/WIRE DESULFURIZER TO LRF 0.0101 0.0000 0.0025 ARGON GAS TO LFF (MM Nm3/YR) 1.0543 1.0543 LRF ELECTRICAL POWER REQ'D 34.8703 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000 1.0000 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000 1.0000 0.0025 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000 1.0000 0.0015			0.3934		0.3934
TOTAL FEED TO BRIQUETTING TOTAL BRIQUETTES TO RHF TOTAL BRIQUETTES TO RHF TOTAL BRIQUETTE ELEC. POWER REQ'D - (MM kWhr/yr) ROTARY HEARTH DRI PRODUCTION: NET REDUCED IRON BRIQUETTES TO EAF (4.0% C) AUXILARY FUEL TO DRI RHF DRI ELEC. POWER REQ'D - (MM kWhr/yr) 165.0916 EAF STEELMAKING: HBI FEED TO EAF TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) MISC. ADDITIVES 0.0070 STEEL C (CHARGE+SLAG INJ) 0.0000 EAF ELECTRODES 0.0038 0.0000 0.0000 EAF ELECTRODES 0.0038 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000	Ì		0.3934		0.3934
TOTAL BRIQUETTES TO RHF BRIQUETTE ELEC, POWER REQ'D - (MM kWhr/yr) ROTARY HEARTH DRI PRODUCTION: NET REDUCED IRON BRIQUETTES TO EAF (4.0% C) AUXILARY FUEL TO DRI RHF DRI ELEC, POWER REQ'D - (MM kWhr/yr) 165.0916 EAF STEELMAKING: HBI FEED TO EAF TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) MISC. ADDITIVES D.0070 STEEL C (CHARGE+SLAG INJ) D.0000 D.00		RECYCLE BRIQUETTES TO FEED	0.0949	i	0.0949
BRIQUETTE ELEC. POWER REQ'D - (MM kWhr/yr) ROTARY HEARTH DRI PRODUCTION: NET REDUCED IRON BRIQUETTES TO EAF (4.0% C) AUXILARY FUEL TO DRI RHF DRI ELEC. POWER REQ'D - (MM kWhr/yr) EAF STEELMAKING: HBI FEED TO EAF TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) MISC. ADDITIVES O.0070 STEEL C (CHARGE+SLAG INJ) EAF ELECTRODES LIME CHARGED O2 GAS TO EAF (MM Nm3/YR) AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF ARGON GAS TO LRF (MM Nm3/YR) ALGED ARGON GAS TO LRF (MM Nm3/YR) LIQ. EAF STEEL TO LRF SLAGWIRE DESULFURIZER TO LRF ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING REFINED STEEL TO CASTING NOODO 1.0000 1.			1.9932		1.9932
NET REDUCED IRON BRIQUETTES TO EAF (4.0% C)	!		1.8983		1.8983
NET REDUCED IRON BRIQUETTES TO EAF (4.0% C)		BRIQUETTE ELEC. POWER REQ'D - (MM kWhr/yr)	39.8645		
AUXILARY FUEL TO DRI RHF DRI ELEC. POWER REQ'D - (MM kWhr/yr) EAF STEELMAKING: HBI FEED TO EAF TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) MISC. ADDITIVES STEEL C (CHARGE+SLAG INJ) STEEL C (CHARGE+SLAG INJ) AUX. FUEL TO EAF O2 GAS TO EAF (MM Nm3/YR) AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF SLAGWIRE DESULFURIZER TO LRF ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING O.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000	ROTARY HEAR	TH DRI PRODUCTION:			
AUXILARY FUEL TO DRI RHF DRI ELEC. POWER REQ'D - (MM kWhr/yr) EAF STEELMAKING: HBI FEED TO EAF TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) MISC. ADDITIVES STEEL C (CHARGE+SLAG INJ) STEEL C (CHARGE+SLAG INJ) AUX. FUEL TO EAF O2 GAS TO EAF (MM Nm3/YR) AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF SLAGWIRE DESULFURIZER TO LRF ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING O.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000 1.0000		NET REDUCED IRON BRIQUETTES TO EAF (4.0% C)	1.1217		1.1217
### PRI ELEC. POWER REQ'D - (MM kWhr/yr) 165.0916 ###################################		AUXILARY FUEL TO DRI		0.0567	
HBI FEED TO EAF TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) MISC. ADDITIVES STEEL C (CHARGE+SLAG INJ) EAF ELECTRODES LIME CHARGED O2 GAS TO EAF (MM Nm3/YR) AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING NET STEEL TO CASTING 1.1217 1.1217 0.0000 0.0048 0.0000 0.0000 0.0000 0.0000 0.0000 0.0000 0.00101 0.0000 0.00101 0.0000 0.0025 0.0000 0.0025 0.0000 0.0025 0.0000 1.0000		RHF DRI ELEC. POWER REQ'D - (MM kWhr/yr)	165.0916		
TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) MISC. ADDITIVES STEEL C (CHARGE+SLAG INJ) EAF ELECTRODES LIME CHARGED O2 GAS TO EAF (MM Nm3/YR) AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF SLAGWIRE DESULFURIZER TO LRF ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING NET STEEL OLAF REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING O.0000 0.0648 0.0000 0.0000 0.0000 0.0000 0.00124 0.0000 0.0124 0.0000 1.0543	EAF STEELMA	KING:		<u></u>	
TOTAL STEEL SCRAP (100% DRI, REVERT ONLY) MISC. ADDITIVES STEEL C (CHARGE+SLAG INJ) EAF ELECTRODES LIME CHARGED O2 GAS TO EAF (MM Nm3/YR) AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING NET STEEL OLAR PROPONIOSE		HBI FEED TO EAF	1.1217		1 1217
MISC. ADDITIVES STEEL C (CHARGE+SLAG INJ) ST		TOTAL STEEL SCRAP (100% DRI, REVERT ONLY)	0.0648	0.0000	
STEEL C (CHARGE+SLAG INJ) EAF ELECTRODES LIME CHARGED O2 GAS TO EAF (MM Nm3/YR) AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF ARGON GAS TO LRF (MM Nm3/YR) ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING NET STEEL OLAR PROPONIOSE 0.0000	i	MISC. ADDITIVES	0.0070		
EAF ELECTRODES LIME CHARGED O2 GAS TO EAF (MM Nm3/YR) AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF SLAGWIRE DESULFURIZER TO LRF ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING NET STEEL OLAR PROPONIOSE 0.0008 0.0008 0.0008 0.0000 1.0543 1.0543 1.0543 0.0000 0.0101 0.0000 0.0025 0.0000 0.0025 0.0000 1.0000 1.0000 1.0000 1.0000		STEEL C (CHARGE+SLAG INJ)	0.0000	· ·	
LIME CHARGED O2 GAS TO EAF (MM Nm3/YR) AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF SLAGWIRE DESULFURIZER TO LRF ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING NET STEEL OLASTING 0.0124 0.0000 0.0124 44.0000 0.0023 597.4453 1.0543 1.0543 1.0543 0.0101 0.0000 0.0101 0.0000 0.0101 0.0025 0.0000 0.0025 0.0000 0.0025		EAF ELECTRODES	0.0038		
O2 GAS TO EAF (MM Nm3/YR) AUX. FUEL TO EAF EAF ELECTRICAL POWER REQ'D LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF SLAGWIRE DESULFURIZER TO LRF ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING NET STEEL OLAR PROPONIOSE 44.0000 0.0023 597.4453 1.0543 1.0543 1.0543 0.0101 0.0000 0.0101 0.0000 0.0025 0.0000 0.0025 0.0633 1.0000 1.0000 1.0000		···· - · · · · · · · · · · · · · · · ·	0.0124	0.0000	· ·
EAF ELECTRICAL POWER REQ'D 597.4453 LADLE REFINING: LIQ. EAF STEEL TO LRF 0.0000 1.0543 1.0543 PULVERIZED LIME TO LRF 0.0101 0.0000 0.0101 SLAG/WIRE DESULFURIZER TO LRF 0.0025 0.0000 0.0025 ARGON GAS TO LRF (MM Nm3/YR) 0.0633 LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) 34.8703 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000		O2 GAS TO EAF (MM Nm3/YR)			5.5.2.
LADLE REFINING: LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF SLAG/WIRE DESULFURIZER TO LRF ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING NET STEEL CLAD REPORTS		AUX. FUEL TO EAF		0.0023	
LIQ. EAF STEEL TO LRF PULVERIZED LIME TO LRF SLAGWIRE DESULFURIZER TO LRF ARGON GAS TO LRF (MM Nm3/YR) LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) REFINED STEEL TO CASTING NET STEEL CLAR PROPORTOR		EAF ELECTRICAL POWER REQ'D	597.4453		
PULVERIZED LIME TO LRF 0.0101 0.0000 0.0101 SLAG/WIRE DESULFURIZER TO LRF 0.0025 0.0000 0.0025 ARGON GAS TO LRF (MM Nm3/YR) 0.0633 LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) 34.8703 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000	LADLE REFINIT	NG:			
PULVERIZED LIME TO LRF 0.0101 0.0000 0.0101 SLAG/WIRE DESULFURIZER TO LRF 0.0025 0.0000 0.0025 ARGON GAS TO LRF (MM Nm3/YR) 0.0633 LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) 34.8703 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000		LIQ. EAF STEEL TO LRF	0.0000	1.0543 T	1.05/3
SLAG/WIRE DESULFURIZER TO LRF 0.0025 0.0000 0.0025 ARGON GAS TO LRF (MM Nm3/YR) 0.0633 LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) 34.8703 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000		PULVERIZED LIME TO LRF			
ARGON GAS TO LRF (MM Nm3/YR) 0.0633 LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) 34.8703 REFINED STEEL TO CASTING 0.0000 1.0000 1.0000	1	SLAG/WIRE DESULFURIZER TO LRF			
LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr) 34.8703 REFINED STEEL TO CASTING 0.0000 1.0000 NET STEEL SLAP PROPERTY 0.0000 1.0000		ARGON GAS TO LRF (MM Nm3/YR)	******		0.0025
REFINED STEEL TO CASTING 0.0000 1.0000 1.0000			34.8703	0.0000	
MET CTEL CLAR PROPLICES			l	1.0000	1 0000
		NET STEEL SLAB PRODUCED	0.9768	0.0000	0.9768

AMAUMEE

Rev. 2

SUMMARY CONSUMABLES

22-June-2000

MAUMEE ROTARY HEARTH FURNACE DRI WITH BRIQUETTES/EAF 100% DRI CHARGE - 4.0 wt.% CARBON

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	¢tt IINIT
PER UNIT		(111111 11111 1111)	WILAR	φ/III. L.S.	\$/mt UNIT
	ORE FINES:		L		
	TOTAL IRON UNIT FEED	1.5735			
\$21.19	IRON ORE FINES TO BRIQUETTING	0.7868	\$16,671,888	\$16.67	\$10.60
\$25.00	MILL SCALE TO BRIQUETTING (PULVERIZED)	0.3934	\$9,834,352	\$9.83	\$6.25
\$15.00	RESIDUAL IRON UNITS TO BRIQ. (RECYCLE CHARGE	0.3934	\$5,900,611	\$5.90	\$3.75
	SUB-TOTAL IRON UNIT FEED:	,	\$32,406,850	\$32.41	\$20.60
	GREEN BRIQUETTE PRODUCTION:	<u>-</u> -	75-1170,000	V02.41	φ20.00
\$40.71	COAL FINES TO BRIQUETTING	0.3248	\$13,223,089	\$13.22	\$6.97
\$90.02	BINDER TO BRIQUETTING	0.0000	\$0	\$0.00	\$0.00
	RECYCLE DUST TO BRIQUETTING (INCL. IN ABOVE)	0.0000		ψ0.00	φ0.00
	RECYCLE PELLETS TO BRIQUETTING	0.0949			
	GROSS GREEN-BALL BRIQUETTES	1.9932	-		
\$0.033	ELEC. POWER IN G-B BRIQUETTING - (MM kWhr/yr)	39.8645	\$1,315,529	\$1.32	\$0.69
0.0582	LABOR FOR G-B BRIQUETTING - (MH-HR/mt PELLET)	1.9932	\$4,469,292	\$4.47	\$2.35
\$11.50	OTHER COSTS IN G-B BRIQUETTING -(\$/mt)	1.9932	\$22,922,104	\$22.92	\$2.33 \$12.07
	SUB-TOTAL GREEN-BALL PELLETIZING:	7.0002	\$41,930,014	\$41.93	\$12.07 \$22.09
	ROTARY HEARTH FURNACE:		Q+1,000,014	Ψ41.50	\$22.08
	DRI LEAVING RHF TO SAF	1.1217			
	GREEN-BALL PELLETS FEED TO RHF	1.8983			
\$124.450	NATURAL GAS FUEL TO RHF - (MM mt/yr)	0.0567	\$7,058,058	\$7.06	\$6.29
\$0.033	ELECT. POWER CONSUM. IN RHF - (MM kWhr/yr)	165.0916	\$5,448,023	\$7.00 \$5.45	\$4.86
0.1098	LABOR IN RHF - (\$/mt)	1.1217	\$4,742,672	\$4.74	\$4.00 \$4.23
\$13.69	OTHER IN RHF - (\$/mt)	1.1217	\$15,355,662		
	SUB-TOTAL SAF HOT METAL:	1.1217	\$32,604,415	<u>\$15.36</u> \$32.60	<u>\$13.69</u> \$29.07
	EAF STEELMAKING:	I	Ψ02,004,410	\$32.60	\$29.07
	REFINED STEEL TO LRF	1.0543			****
\$10.00	REVERT STEEL SCRAP (REVERT ONLY)	0.0648	\$647,901	\$0.65	\$0.61
\$1,075.81	MISC. ADDITIVES - (AVG. \$/mt)	0.0070	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0000	\$0	\$0.00	\$0.00
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,941,017	\$3.94	\$3.74
\$77.10	LIME CHARGED	0.0124	\$952,968	\$0.95	\$0.90
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	44.0000	\$1,848,000	\$1.85	\$1.75
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$1.75 \$4.25
\$21.51	EAF OTHER - (\$/mt L.S.)	1.0000	\$21,510,000	\$21.51	\$20.40
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	597.4453	\$19,715,695	\$19.72	\$20.40 \$18.70
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,652	\$0.29	\$0.27
	SUB-TOTAL EAF STEELMAKING:	1.0025	\$60,969,232	\$60.97	\$57.83
	LADLE REFINING:		\$50,000,E52	Ψ00.31	φ37.03
	LIQ. EAF STEEL TO CASTING	1.0000	- T		
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0101	\$1,710,940	\$1.71	\$1.71
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0025	\$1,750,000	\$1.75	\$1.75
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,182	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$0.02 \$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8703	\$1,150,721	\$1.15	
	SUB-TOTAL LRF:	2	\$9,124,443	\$9.12	<u>\$1.15</u> \$9.12
			₩ 0,12-1,-1-0	ψ3.12	φ3.12
	TOTAL THROUGH LIQUID STEEL:		\$177,034,955	\$177.03	

SUMMARY CONSUMABLES AITMK3

ITMK3 PROCESS TO PRODUCE SHOT IRON FOR EAF FEED 22-June-2000

MAXIMUM SHOT IRON CHARGED Rev. 3

BASIS:

0.1181 MM MT/YEAR PURCHASED SCRAP CHARGED 0.0363 MM MT/YEAR RECYCLED SCRAP CHARGED 1.0261 MM MT/YEAR SHOT IRON & SLAG PRODUCED 0.9235 MM MT/YEAR HOT SHOT IRON (TARGET) 0.9235 MM MT/YEAR HOT SHOT IRON METAL (CALC.) 1.0000 MM MT/YEAR LIQUID STEEL (TARGET) 0.9770 MM MT/YEAR CAST SLAB EQUIVALENT (CALC.)

SUMMARY:

1.454 MMM MT/YEAR FINE ORE FEED 2,725.4 MMM Nm3/YEAR AIR TO ITF 0.0 MMM Nm3/YEAR OXYGEN TO ITF

51.83 MM Nm3/YEAR NATURAL GAS TO PELLET DRYER

87.82 MMM Nm3/YEAR NATURAL GAS TO ITF 0.404 MMM MT/YEAR COAL TO PELLET 0.000 MMM MT/YEAR FLUX ADDED TO PELLET 1.878 MMM MT/YEAR NET G.B. PELLETS PRODUCED

130 ELECTRIC POWER CONSUMPTION IN ITF - (kWhr/mt DRI)

1.454 FINE IRON ORE FEED - (MM MT/YR)
77.00% PERCENT FINE ORE TO PELLET

64.50% PERCENT IRON IN FINE ORE - (wt.% Fe)

1.800 NATURAL GAS TO ITF - (GJ/mt PELLET) 51.827 NATURAL GAS TO ITF- (Nm3/mt PELLET)

3.050 NATURAL GAS TO ITF - (GJ/mt DRI)

87.819 NATURAL GAS TO ITF- (Nm3/mt DRI)

2,725,405 TOTAL AIR TO ITF - (Nm3/mt DRI)

0.000 OXYGEN TO ITF - (Nm3/mt DRI)

80.00% PERCENT C IN COAL

3,189.73 GAS VOLUME LEAVING ITF - (Nm3/mt HM)

18.6200 ELECTRIC POWER CONSUMMED IN G-B PELLET. - (kWhr/mt GB)

0.8999 NET IRON RECOVERY IN SCREENS

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
PELLETIZING/D	RYING:			
	IRON ORE FINES TO PELLETIZING	1.4535	0.000	1.4535
	COAL FINES TO PELLETIZING	0.4038	0.0018	0.4056
	BINDER TO PELLETIZING	0.0303	0.0015	0.0218
	RECYCLE DUST TO PELLETIZING	0.0000	0.0000	0.0000
	RECYCLE PELLETS TO PELLETIZING	0.0000	0.0000	0.0000
	GROSS PELLETS	1.8776	0.0033	1.8809
	FUEL TO PELLET DRYING - (MM Nm3/yr)	51.8274	0.0385	
	PELLETS FEED TO RHF	1.8776	0.0000	1.8776
	ELEC. POWER IN PELLETIZING - (MM kWhr/yr)	34.9615		
ITF DIRECT REI	DUCTION:	L		
	NATURAL GAS FUEL TO ITF (MM Nm3/yr)	87.8186	0.06519	
	COMBUSTION AIR TO ITF - (MM Nm3/yr)	2,725.4053	3.52340	
	SI LEAVING ITF TO SCREENS	1.0261	0.000	1.0261
	ELECT. POWER CONSUMMED IN ITF - (MM kWhrlyr)	133.3960		

AITMK3

SUMMARY CONSUMABLES

22-June-2000

ITmk3 PROCESS TO PRODUCE SHOT IRON FOR EAF FEED

Rev. 3

MAXIMUM SHOT IRON CHARGED

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL.
EAF STEELMAN	(INC.	(MM T/YR)	(MM T/YR)	(MM T/YR)
EAF STEELINA!		<u> </u>	27.1	
	SHOT IRON NET (W/O SLAG)	0.9235		0.9235
	PURCHASE STEEL SCRAP TO EAF	0.1181		0.1181
	REVERT STEEL SCRAP TO EAF	0.0363		0.0363
	MISC. ADDITIVES	0.0155		0.0155
	STEEL C (CHARGE+SLAG INJ)	0.0130		0.0130
	EAF ELECTRODES	0.0038		.0.0005
	LIME CHARGED	0.0243		0.0243
	O2 GAS TO EAF (MM Nm3/YR)		52.60	0.0240
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (MM kWhr/mt)	467,0000	0.0020	
	LIQ. EAF STEEL TO LRF	0.0000	1.0032	1.0032
		0.0000	1.0032	1.0032
LADLE REFININ	G:			
	LIQ. EAF STEEL TO LRF	0.0000	1,0032	1.0032
	LIME TO LADLE REF. FCE.	0.0053	1.0052	
	SLAG/WIRE DESULFURIZER TO LRF	0.0025		0.0053
	ARGON GAS TO LRF (MM Nm3/YR)	0.0023	0.000	0.0004
	LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	34.8703	0.063	
	REFINED STEEL TO CASTING	t I	4 0000	
		0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

AITMK3

Rev. 3

SUMMARY CONSUMABLES

22-June-2000

ITmk3 PROCESS TO PRODUCE SHOT IRON FOR EAF FEED MAXIMUM SHOT IRON CHARGED

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER ORIT	ORE FINES:				
\$21.19	IRON ORE FINES TO PELLETIZING	1.4535	\$30,800,714	\$30.80	\$21.19
,	GREEN BALL PELLETIZING:		+ + + + + + + + + + + + + + + + + + + 	400.00	<u> </u>
\$40.71	COAL FINES TO PELLETIZING	0.4038	\$16,438,030	\$16.44	\$8.75
\$90.02	BINDER TO PELLETIZING	0.0363	\$3,266,996	\$3,27	\$1.74
	RECYCLE DUST TO PELLETIZING	0.0000	, ,,	7 - 1	*
	RECYCLE PELLETS TO PELLETIZING	0.0000			
	GROSS GREEN-BALL PELLETS	1.8809			
\$0.033	ELEC. POWER IN G-B PELLET (MM kWhr/yr)	34.9615	\$1,153,729	\$1.15	\$0.61
\$124.45	HEAT FOR DRYING (N.G. EQUIV.)	0.0385	\$4,787,689	\$4.79	\$2.55
0.0874	LABOR FOR PELLETIZING - (MH-HR/mt PELLET)	1.8809	\$6,326,227	\$6.33	\$3.37
\$3.45	OTHER COSTS IN G-B PELLETIZING -(\$/mt)	1.8809	\$6,489,190	<u>\$6.49</u>	<u>\$3.46</u>
	SUB-TOTAL GREEN-BALL PELLETIZING:		\$38,461,860	\$38.46	\$20.48
	ROTARY HEARTH FURNACE:				
	GREEN-BALL PELLETS FEED TO RHF	1.8776			
1	SI LEAVING RHF TO SCREENS	1.0261			
	SHOT IRON NET (W/O SLAG)	0.9235			
\$124.450	NATURAL GAS FUEL TO RHF -	0.0652	\$8,112,617	\$8.11	\$8.78
\$0.033	ELECT. POWER CONSUM. IN RHF - (MM kWhr/yr)	133.3960	\$4,402,067	\$4.40	\$4.77
0.1098	LABOR IN RHF - (\$/mt)	1.0261	\$4,338,678	\$4.34	\$4.70
\$13.69	OTHER IN RHF - (\$/mt)	1.0261	<u>\$14,047,623</u>	<u>\$14.05</u>	<u>\$15.21</u>
<u> </u>	SUB-TOTAL RHF HOT SHOT IRON:		\$30,900,985	\$30.90	\$33.46
	EAF STEELMAKING:				
	REFINED STEEL TO LRF	1.0032			
\$140.00	NET HOT SHOT CHARGE TO EAF PURCHASED SCRAP TO EAF	0.9112	#40 F00 070	*40.50	***
\$10.00	REVERT STEEL SCRAP (REVERT ONLY)	0.1181 0.0363	\$16,530,376	\$16.53	\$16.48
\$490.53	MISC. ADDITIVES - (AVG. \$/mt)	0.0363	\$362,919	\$0.36	\$0.36
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0130	\$7,580,000	\$7.58	\$7.56
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$753,636 \$3,917,931	\$0.75 \$3.92	\$0.75 \$3.91
\$77.10	LIME CHARGED	0.0243	\$1,872,407	\$3.92 \$1.87	\$3.91 \$1.87
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	52.5985	\$2,209,137	\$2.21	\$2.20
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0032	\$4,499,202	\$4.50	\$4.49
\$21.51	EAF OTHER - (\$/mt L.S.)	1.0032	\$21,578,110	\$21.58	\$21.51
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	467,0000	\$15,411,000	\$15.41	\$15.36
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,705	\$0.29	\$0.29
*	SUB-TOTAL EAF STEELMAKING:	0.0020	\$75,003,422	\$75.00	\$74.77
	LADLE REFINING:		7.0,000,1.22	¥10.00	Ψ,,
. 1	LIQ. EAF STEEL TO CASTING	1.0032			-
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$893,142	\$0.89	\$0.89
\$700.00	SLAGWIRE DESULFURIZER TO LRF	0.0025	\$1,750,000	\$1.75	\$1.74
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0032	\$4,511,841	\$4.51	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8703	<u>\$1,150,720</u>	<u>\$1.15</u>	\$1.1 <u>5</u>
	SUB-TOTAL LRF:		\$8,320,888	\$8.32	\$8.29
	TOTAL THROUGH LIQUID STEEL:		\$183,487,869	\$183.49	

FLUID-BED DRI PROCESSES

ACIRCS SUMMARY CONSUMABLES

19-June-2000 CIRCORED/HBI/EAF

Rev. 2 100% DRI/HBI CHARGE - 1.0 wt.% CARBON

BASIS:

1.000 MM MT/YEAR LIQUID STEEL PRODUCT 0.977 MM MT/YEAR NET SLAB PRODUCT

SUMMARY:

1.791 MM MT/YEAR FINE ORE FEED (BY-PRODUCT OF LUMP)

1,544 MM MT/YEAR NET INDURATED MICRO PELLETS

33.075 LRF ELEC. POWER - (kWhr/mt LIQ. STEEL)

1,089 MM MT/YEAR NET DRI TO EAF

ASSUMPTIONS:

TOTAL FUEL FOR ORE SHIPPING (MT/mt FINE ORE) 0.0154 1.30 FUEL REQUIREMENT - MICRO PELLET PLANT (GJ/mt PEL) 26.08 FUEL REQUIREMENT - MICRO-PELLET PLANT (kg N.G./mt PEL) 27.6 MICRO PELLET PLANT ELEC. POWER REQ'D (kWhr/mt FEED) 1.00% DRI/HBI PERCENT CARBON - (WT.% C) FUEL TO DRI - (GJ/mt DRI) 15.05 301.95 FUEL TO DRI - (kg/mt DRI) 147.18 HBI ELEC. POWER REQ'D - (kWhr/mt HBI) AUX. FUEL TO EAF/LRF - kg/mt LIQ. ST. 2.20 EAF ELEC. POWER (TOTAL) - (kWhr/mt LIQ. STEEL) 566.7

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
FINE ORE MICE	OPELLETIZING:			
	ORE FINES DELIVERED TO PLANT SITE	1.7908		1.7908
	NET ORE FINES FEED TO MICRO-PELL.	1.7908		1.7908
	BINDER TO MICRO-PELLET	0.0015		0.0015
	FUEL (DRYING, INDURATION, ETC.)	1	0.0467	
	MICRO-PELLET ELEC. POWER REQ'D - (MM kWhr/yr)	49.3584		
DIRECT REDUC	TION - CFB/BB:		1	
	NET IND. MICRO-PELLETS, ETC. TO CFB	1.5436		1.5436
	NET DRI TO EAF (1.0% C)	1.0890		1.0890
	FUEL TO DRI		0.3288	
	DRI/HBI ELECTRICAL POWER REQ'D - (MM kWhr/yr)	160.2832		
EAF STEELMAI				
	HBI FEED TO EAF	1.0890		1.0890
	TOTAL STEEL SCRAP (100% DRI)	0.0648	0.0000	0.0648
	MISC. ADDITIVES	0.0070	0.0000	0.0070
	STEEL C (CHARGE+SLAG INJ)	0.0120	0.0000	0.0120
	EAF ELECTRODES	0.0038	0.0000	0.0038
	LIME CHARGED	0.0124	0.0000	0.0124
	O2 GAS TO EAF (MM Nm3/YR)		11.0000	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	597.4453		
LADLE REFINI				
	LIQ. EAF STEEL TO LRF	0.0000	1.0543	1.0543
	SLAG/WIRE DESULFURIZER TO LRF	0.0004	0.0000	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)		0.0633	
	LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	34.8703		
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9768	0.0000	0.9768

ACIRCS

19-June-2000

SUMMARY CONSUMABLES CIRCORED/HBI/EAF

Rev. 2

100% DRI/HBI CHARGE - 1.0 wt.% CARBON

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED \$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

\$0.033 ELECTRICAL POWER RATE - (\$/kWhr)
17.00 ELECTRIC POWER HOT BRIQUETTING - (kWhr/mt) \$7.00 HOT BRIQUETTING MAINTENANCE - (\$/mt)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT					, , , , , , , , , , , , , , , , , , ,
	ORE:				
\$21.19	IRON ORE FINES DELIVERED - (\$/mt DRY)	1.7908	\$37,946,614	\$37.95	\$21.19
	FINE ORE MICROPELLETIZING:				
	ORE FINES DELIVERED TO PLANT SITE	1.7908			
	NET IND. MICRO-PELLETS, ETC. TO CFB	1.5436			
\$90.02	BINDER TO MICRO-PELLET	0.0015	\$134,778	\$0.13	\$0.09
INCL. CRD	LABOR MICROPELLETIZING - (MN-HR/mt)				
INCL. CRD	OTHER MICROPELLETIZING - (\$/mt)				
\$0.033	MICRO-PELLET ELEC. POWER REQ'D - (MM kWhr/yr)	49.3584	\$1,628,826	\$1.63	\$1.06
\$124.45	FUEL (DRYING, INDURATION, ETC.)	0.0467	<u>\$5,813,063</u>	<u>\$5.81</u>	\$3.77
	SUB-TOTAL PELLETIZING:		\$7,576,666	\$7.58	\$4.91
	DIRECT REDUCTION IN CFB/BB FLUID BED REACTORS				
	DRI TO EAF (1.0% C)	1.0890			
0.1526	DRI/MICROPEL. LABOR - (MN-HR/mt DRI)	1.0890	\$6,399,932	\$6.40	\$5.88
\$16.00	DRI OTHER - (\$/mt DRI)	1.0890	\$17,424,006	\$17.42	\$16.00
\$0.033	ELECTRIC POWER HOT BRIQUETTING - (kWhr/mt)	17.00	\$561,000	\$0.56	\$0.52
\$7.00	HOT BRIQUETTING MAINTENANCE - (\$/mt)	1.0890	\$7,623,003	\$7.62	\$7.00
\$0.033	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	160.2832	\$5,289,344	\$5.29	\$4.86
\$124.45	N.G. FUEL TO DRI - (\$/mt)	0.3288	\$40,922,190	\$40.92	\$37.58
	SUB-TOTAL DRI PRODUCTION:		\$78,219,475	\$78.22	\$71.83
	EAF STEELMAKING:				
_	REFINED STEEL TO LRF	1.0543			
\$10.00	TOTAL STEEL SCRAP (100% DRI, REVERT ONLY)	0.0648	\$647,901	\$0.65	\$0.61
\$1,075.81	MISC. ADDITIVES - (AVG. \$/mt)	0.0070	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0120	\$698,479	\$0.70	\$0.66
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,941,017	\$3.94	\$3.74
\$77.10	LIME CHARGED	0.0124	\$952,968	\$0.95	\$0.9
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	11.0000	\$462,000	\$0.46	\$0.44
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.2
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$15.96
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	597.4453	\$19,715,695	\$19.72	\$18.70
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,652	\$0.29	\$0.2
	SUB-TOTAL EAF STEELMAKING:		\$55,601,711	\$55.60	\$52.74
	LADLE REFINING:	. "	***************************************		
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0000	\$0	\$0.00	\$0.00
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,299	\$0.26	\$0.20
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,182	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8703	\$1,150,721	\$1.15	\$1.1
	SUB-TOTAL LRF:		\$5,921,802	\$5.92	\$5.92
	TOTAL THROUGH LIQUID STEEL:		\$185,266,268	\$185.27	

SUMMARY CONSUMABLES

19-June-2000

CIRCOFER PROCESS TO PRODUCE HOT METAL

Rev. 2

MAXIMUM HOT METAL CHARGED - CFB/SAF/EAF

Page 1 BASIS:

> MM MT/YEAR PURCHASED SCRAP CHARGED 0.1181

0.0363 MM MT/YEAR RECYCLED SCRAP CHARGED

1.0261 MM MT/YEAR DRI CHARGED

0.9112 MM MT/YEAR LIQUID HOT METAL (TARGET)

0.9112 MM MT/YEAR LIQUID HOT METAL (CALC.)

1.0000 MM MT/YEAR LIQUID STEEL (TARGET)

0.9770 MM MT/YEAR CAST SLAB EQUIVALENT (CALC.)

SUMMARY:

1.737 MMM MT/YEAR FINE ORE FEED

201.1 MMM Nm3/YEAR OXYGEN TO CFB

0.482 MMM MT/YEAR COAL IN CFB

ASSUMPTIONS:

112.24 ELECTRIC POWER CONSUMPTION IN CFB - (kWhr/mt DRI)

25.246 CUMULATIVE E. POWER IN FINE ORE - (kWhr/mt)

196.000 OXYGEN TO CFB - (Nm3/mt DRI)
0.001 BINDER TO MICROPELLETIZING - (MT/mt FEED ORE)

0.0696 FLUX CHARGED (B. LIME) TO SAF+LRF - (MT/mt HM)

0.0367 SILICA FLUX TO SAF - (MT/mt HM)

0.0050 DESULFURIZING ADDITIVES TO LRF - (MT/mt HM)

0.0239 CARBON (AS COAL) CHARGE TO SAF - (MT/mt HM)

0.00225 ELECTRODES TO SAF - (MT/mt HM)

18.6200 ELECTRIC POWER CONSUMMED IN SAF - (kWhr/mt GB)

350.00 ELECTRIC POWER CONSUMPTION SAF - (kWhr/mt HM)

0.150% STEEL SCRAP PERCENT CARBON - (wt.% C) 130.0 EAF ELEC. POWER (TOTAL) - (kWhr/mt LIQ. STEEL)

30 LRF ELEC. POWER - (kWhr/mt LIQ. STEEL)

0.00 ELEC. POWER GENERATED - (kWhr/mt HM)

2.20 AUX. FUEL TO EAF - kg/T LIQ. ST.

PROGRAM OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
FINE ORE MICR	OPELLETING:	•	•	
	IRON ORE FINES TO CIRCOFER	1,7367		1.7367
	COAL FINES TO CIRCOFER	0.4823		0.4823
	BINDER TO MICROPELLETIZING	0.0017		0.0017
	RECYCLE DUST TO MICROPELLETIZING	0.0868		0.0868
	MICRO-PELLET ELEC. POWER REQ'D - (MM kWhr/yr)	49.3584		
DIRECT REDUC	TION IN CFB/BB:			
	DRI LEAVING CFB TO SAF	1.0261	0.000	1.0261
]	OXYGEN TO CFB - (Nm3/mt DRI)	196.00		
	ELECT. POWER CONSUMMED IN CFB - (MM kWhr/yr)	115.1720		
IRONMAKING IN	SAF FURNACE:			
	NET DRI CHARGE TO SAF (>450 °C)	1.0261	0.0000	1.0261
	LIME FLUX TO SAF	0.0635		
	SILICA FLUX TO SAF	0.0334		
	ELECTRODES TO SAF	0.0021		
	SAF CHARGE CARBON	0.0217		
	SLAGWIRE DESULFURIZER TO LTF	0.0046		
	ELECTRIC POWER CONSUMP. SAF/LTF - (MM kWhr/yr)	318.9235		

SUMMARY CONSUMABLES

19-June-2000

CIRCOFER PROCESS TO PRODUCE HOT METAL MAXIMUM HOT METAL CHARGED - CFB/SAF/EAF

Rev. 2 Page 2

STEELMAKING IN EAF:			
NET HOT METAL CHARGE TO EAF	0.9112		
TOTAL STEEL SCRAP TO EAF	0.1544		0.1544
MISC. ADDITIVES	0.0155		0.0155
STEEL C (CHARGE+SLAG INJ)	0.0130		0.0130
EAF ELECTRODES	0.0005		0.0005
LIME CHARGED	0.0243		0.0243
O2 GAS TO EAF (MM Nm3/YR)		52.60	
AUX. FUEL TO EAF (AS N.G.)		0.0023	
EAF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	130.0000		
LADLE REFINING:			
LIQ. EAF STEEL TO LRF	0.0000	1.0032	1.0032
LIME TO LADLE REF. FCE.	0.0053		0.0053
SLAG/WIRE DESULFURIZER TO LRF	0.0004		0.0004
ARGON GAS TO LRF (MM Nm3/YR)		0.063	
LRF ELECTRICAL POWER REQ'D	30.0950		
REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

Rev. 2

SUMMARY CONSUMABLES

19-June-2000

CIRCOFER PROCESS TO PRODUCE HOT METAL MAXIMUM HOT METAL CHARGED - CFB/SAF/EAF

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED \$124.45 N.G. FUEL COSTS - \$/mt

\$413.85 DIESEL FUEL COSTS - \$/mt

\$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

17.00 ELECTRIC POWER HOT BRIQUETTING - (kWhr/mt) \$7.00 HOT BRIQUETTING MAINTENANCE - (\$/mt)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT					·
	ORE:				
\$21.19	IRON ORE FINES DELIVERED - (\$/mt DRY)	1.7367	\$36,799,736	\$36.80	\$21.19
	FINE ORE MICROPELLETIZING:				
	ORE FINES DELIVERED TO PLANT SITE	1.7367			
\$5.00	RECYCLE DUST TO MICROPELLETIZING	0.0868	\$434,164	\$0.43	\$0.25
\$26.67	COAL FINES TO MICROPELLETIZING	0.4823	\$12,862,348	\$12.86	\$7.41
	NET IND. MICRO-PELLETS, ETC. TO CFB	1.5436			
\$90.02	BINDER TO MICRO-PELLET	0.0017	\$156,334	\$0.16	\$0.10
INCL, CFB	LABOR MICROPELLETIZING - (MN-HR/mt)				
INCL. CFB	OTHER MICROPELLETIZING - (\$/mt)				
\$0.033	MICRO-PELLET ELEC. POWER REQ'D - (MM kWhr/yr)	49.3584	<u>\$1,628,826</u>	<u>\$1.63</u>	<u>\$1.06</u>
	SUB-TOTAL PELLETIZING:		\$15,081,672	\$15.08	\$8.81
,, <u></u> ,	DIRECT REDUCTION IN CFB/BB FLUID BED REACTORS				
	HBI TO SAF (1.0% C, >450°C)	1.0261			
0.1310	DRI/MICROPEL. LABOR - (MN-HR/mt DRI)	1.0261	\$5,176,831	\$5.18	\$5.05
\$0.042	OXYGEN TO CFB - (Nm3/mt DRI)	196.00	\$8,232,000	\$8.23	\$8.02
0.1526	LABOR (DRI & MICRO PELLET.) - (MN-HR/mt DRI)	1.0261	\$6,028,575	\$6.03	\$5.88
\$19.51	DRI OTHER - (\$/mt DRI)	1.0261	\$20,019,659	\$20.02	\$19.51
\$0.033	ELECTRIC POWER HOT BRIQUETTING - (kWhr/mt)	17.00	\$561,000	\$0.56	\$0.55
\$7.00	HOT BRIQUETTING MAINTENANCE - (\$/mt)	1.0261	\$7,182,861	\$7.18	\$7.00
\$0.033	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	115.1720	<u>\$3,800,677</u>	<u>\$3.80</u>	<u>\$3.70</u>
	SUB-TOTAL DRI PRODUCTION:		\$51,001,603	\$51.00	\$49.70
	IRONMAKING IN SAF FURNACE:				
	NET DRI CHARGE TO SAF (>450 °C)	1.0261			
	NET HOT METAL CHARGE TO EAF	0.9112			
\$77.83	LIME FLUX TO SAF	0.0635	\$4,939,234	\$4.94	\$5.42
\$50.00	SILICA FLUX TO SAF	0.0334	\$1,672,070	\$1.67	\$1.84
\$1,031.03	ELECTRODES TO SAF	0.0021	\$2,113,850	\$2.11	\$2.32
\$58.16	SAF CHARGE CARBON	0.0217	\$1,264,392	\$1.26	\$1.39
\$4.83	SLAG/WIRE DESULFURIZER TO LTF - (AVG.\$/MM mt)	0.9112	\$4,400,000	\$4.40	\$4.83
\$0.72	LADLE COSTS - (\$/mt)	0.9112	\$656,071	\$0.66	\$0.72
\$0.033	ELECTRIC POWER CONSUMP. SAF/LTF - (MM kWhr/yr)	318.9235	\$10,524,475	\$10.52	\$11.55
0.1019	SAF LABOR - (MN-HR/mt)	0.9112	\$3,574,026	\$3.57	\$3.48
10.46	SAF OTHER - (\$/mt)	0.9112	<u>\$9,531,256</u>	<u>\$9.53</u>	<u>\$9.29</u>
	SUB-TOTAL HM PRODUCTION IN SAF:		\$38,675,376	\$38.68	\$40.83

SUMMARY CONSUMABLES

19-June-2000

CIRCOFER PROCESS TO PRODUCE HOT METAL

Rev. 2

MAXIMUM HOT METAL CHARGED - CFB/SAF/EAF

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT			İ	·	
	EAF STEELMAKING:		·,.·	•••	
	REFINED STEEL TO LRF	1.0032			
	NET HOT METAL CHARGE TO EAF	0.9112			
\$10.00	TOTAL STEEL SCRAP (100% DRI, REVERT ONLY)	0.1544	\$1,543,660	\$1.54	\$1.54
\$490.53	MISC. ADDITIVES - (AVG. \$/mt)	0.0155	\$7,580,000	\$7.58	\$7.56
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0130	\$753,636	\$0.75	\$0.75
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0005	\$472,824	\$0.47	\$0.47
\$77.10	LIME CHARGED	0.0243	\$1,872,407	\$1.87	\$1.87
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	52.5985	\$2,209,137	\$2.21	\$2.20
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.47
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$16.78
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	130.0000	\$4,290,000	\$4.29	\$4.28
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	<u>\$288,705</u>	<u>\$0.29</u>	\$0.29
	SUB-TOTAL EAF STEELMAKING:		\$40,325,368	\$40.33	\$40.20
	LADLE REFINING:			***************************************	
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$893,142	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,347	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	30.0950	<u>\$993,135</u>	<u>\$0.99</u>	<u>\$0.99</u>
	SUB-TOTAL LRF:		\$6,657,409	\$6.66	\$6.66
	TOTAL THROUGH LIQUID STEEL:		\$188,541,164	\$188.54	

AFINMT

SUMMARY CONSUMABLES

20-June-2000

FINMET FLUIDED BED DIRECT REDUCTION HBI/EAF

Rev. 2

100% DRI CHARGE - 1.0 wt.% CARBON

BASIS:

1.000 MM MT/YEAR LIQUID STEEL PRODUCT 0.977 MM MT/YEAR NET SLAB PRODUCT

SUMMARY:

1.751 MM MT/YEAR FINE ORE FEED (BY-PRODUCT OF LUMP)

1.509 MM MT/YEAR NET INDURATED MICRO PELLETS TO FL. BEDS

1.089 MM MT/YEAR NET DRI/HBI TO EAF

ASSUMPTIONS:

0.0154 TOTAL FUEL FOR ORE SHIPPING (MT/mt FINE ORE)

1.30 FUEL REQUIREMENT - MICRO PELLET PLANT (GJ/mt PEL)
26.08 FUEL REQUIREMENT - MICRO-PELLET PLANT (kg N.G./mt PEL)
16.5 MICRO PELLET PLANT ELEC. POWER REQ'D (kWhr/mt FEED) FUEL REQUIREMENT - MICRO-PELLET PLANT (kg N.G./mt PEL)

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
FINE ORE MIC	ROPELLETIZING:	· · ·		
	ORE FINES DELIVERED TO PLANT SITE	1.7511		1.7511
	NET ORE FINES FEED TO MICRO-PELL.	1.7511		1.7511
	BINDER TO MICRO-PELLET	0.0015	}	0.0015
1	FUEL (DRYING, INDURATION, ETC.)		0.0457	
	MICRO-PELLET ELEC. POWER REQ'D - (kWhr/yr)	28.9590		
DIRECT REDU	CTION - MULTI-STAGE FLUIDIZED BED:			
	NET IND. MICRO-PELLETS, ETC. TO FB	1.5091		1.5091
	NET HBI TO EAF (1.0% C)	1.0890		1.0890
	FUEL TO DRI	l i	0.2830	
	DRI/HBI ELECTRICAL POWER REQ'D - (kWhr/mt)	187.5973		
EAF STEELMA	AKING:			
	HBI FEED TO EAF	1.0890		1.0890
	TOTAL STEEL SCRAP (100% DRI, REVERT ONLY)	0.0648	0.0000	0.0648
ļ	MISC. ADDITIVES	0.0070	0.0000	0.0070
	STEEL C (CHARGE+SLAG INJ)	0.0120	0.0000	0.0120
	EAF ELECTRODES	0.0038	0.0000	0.0038
	LIME CHARGED	0.0124	0.0000	0.0124
	O2 GAS TO EAF (MM Nm3/YR)		11.0000	
1	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (kWhr/mt)	597.4453		
LADLE REFIN	ING:			
	LIQ. EAF STEEL TO LRF	0.0000	1.0543	1.0543
1	SLAG/WIRE DESULFURIZER TO LRF	0.0004	0.0000	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)		0.0633	
1	LRF ELECTRICAL POWER REQ'D - (kWhr/mt)	34.8703		
	REFINED STEEL TO CASTING	0.0000	1.0521	1.0521
	NET STEEL SLAB PRODUCED	0.9768	0.0000	0.9768

AFINMT

SUMMARY CONSUMABLES

20-June-2000

FINMET FLUIDED BED DIRECT REDUCTION HBI/EAF

Rev. 2

100% DRI CHARGE - 1.0 wt.% CARBON

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

\$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

17.00 ELECTRIC POWER HOT BRIQUETTING - (kWhr/mt)

\$7.00 HOT BRIQUETTING MAINTENANCE - (\$/mt)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT	ORE	<u> </u>	<u>1</u>		
004.40	ORE:	4 9544 [
\$21.19	IRON ORE FINES DELIVERED - (\$/mt DRY)	1.7511	\$37,106,044	\$37.11	\$21.19
	FINE ORE MICROPELLETIZING:		····		
	ORE FINES DELIVERED TO PLANT SITE	1.7511			
	NET IND. MICRO-PELLETS, ETC. TO FB	1.5091			
\$90.02	BINDER TO MICRO-PELLET	0.0015	\$134,778	\$0.13	\$0.09
INCL. CRD	LABOR MICROPELLETIZING - (MN-HR/mt)	ľ			
INCL. CRD	OTHER MICROPELLETIZING - (\$/mt)				
\$0.033	MICRO-PELLET ELEC. POWER REQ'D - (MM kWhr/yr)	28.9590	\$955,647	\$0.96	\$0.63
\$124.45	FUEL (DRYING, INDURATION, ETC.)	0.0457	<u>\$5,684,295</u>	<u>\$5.68</u>	\$3.77
	SUB-TOTAL PELLETIZING:		\$6,774,720	\$6.77	\$4.49
	DIRECT REDUCTION IN CFB/BB FLUID BED REACTO	DRS:			
	DRI TO EAF (1.0% C)	1.0890			· · ·
0.1848	DRI/MICROPEL. LABOR - (MN-HR/mt DRI)	1.0890	\$7,748,978	\$7.75	\$7.12
\$20.55	DRI OTHER - (\$/mt DRI)	1.0890	\$22,378,958	\$22.38	\$20.55
\$7.00	HOT BRIQUETTING MAINTENANCE - (\$/mt)	1.0890	\$7,623,003	\$7.62	\$7.00
\$0.033	HOT BRIQUETTING POWER REQ'D - (\$/mt)	17.0000	\$561,000	\$0.56	\$0.52
\$0.033	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	187.5973	\$6,190,712	\$6.19	\$5.68
\$124.45	N.G. FUEL TO DRI - (\$/mt)	0.2830	\$35,214,164	\$35.21	\$32.34
	SUB-TOTAL DRI PRODUCTION:		\$79,716,815	\$79.72	\$73.20
	EAF STEELMAKING:		1.0,7,0,0.0		V. C.20
	REFINED STEEL TO LRF	1.0543			
\$10.00	TOTAL STEEL SCRAP (100% DRI, REVERT ONLY)	0.0648	\$647,901	\$0.65	\$0.61
\$1,075.81	MISC. ADDITIVES - (AVG. \$/mt)	0.0070	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0120	\$698,479	\$0.70	\$0.66
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,941,017	\$3.94	\$3.74
\$77.10	LIME CHARGED	0.0030	\$952,968	\$0.95	\$0.90
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	11.0000	\$462,000	\$0.95 \$0.46	\$0.90
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,250	\$0.46 \$4.49	\$0.44 \$4.25
\$16.83	EAF OTHER - (\$/mt L.S.)	1,0000		· ·	
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)		\$16,830,000	\$16.83	\$15.96
	, , ,	597.4453	\$19,715,695	\$19.72	\$18.70
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	<u>\$288,652</u>	\$0.29	\$0.27
	SUB-TOTAL EAF STEELMAKING:	<u> </u>	\$55,601,961	\$55.60	\$52.74
	LADLE REFINING:	4 0000			
040040	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0000	\$0	\$0.00	\$0.00
\$700.00	SLAGWIRE DESULFURIZER TO LRF	0.0004	\$258,299	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,182	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8703	<u>\$1,150,721</u>	<u>\$1.15</u>	<u>\$1.1</u> 5
	SUB-TOTAL LRF:		\$5,921,802	\$5.92	\$5.92
	TOTAL THROUGH LIQUID STEEL:		\$185,121,343	\$185.12	

AIRCB

SUMMARY CONSUMABLES GENERIC IRON CARBIDE/EAF

20-June-2000 Rev. 2

100% IC CHARGE - 6.5 wt.% CARBON

BASIS:

1.000 MM MT/YEAR LIQUID STEEL PRODUCT 0.977 MM MT/YEAR NET SLAB PRODUCT

SUMMARY:

1.701 MM MT/YEAR FINE ORE FEED (BY-PRODUCT OF LUMP)

13.40 268.86

1.229 MM MT/YEAR NET IC TO EAF

33.075

ASSUMPTIONS:

0.0154 TOTAL FUEL FOR ORE SHIPPING (MT/mt FINE ORE)

0.0364

6.50% EFFECTIVE IC PERCENT CARBON - (WT.% C)

9,000.00

67.20% ORE FINES PERCENT IRON - (WT.% Fe DRY)

1.0763

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM: T/YR)	TOTAL
ORE HANDLIN	IG/DEL IV/EPV	(WM I/IK)	(IVIIV: 17 TK)	(MM T/YR)
OKE HANDLIN	ORE FINES DELIVERED TO PLANT SITE	1.7011		1.7011
	ORE FINES DELIVERED TO PLANT SITE	1.7011		1.7011
FLUID-BED RE	EDUCTION PROCESS:	•		
	NET IRON CARBIDE TO EAF (1.0% C)	1.2289		1.2289
ļ	FUEL TO IRON CARBIDE REACTOR		0.3304	
	IRON CARBIDE ELEC. POWER REQ'D - (MM kWhr/yr)	253.4460		[
EAF STEELMA	AKING:		<u>l</u>	
	IRON CARBIDE FEED TO EAF	1.2289		1.2289
	TOTAL STEEL SCRAP (100% IC, REVERT ONLY)	0.0648	0.0000	0.0648
	MISC. ADDITIVES	0.0070	0.0000	0.0070
	STEEL C (CHARGE+SLAG INJ)	0.0000	0.0000	0.0000
	EAF ELECTRODES	0.0038	0.0000	0.0038
	LIME CHARGED	0.0124	0.0000	0.0124
	O2 GAS TO EAF (MM Nm3/YR)	1	71.5000	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	509.2178		
LADLE REFIN	ING:		<u>l</u> .	
	LIQ. EAF STEEL TO LRF	0.0000	1.0543	1.0543
	SLAGWIRE DESULFURIZER TO LRF	0.0004	0.0000	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)		0.0633	
	LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	34.8703		
	REFINED STEEL TO CASTING	0.0000	1.0521	1.0521
	NET STEEL SLAB PRODUCED	0.9768	0.0000	0.9768

AIRCB

SUMMARY CONSUMABLES GENERIC IRON CARBIDE/EAF

Rev. 2

20-June-2000

100% IC CHARGE - 6.5 wt.% CARBON

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt \$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT					
	ORE:				
\$21.19	IRON ORE FINES DELIVERED - (\$/mt DRY)	1.7011	\$36,045,872	\$36.05	\$21.19
	DIRECT REDUCTION IN CFB/BB FLUID BED REACTORS	3:			
	IC TO EAF (1.0% C)	1.2289			
0.1607	IC & OSBL LABOR - (MN-HR/mt DRI)	1.2289	\$7,604,364	\$7.60	\$6.19
\$19.74	IC OTHER - (\$/mt DRI)	1.2289	\$24,258,267	\$24.26	\$19.74
\$0.033	IC ELECTRICAL POWER REQ'D (MM kWhr/yr)	253.4460	\$8,363,719	\$8.36	\$6.81
\$124.45	N.G. FUEL TO IC - (\$/mt)	0.3304	<u>\$41,118,476</u>	<u>\$41.12</u>	<u>\$33.46</u>
	SUB-TOTAL DRI PRODUCTION:		\$81,344,826	\$81.34	\$66.19
	EAF STEELMAKING:				
	REFINED STEEL TO LRF	1.0543			
\$10.00	TOTAL STEEL SCRAP (100% DRI, REVERT ONLY)	0.0648	\$647,901	\$0.65	\$0.61
\$1,075.81	MISC. ADDITIVES - (AVG. \$/mt)	0.0070	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0000	\$0	\$0.00	\$0.00
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,941,017	\$3.94	\$3.74
\$77.10	LIME CHARGED	0.0124	\$952,968	\$0.95	\$0.90
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	71.5000	\$3,003,000	\$3.00	\$2.85
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.25
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$15.96
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	509.2178	\$16,804,187	\$16.80	\$15.94
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	<u>\$288,652</u>	<u>\$0.29</u>	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$54,532,724	\$54.53	\$51.73
	LADLE REFINING:				
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0000	\$0	\$0.00	\$0.00
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,299	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,182	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8703	<u>\$1,150,721</u>	<u>\$1.15</u>	<u>\$1.15</u>
	SUB-TOTAL LRF:		\$5,921,802	\$5.92	\$5.92
	TOTAL THROUGH LIQUID STEEL:		\$177,845,224	\$177.85	
	TOTAL THROUGH LIQUID STEEL:		\$177,845,224	\$177.85	

AIC2

SUMMARY CONSUMABLES IRON CARBIDE/SAF MELTER/EAF

20-June-2000

40% IRON CARBIDE CHARGE - 6.5 wt.% CARBON

Rev. 1 BASIS:

1,000 MM MT/YEAR LIQUID STEEL PRODUCT 0.977 MM MT/YEAR NET SLAB PRODUCT

SUMMARY:

0.680 MM MT/YEAR FINE ORE FEED (BY-PRODUCT OF LUMP)

0.492 MM MT/YEAR NET IC TO SAF

ASSUMPTIONS:

18.6200 ELECTRIC POWER CONSUMMED IN SAF - (kWhr/mt GB)
350.00 ELECTRIC POWER CONSUMPTION SAF - (kWhr/mt HM)
0.9301 NET IRON RECOVERY IN SAF + LTF

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
ORE HANDLING				
	ORE FINES DELIVERED TO PLANT SITE	0.6804		0.6804
FLUID-BED RED	DUCTION PROCESS:		1	
	NET IRON CARBIDE TO SAF (6.5% C)	0.4916		0.4916
	FUEL TO IRON CARBIDE REACTOR		0.1322	
	IRON CARBIDE ELEC. POWER REQ'D - (kWhr/yr)	101.3784		
SUBMERGED A	RC MELTING FURNACE FOR IC:	1		
	NET IC CHARGE TO SAF	0.4916	0.0000	0.4916
	LIME FLUX TO SAF	0.0298		j
	SILICA FLUX TO SAF	0.0157	1	
	ELECTRODES TO SAF	0.0010		
	SAF CHARGE CARBON	0.0000		
	SLAG/WIRE DESULFURIZER TO LTF	0.0021		
	ELECTRIC POWER CONSUMP. SAF - (kWhr/yr)	149.8423		
EAF STEELMAN	(ING:	1	1	
	NET HOT METAL CHARGE TO EAF	0.4281		
	TOTAL STEEL SCRAP TO EAF	0.6375		0.1544
	MISC. ADDITIVES	0.0155		0.0155
	STEEL C (CHARGE+SLAG INJ)	0.0130		0.0130
	EAF ELECTRODES	0.0029		0.0005
	LIME CHARGED	0.0243		0.0243
1	O2 GAS TO EAF (MM Nm3/YR)		44.48	i
	AUX. FUEL TO EAF	1 1	0.0023	0.0053
	EAF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	268.3688	0.063	
LADLE REFININ	IG:	1		
	LIQ. EAF STEEL TO LRF	0.0000	1.0317	1.0317
1	LIME TO LADLE REF. FCE.	0.0053	1	0.0053
1	SLAG/WIRE DESULFURIZER TO LRF	0.0004		0.0004
	ARGON GAS TO LRF (MM Nm3/YR)	0.0000	0.063	0.0000
	LRF ELECTRICAL POWER REQ'D	30.0950	0.0000	0.9770
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

AIC2

Rev. 1

SUMMARY CONSUMABLES IRON CARBIDE/SAF MELTER/EAF

20-June-2000

40% IRON CARBIDE CHARGE - 6.5 wt.% CARBON

ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

\$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT			Ĭ		
•	ORE:				
\$21.19	IRON ORE FINES DELIVERED - (\$/mt DRY)	0.6804	\$14,418,349	\$14.42	\$21.19
	DIRECT REDUCTION IN CFB/BB FLUID BED REACTO	RS:		-	
	IC TO SAF (6.5% C)	0.4916			
0.1607	IC & OSBL LABOR - (MN-HR/mt DRI)	0.4916	\$3,041,230	\$3.04	\$6.19
\$19.74	IC OTHER - (\$/mt DRI)	0.4916	\$9,703,307	\$9.70	\$19.74
\$0.033	IC ELECTRICAL POWER REQ'D (MM kWhr/yr)	101.3784	\$3,345,488	\$3.35	\$6.81
\$124.45	FUEL TO IRON CARBIDE REACTOR	0.1322	\$16,447,390	<u>\$16.45</u>	<u>\$33.46</u>
	SUB-TOTAL DRI PRODUCTION:		\$32,537,414	\$32.54	\$66.19
	IRONMAKING IN SAF FURNACE:				
<u> </u>	NET DRI CHARGE TO SAF (>450 °C)	16.2213			
	NET HOT METAL CHARGE TO EAF	0.4281			
\$77.83	LIME FLUX TO SAF	0.0298	\$2,320,639	\$2.32	\$5.42
\$50.00	SILICA FLUX TO SAF	0.0157	\$785,602	\$0.79	\$1.84
\$1,031.03	ELECTRODES TO SAF	0.0010	\$993,167	\$0.99	\$2.32
\$0.00	SAF CHARGE CARBON	0.0000	\$0	\$0.00	\$0.00
\$700.00	SLAG/WIRE DESULFURIZER TO LTF - (AVG.\$/MM mt)	0.0021	\$1,498,423	\$1.50	\$3.50
\$0.72	LADLE COSTS - (\$/mt)	0.4281	\$308,247	\$0.31	\$0.72
\$0.033	ELECTRIC POWER CONSUMP. SAF/LTF - (MM kWhr/y	149.8423	\$4,944,797	\$4.94	\$11.55
0.1019	SAF LABOR - (MN-HR/mt)	0.4281	\$1,679,213	\$1.68	\$3.92
10.46	SAF OTHER - (\$/mt)	0.4281	\$4,478,145	\$4.48	\$10.46
	SUB-TOTAL HM PRODUCTION IN SAF:		\$17,008,232	\$17.01	\$39.73
	EAF STEELMAKING:	L	, , ,	,	
I	REFINED STEEL TO LRF	1.0317		<u> </u>	
	NET HOT METAL CHARGE TO EAF	0.4281			
\$140.00	TOTAL STEEL SCRAP (PURCHASED & REVERT)	0.6375	\$89,247,071	\$89.25	\$86.51
\$490.53	MISC. ADDITIVES - (AVG. \$/mt)	0.0155	\$7,580,000	\$7.58	\$7.35
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0130	\$755,950	\$0.76	\$0.73
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0029	\$2,990,000	\$2.99	\$2.90
\$77.10	LIME CHARGED	0.0243	\$1,872,407	\$1.87	\$1.81
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	44.4835	\$1,868,305	\$1.87	\$1.81
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0000	\$4,485,000	\$4.49	\$4.35
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0000	\$16,830,000	\$16.83	\$16.31
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	268,3688	\$8,856,170	\$8.86	\$8.58
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,705	\$0.29	\$0.28
412	SUB-TOTAL EAF STEELMAKING:	*****	\$134,773,608	\$134.77	\$130.64
	LADLE REFINING:				
	LIQ. EAF STEEL TO CASTING	1.0000	The state of the s		
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0.0053	\$893,142	\$0.89	\$0.89
\$700.00	SLAGWIRE DESULFURIZER TO LRF	0.0004	\$258,347	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	30.0950	\$993,135	\$0.99	\$0.99
ψ0.000	SUB-TOTAL LRF:		\$6,657,409	\$6.66	\$6.66
<u> </u>		· · · · · · · · · · · · · · · · · · ·	++,557,1,00	Ψ0.50	
	TOTAL THROUGH LIQUID STEEL:		\$205,395,012	\$205.40	
	. on a minor of and of an and		+,,	4_23.40	
<u> </u>					

OTHER PROCESSES

ASLRN

SUMMARY CONSUMABLES SL/RN PROCESS TO PRODUCE DRI

Rev. 3

21-June-2000

MAXIMUM DRI CHARGED - 85.8 WT.%

BASIS:

0.1181 MM MT/YEAR PURCHASED SCRAP CHARGED
0.0363 MM MT/YEAR RECYCLED SCRAP CHARGED
0.9365 MM MT/YEAR DRI CHARGED
0.0000 MM MT/YEAR LIQUID HOT METAL (TARGET)
0.0000 MM MT/YEAR LIQUID HOT METAL (CALC.)

1.0000 MM MT/YEAR LIQUID STEEL (TARGET)
0.9770 MM MT/YEAR CAST SLAB EQUIVALENT (CALC.)

SUMMARY:

1.356 MMM MT/YEAR FINE ORE FEED

3,344.5 MMM Nm3/YEAR AIR

12.6 MMM Nm3/YEAR OXYGEN

55.5 MMM Nm3/YEAR NATURAL GAS

0.702 MMM MT/YEAR COAL

0.052 MMM MT/YEAR FLUX ADDED

2.014 MMM MT/YEAR NET G.B. PELLETS PRODUCED

3.442.3 MMM Nm3/YEAR WASTE FLUE GASES SAF

0.00 MM MT/YEAR NET SLAG PRODUCED

ASSUMPTIONS:

51.38 ELECTRIC POWER CONSUMPTION IN RK - (kWhr/mt DRI)

18.6200 ELECTRIC POWER CONSUMMED IN G-B PELLET. - (kWhr/mt GB)

686.2 EAF ELEC. POWER (TOTAL) - (kWhr/mt LIQ, STEEL)

PROCESS	STREAM LABLE	DRY SOLIDS	LIQUID	TOTAL
OPERATION		(MM T/YR)	(MM T/YR)	(MM T/YR)
GREEN-BALL P	ELLETIZING:			
	IRON ORE FINES TO PELLETIZING	1.3560	0.000	1.3560
	COAL FINES TO PELLETIZING	0.7024	0.0000	0.7024
	BINDER TO PELLETIZING	0.0937	0.0015	0.0951
	RECYCLE DUST TO PELLETIZING	0.2046	0.2046	0.4092
1	RECYCLE PELLETS TO PELLETIZING	0.0516	0.0070	0.0587
1	GROSS PELLETS	2.0653	0.2816	2.3469
	ELEC. POWER IN G-B PELLETIZING - (MM kWhr/yr)	38.4560		
ROTARY KILN I	REDUCTION:			
	PELLETS FEED TO RK	2.0137	0.2746	2.2883
	NATURAL GAS FUEL TO RK - (MM mt/yr)		0.04396	
	COMBUSTION AIR TO RK - (MM mt/yr)		4.32383	
	DRI LEAVING RK	1.0261	0.000	1.0261
	ELECT. POWER CONSUMMED IN RK - (MM kWhr/yr)	52.7222		

ASLRN 21-June-2000

SUMMARY CONSUMABLES SL/RN PROCESS TO PRODUCE DRI

Rev. 3 MAXIMUM DRI CHARGED - 85.8 WT.% DRY SOLIDS LIQUID PROCESS STREAM LABLE TOTAL (MM T/YR) (MM T/YR) OPERATION (MM T/YR) EAF STEELMAKING: 0.0000 NET DRI CHARGE 0.9365 0.9365 TOTAL PURCHASED STEEL SCRAP TO EAF 0.1181 0.1544 TOTAL REVERT STEEL SCRAP TO EAF 0.0363 0.1544 MISC. ADDITIVES 0.0155 0.0155 STEEL C (CHARGE+SLAG INJ) 0.0130 0.0130 EAF ELECTRODES 0.0045 0.0005 0.0243 0.0243 LIME CHARGED O2 GAS TO EAF (MM Nm3/YR) 52.60 LIQ. EAF STEEL TO LRF 0.0000 1.0032 1.0032 AUX. FUEL TO EAF 0.0023 EAF ELECTRICAL POWER REQ'D 686,2000 LADLE REFINING: LIQ. EAF STEEL TO LRF 0.0000 1.0032 1.0032 LIME TO LADLE REF. FCE. 0.0053 0.0053 SLAG/WIRE DESULFURIZER TO LRF 0.0038 0.0004 ARGON GAS TO LRF (MM Nm3/YR) 0.063 30.0950 LRF ELECTRICAL POWER REQ'D - (MM kWhr/mt) REFINED STEEL TO CASTING 0.0000 1.0000 1.0000 0.9770 **NET STEEL SLAB PRODUCED** 0.0000 0.9770 ASLRN

Rev. 3

21-June-2000

SUMMARY CONSUMABLES SL/RN PROCESS TO PRODUCE DRI MAXIMUM DRI CHARGED - 85.8 WT.%

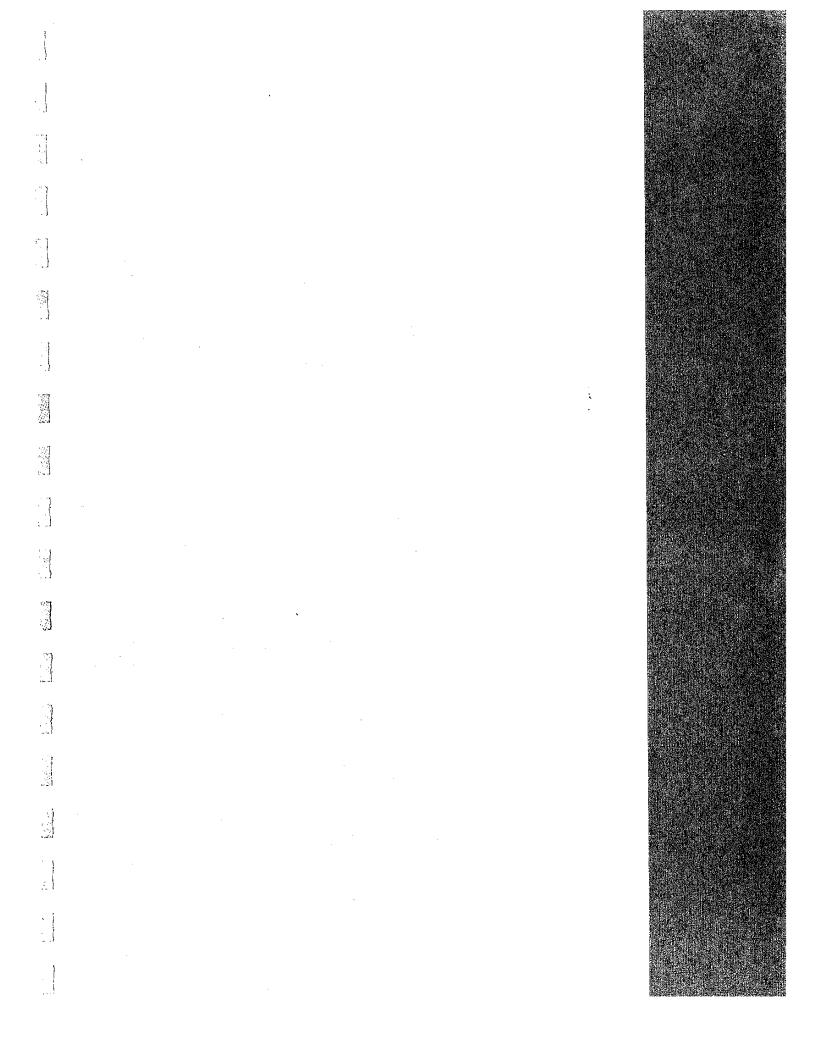
ASSUMPTIONS: CENTRAL, UPPER MID-WEST U.S. LOCATION

\$38.50 LABOR RATE - \$/MAN-HOUR BURDENED

\$124.45 N.G. FUEL COSTS - \$/mt \$413.85 DIESEL FUEL COSTS - \$/mt

\$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT					
	ORE:	4.0500	200 700 040 [200 TO T	001.10
\$21.19	IRON ORE CONC. DELIVERED - (\$/mt DRY)	1.3560	\$28,733,640	\$28.73	\$21.19
	PELLETIZING:	0.04071			
	NET GREENBALL PELLETS:	2.0137			**
0.0742	PELLETIZATION LABOR - (MN-HR/mt PELLETS)	2.0653	\$5,903,673	\$5.90	\$2.93
\$40.71	LOW S FINE COAL TO PELLET (\$/mt PELLETS)	0.7024	\$28,595,091	\$28.60	\$14.20
\$90.02	BINDER TO PELLETIZING - (\$/mt BINDER)	0.0937	\$8,430,373	\$8.43	\$4.19
\$2.36	PELLET OTHER'- (\$/mt PELLETS)	2.0653	\$4,874,121	\$4.87	\$2.42
\$0.033	PELLET ELECTRICAL - (MM kWhr/yr)	38.4560	<u>\$1,269,048</u>	\$1.27	\$0.63
	SUB-TOTAL PELLETIZING:	<u>.</u>	\$49,072,305	\$49.07	\$24.37
	DIRECT REDUCTION IN ROTARY KILN:				
	DRI TO EAF (4.0% C)	0.9365	1		
0.0676	DRI LABOR - (MN-HR/mt DRI)	0.9365	\$2,437,335	\$2.44	\$2.60
11.39	DRI OTHER - (\$/mt DRI)	0.9365	\$10,666,735	\$10.67	\$11.39
\$0.033	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	52.7222	\$1,739,832	\$1.74	\$1.86
\$124.45	N.G. FUEL TO DRI - (\$/mt)	0.0440	<u>\$5,470,822</u>	\$5.47	<u>\$5.84</u>
	SUB-TOTAL DRI PRODUCTION:		\$20,314,724	\$20.31	\$21.69
	EAF STEELMAKING:				
	REFINED STEEL TO LRF	1.0032			
\$140.00	PURCHASED STEEL SCRAP (86.5% DRI)	0.1181	\$16,530,376	\$16.53	\$16.48
\$10.00	REVERT STEEL SCRAP (86.5% DRI)	0.0363	\$362,919	\$0.36	\$0.36
\$490.53	MISC. ADDITIVES - (AVG. \$/mt)	0.0155	\$7,580,000	\$7.58	\$7.56
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0130	\$753,636	\$0.75	\$0.75
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0045	\$4,639,655	\$4.64	\$4.63
\$77.10	LIME CHARGED	0.0243	\$1,872,407	\$1.87	\$1.87
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	52,5985	\$2,209,137	\$2.21	\$2.20
0.1165	EAF LABOR - (MN-HR/mt L.S.)	1.0032	\$4,499,202	\$4.50	\$4.49
\$16.83	EAF OTHER - (\$/mt L.S.)	1.0032	\$16,883,291	\$16.88	\$16.83
\$0.033	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	686.2000	\$22,644,600	\$22.64	\$22.57
\$124,45	N.G. AUX. FUEL TO EAF	0.0023	\$288,705	\$0.29	\$0.29
V	SUB-TOTAL EAF STEELMAKING:		\$78,263,927	\$78.26	\$78.02
,	LADLE REFINING:		<i>ψ. υμπυυγυπ</i>	4	
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE (\$/mt)	0,0053	\$893,142	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0038	\$2,660,000	\$2.66	\$2.66
\$0,240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
\$4.498	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	30.0950	\$993,135	\$0.99	\$0.99
\$0.000	SUB-TOTAL LRF:	55.5556	\$9,059,062	\$9.06	\$9.06
	TOTAL THROUGH LIQUID STEEL:		\$185,443,658	\$185.44	



APPENDIX F-3 IRONMAKING PROCESS SUMMARIES

F-3 Ironmaking Process Summaries (Cumulative CO₂ Emissions, Electrical Power Requirements)

The detailed Energy and Mass balance spreadsheets (Appendix C) for the Ironmaking processes considered in this evaluation of Alternative Ironmaking Processes yield estimates of the Total Cumulative CO₂ Emission from the various Process Steps required to produce an equivalent 1.0 million metric tonnes of refined Liquid Steel product. In addition, the total Cumulative Electrical Power Requirements to produce the Liquid Steel product are also defined by the Spreadsheet Energy and Mass Balances.

Utilizing the equivalent emissions (North American Average) of CO₂ from the generation of electrical power (Appendix A3.1), estimates of the cumulative CO₂ emissions from that source were also made. Thus the combined equivalent CO₂ emissions for the total Ironmaking Process could be made by adding the two components (process and electrical power generation source).

The estimates for each Ironmaking Alternative Process (through Refined Liquid Steel Production) are presented in a summary table in this section.

SUMMARY OF VARIOUS PROCESSES FOR IRONMAKING/STEELMAKING (BASIS: 1.00 MM mt/yr LIQUID STEEL PRODUCTION)

APPENDIX	IRONMAKING PROCESS	ن ج	COMPONENT ELEC. POWER REQ'D.	TOTAL ELEC. POWER REQ'D.	PROCESS CO2 PRODUCED	EQUIV. E.P. CO2 PRODUCED	TOTAL CO2 EQUIVALENT
SHAFTE	SHAFT FURNACE DRI - VARIATION IN CARBON	(kWhr/mt LS) (kWhr/	(kWhr/mt LS)	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)	(mt/mt LS)
5	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON		62.77	1,326.73	1.0514	1.2103	2.2617
C-2	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON	1,267.15	86.27	1,353.42	1.1562	1.2345	2.3907
ب	100% STEEL SCRAP CHARGE TO EAF	761.83	60.62	822.45	0.0874	0.8035	0.8909
7.4	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON	967.43	62.94	1,030.37	0.4283	0.9398	1.3681
ပ	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON	968.31	96.50	1,064.81	0.4599	0.9712	1.4311
g-2	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF	1,134.50	132.87	1,267.37	0.9086	1.1560	2.0646
C-7	C-7 30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	607.84	187.60	795.44	0.8974	0.7771	1.6746
ر- 8	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	607.84	193.59	801.43 (141.08)	0.9594	0.6021	1.5615
6 - 5	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	807.06	195.33	1,002.39	0.9027	0.9143	1.8170
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION	568.06	117.64	685.69	1.1545	0.2805	1.4350
C-11	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION	568.06	117.64	685.69	1.1545	0.6254	1.7799
C-12	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF	563.70	379.21	942.91	2.9239	0.8600	3.7839
C-13	HISMELT WITH 32.7% HOT METAL TO CHARGE TO EAF	583.99	263.37	847.37	0.8689	0.7729	1.6418

D.O.E. IRONMAKING - SUMMARY OF CUMULATIVE ELECTRIC POWER CONSUMPTION AND CARBON DIOXIDE GAS EMISSION, Rev. 3

SUMMARY OF VARIOUS PROCESSES FOR IRONMAKING/STEELMAKING (BASIS: 1.00 MM mt/yr LIQUID STEEL PRODUCTION)

C-14 REDSMELT HOT METAL WITH ONLY EARTH FURNACES	APPENDIX	IRONMAKING PROCESS	PROCESS ELEC. POWER REQ'D.	COMPONENT ELEC. POWER REQ'D.	TOTAL ELEC. POWER REQ'D.	PROCESS CO2 PRODUCED	EQUIV. E.P. CO2 PRODUCED	TOTAL CO2 EQUIVALENT
IRNACES DT METAL WITH ONLY RAP CHARGE TO EAF SUETTE DRI/EAF WITH LE SCRAP CHARGE TO EAF WITH ONLY RAP CHARGE TO EAF SI/SAF/EAF WITH ONLY RAP CHARGE TO EAF AF WITH ONLY RAP CHARGE TO EAF AF WITH ONLY RAP CHARGE TO EAF AF WITH ONLY RAP CHARGE TO EAF AF WITH ONLY RAP CHARGE TO EAF AF WITH ONLY RAP CHARGE TO EAF RAP CHARGE TO EAF RAP CHARGE TO EAF RAP CHARGE TO EAF RAP CHARGE TO EAF			(kWhr/mt LS)	(KWhr/mt LS)	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)	(mt/mt LS)
OT METAL WITH ONLY SAP CHARGE TO EAF SUETTE DRI/EAF WITH LE SCRAP CHARGE TO EAF SWITH ONLY SAP CHARGE TO EAF SI/SAF/EAF WITH ONLY SAP CHARGE TO EAF AF WITH ONLY SAP CHARGE TO EAF AF WITH ONLY SAP CHARGE TO EAF AF WITH ONLY SAP CHARGE TO EAF AF WITH ONLY SAP CHARGE TO EAF AF WITH ONLY SAP CHARGE TO EAF AF WITH ONLY SAP CHARGE TO EAF SAP CHARGE TO EAF AP CHARGE TO EAF SAP CHARGE TO EAF	OTARY	HEARTH FURNACES						
LE SCRAP CHARGE TO EAF LE SCRAP CHARGE TO EAF ANTH ONLY AP CHARGE TO EAF SIEAF WITH ONLY AP CHARGE TO EAF AF WITH ONLY AP CHARGE TO EAF AF WITH ONLY AP CHARGE TO EAF AF WITH ONLY AP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF		REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	513.46	176.82	690.28	1.3624	0.6296	1.9921
SAP CHARGE TO EAF SUEAF WITH ONLY SAP CHARGE TO EAF SUSAFIEAF WITH ONLY SAP CHARGE TO EAF AF WITH ONLY SAP CHARGE TO EAF AR CHARGE TO EAF N CARBIDE/EAF SAP CHARGE TO EAF YELN WITH ONLY SAP CHARGE TO EAF		MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	837.27	128.82	966.09	1.1498	0.8812	2.0310
SIVEAF WITH ONLY SAP CHARGE TO EAF SIJSAF/EAF WITH ONLY SAP CHARGE TO EAF AF WITH ONLY SAP CHARGE TO EAF AP CHARGE TO EAF TO CARBIDE/EAF SAP CHARGE TO EAF SAP CHARGE TO EAF SAP CHARGE TO EAF SAP CHARGE TO EAF	C-16	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	670.17	155.23	825.40	1.5213	0.7529	2.2742
SINEAF WITH ONLY SAP CHARGE TO EAF SISAF/EAF WITH ONLY SAP CHARGE TO EAF AF WITH ONLY SAP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF	LUID-BE	D DRI/HBI						
IISAF/EAF WITH ONLY AP CHARGE TO EAF AF WITH ONLY AP CHARGE TO EAF N CARBIDE/EAF AP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF AP CHARGE TO EAF		CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	841.96	58.89	900.84	1.1999	0.8217	2.0217
AF WITH ONLY AP CHARGE TO EAF N CARBIDE/EAF AP CHARGE TO EAF KILN WITH ONLY AP CHARGE TO EAF	C-18	CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	594.19	186.80	780.99	1.6404	0.7124	2.3528
N CARBIDE/EAF AP CHARGE TO EAF KILN WITH ONLY AP CHARGE TO EAF		FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	848.87	58.89	907.76	1.0742	0.8280	1.9022
Y KILN WITH ONLY SAP CHARGE TO EAF		GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF	797.53	175.42	972.95	1.2864	0.8874	2.1738
SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	THER P	ROCESSES						
		SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	807.27	192.47	999.74	2.2869	0.9119	3.1988

APPENDIX F-4

IRONMAKING PROCESS RELATIVE OPERATING COSTS (OPEX)

F-4 Ironmaking Process Relative Operating Costs (OPEX)

Operating costs for each Ironmaking Process (OPEX) were developed and built up from breakdowns of the operating cost components for each process unit operation in the sequence. That is, from the mines (for iron ore or other components) through ore preparation, the ironmaking process steps and the EAF/LRF to produce the refined liquid steel product. All costs are normalized on the 1.0 million annual metric tonnes of Refined Liquid Steel product basis.

Since the same procedures and common elements, where appropriate, were utilized in developing the estimates of the OPEX for each process, the relative accuracy and precision of these estimates when utilized for comparing the processes is believed to be very good. The built-up OPEX estimates produced in this manner were also compared to historical reported operating costs for the processes, to Vendor-supplied estimates and to internal detailed feasibility estimates prepared by Lockwood Greene for various commercial clients. The built-up estimates, considering differences in commodity and energy cost components, compared closely with those more detailed internal estimates.

The key methodology followed for the Operating Cost Estimates (OPEX) for each process were:

- The primary basis for consumables were the Energy and Mass Balance Spreadsheets (Appendix C).
- Commodity or consumable costs were either local (i.e. Upper Mid-West U.S.A. location) or built up from the individual commodity process components (Appendix F-1).
- Labor rates utilized was from a recent LGE Feasibility Study. It is an allin rate (including supervision component, overhead and burden) for the Upper Mid-West location.
- Labor man-hours (as man-hours/mt of product) for each of the Process unit operations or steps were either based on Vendor inputs for those process steps or were factored from LGE internal, detailed feasibility studies.

- Other considerations, including: allowances for Outside Boundary Limit (OSBL) facilities and ancillaries, Vendor or Licensing Fees, maintenance spare parts and supplies, etc. were also factored from the recent LGE feasibility studies for the similar process unit operations or steps.
- The factors, as required, were defined utilizing the operating cost components of the detailed internal LGE feasibility studies for the appropriate process operation (i.e. mining, concentration, pelletizing, ironmaking process, EAF, LRF, etc.).

The OPEX spreadsheets for the individual Ironmaking Processes are provided in Appendix F-2. The results are summarized in the tables in this Appendix Section.

LIQUID STEEL PRODUCTION COSTS - STEEL SCRAP SENSITIVITY

Early in the Alternative Ironmaking Process Study it was realized that two factors in developing the OPEX costs needed to be addressed:

- The processes for producing iron units needed to be compared on an equalized basis. That is, processes producing molten iron products needed to be compared to processes producing solid, direct-reduced iron products.
- In addition, a normalized ultimate product (i.e. refined liquid steel from an EAF/LRF process) at a consistent rate of production (i.e. 1.0 million metric tonnes per year of L.S.) was the uniform target rate for all ironmaking processes.

The problem with this, however, is that some of the Ironmaking processes require (or typically are used) with a specified amount of steel scrap as the charge to an EAF. In some cases also, the optimal utilization of the Ironmaking process or the technically-feasible process is <u>not</u> to charge 100% of the iron units from the ironmaking process to the EAF. The balance of the iron units (or requirements for coolant, or product purity, etc.) would come from a combination of recycled and purchased steel scrap.

The cost of steel scrap (a composite scrap charge is assumed as the basis for these EAF processes) has widely fluctuated during the past 2 or 3 years (see Appendix F1.10). As a consequence, when developing an OPEX through the liquid steel production or when trying to compare the relative economic

viability of the overall processes (i.e. as a simple Internal Rate of Return calculation), the scrap price (or cost) is a <u>significant variable</u> in this analysis. Therefore, the OPEX costs for production of Liquid Steel are sensitized on the steel scrap price. For the basis of this analysis, costs for steel scrap of \$100, \$120 and \$140 per metric tonne of steel scrap are sensitized in the Summary OPEX tables in this section.

Subsequent financial analyses comparisons of the Alternative Ironmaking Processes (by utilizing a simple Internal Rate of Return calculation) utilized the operating costs reflecting each of the above steel scrap price (i.e. \$100, \$120 and \$140 per metric tonne) sensitivities. The value of the refined Liquid Steel produced, after EAF steelmaking and LRF treatment, was taken to be \$250 per metric tonne for all of the Internal Rate of Return calculations. This assumed value of the Liquid Steel (prior to continuous casting and/or hot band production) was consistent for all Alternative Ironmaking Processes. Thus, a relative financial comparison between the various processes could be made,

The OPEX estimates for each process evaluated are summarized and tabulated for each of the steel scrap prices in this Section.

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES SENSITIVITY: \$100.00/mt STEEL SCRAP PRICE

		LE TOTAL	-	\$6.82 \$205.39	\$6.82 \$206.42	\$6.82 \$176.83	\$6.82 \$188.64	\$6.82 \$189.99	.82 \$196.15	82 \$189.65	82 \$178.23	82 \$198.05	82 \$177.67	82 \$190.98	32 \$228.34	•
		LADLE	4						6 \$6.82	8 \$6.82	8 \$6.82	7 \$6.82	\$6.82	\$6.82	\$6.82	
		STEEL MKG		\$60.17	\$61.09	\$67.21	\$59.68	\$60.73	\$58.16	\$53.98	\$53.98	\$61.57	\$52.05	\$52.05	\$49.51	
	TEEL	PURCHASED EAF SCRAP				\$102.80	\$73.64	\$73.64		\$73.66	\$73.66	\$73.66	\$73.66	\$73.66		
	COST PER NET MT LIQUID STEEL	HOT METAL PROD.								\$32.75	\$29.41	AS PIG \$33.56	\$23.86	\$37.17	\$75.27	
	COST PER NE	REDUCTION		\$49.99	\$49.99		\$16.87	\$17.14	\$42.76						\$20.84	
		PELLETIZING/ BRIQUETTING		\$24.10	\$24.13		\$10.30	\$10.31	\$24.10			· · · · · · · · · · · · · · · · · · ·	\$21.28	\$21.28	\$34.17	
	0,100	CONC. DELIVERED		\$64.31	\$64.39		\$21.33	\$21.34	\$64.31	\$18.45	\$10.29	\$18.45	,			
	111111111111111111111111111111111111111	ORE, OTHER IRON UNITS								\$3.99	\$4.07	\$3.99			\$41.73	
SENSITIVITY: \$100.00/mt STEEL SCRAP PRICE	-		_	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON	100% STEEL SCRAP CHARGE TO EAF	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON	C-6 HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF	
SENSI	j ⊆	j Z	SHAFI	<u>.</u>	C-5	6.3	2	C-5	C-6	C-7	C-8	6-0	C-10	C-11	C-12	

D.O.E. IRONMAKING - RELATIVE OPERATING COSTS THROUGH LIQUID STEEL PRODUCTION

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES (BASIS: 1.00 MM mt/yr LIQUID STEEL PRODUCTION)

SENSITIVITY: \$100,00/mt STEEL SCRAP PRICE

SEQ.	NO.	ROTARY HEARTH FURNACES	C-14 REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	C-15 MAUMEE BRIQUE ONLY RECYCLE S	C-16 ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE	FLUID-BED DRI/HBI	C-17 CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO E	C-18 CIRCOFER/HBI/SA RECYCLE SCRAP	C-19 FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE T	C-20a GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF	C-20b GENERIC IRON CARBIDE/SAF/EAF 60% SCRAP CHARGE TO EAF	OTHER PROCESSES	NO TOO HOLD TO CO
PROCESS		CES	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF		CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	ARBIDE/EAF CHARGE TO EAF	ARBIDE/SAF/EAF (GE TO EAF		V INC HTMM IN IN VOLTA ON INC. 19
	ORE, OTHER IRON UNITS		\$30.80	\$32.41	\$30.80		\$37.95	\$36.80	\$37.11	\$36.05	\$14.42		¢28 73
	CONC. DELIVERED												
	PELLETIZING/ BRIQUETTING		\$31.78	\$41.93	\$38.46		\$7.58	\$15.08	\$6.77				20 040
COST PER NET MT LIQUID STEEL	REDUCTION		\$22.33	\$32.60	\$30.90		\$78.22	\$51.00	\$79.72	\$81.34	\$32.54		140000
MT LIQUID ST	HOT METAL PROD.		\$38.68					\$38.68			\$17.01		
reel	PURCHASED EAF SCRAP		\$11.81	_ -	\$11.81						\$63.75		70770
	EAF STEELMKG.		\$46.24	\$60.97	\$58.47		\$55.60	\$40.33	\$55.60	\$54.53	\$45.52		004 70
	LADLE		\$6.67	\$9.12	\$8.32		\$5.92	\$6.66	\$5.92	\$5.92	\$6.66		00 00
;	TOTAL LIQ. STEEL		\$188.31	\$177.03	\$178.76		\$185.27	\$188.55	\$185.12	\$177.84	\$179.90		6400.74

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES

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SENS	TIVITY: \$120.00/mt									
SEQ.	PROCESS				COST PER NET MT LIQUID STEEL	MT LIQUID ST	EEL			
<u>.</u>		ORE, OTHER	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	STEEL MKG.	LADLE	TOTAL
SHAF	SHAFT FURNACE DRI PROCESSES:									
2	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON		\$64.31	\$24.10	\$49.99			\$60.17	\$6.82	\$205.39
C-5	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON		\$64.39	\$24.13	\$49.99			\$61.09	\$6.82	\$206.42
<u>ਤ</u>	100% STEEL SCRAP CHARGE TO EAF						\$123.36	\$67.21	\$6.82	\$197.39
0.44	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON		\$21.33	\$10.30	\$16.87	·	\$88.36	\$59.68	\$6.82	\$203.36
	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON		\$21.34	\$10.31	\$17.14		\$88.37	\$60.73	\$6.82	\$204.72
9-O	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF		\$64.31	\$24.10	\$42.76			\$58.16	\$6.82	\$196.15
C-7	C-7 30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	\$3.99	\$18.45			\$32.75	\$88.40	\$53.98	\$6.82	\$204.39
ဗီ ———	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	\$4.07	\$10.29			\$29.41	\$88.40	\$53.98	\$6.82	\$192.97
ဝို	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	\$3.99	\$18.45			\$33.56	\$88.40	\$61.57	\$6.82	\$212.79
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION			\$21.28		\$23.86	\$88.40	\$52.05	\$6.82	\$192.41
C-1	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION			\$21.28		\$37.17	\$88.40	\$52.05	\$6.82	\$205.72
C-12	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF	\$41.73		\$34.17	\$20.84	\$75.27	— ··· • · · · · · · · · · · · · · · · ·	\$49.51	\$6.82	\$228.34
C-13	HISMELT WITH 32.7% HOT METAL. TO CHARGE TO EAF		\$23.46			\$25.96	\$88.40	\$52.06	\$8.31	\$198.19

D.O.E. IRONMAKING - RELATIVE OPERATING COSTS THROUGH LIQUID STEEL PRODUCTION

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES

(BASIS: 1.00 MM mt/yr LIQUID STEEL PRODUCTION)

SENSITIVITY: \$120.00/mt STEEL SCRAP PRICE

SENS	1V11Y: \$120.00/mt									
SEQ	PROCESS				COST PER NET MT LIQUID STEEI	MT LIQUID ST	TEEL			
Ö		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEELMKG.	LADLE REFINING	TOTAL LIQ. STEEL
ROTA	ROTARY HEARTH FURNACES									
C-14	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$30.80		\$31.78	\$22.33	\$38.68	\$14.17	\$46.24	\$6.67	\$190.67
C-15	MAUMEE BRIQUETTE DRIJEAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$32.41		\$41.93	\$32.60			\$60.97	\$9.12	\$177.03
C-16	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$30.80		\$38.46	\$30.90		\$14.17	\$58.47	\$8.32	\$181.12
FLUID	FLUID-BED DRI/HBI									
C-17	C-17 CIRCOREDI/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$37.95		\$7.58	\$78.22			\$55.60	\$5.92	\$185.27
C-18	CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$36.80		\$15.08	\$51.00	\$38.68		\$40.33	\$6.66	\$188.55
C-19	FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$37.11		\$6.77	\$79.72			\$55.60	\$5.92	\$185.12
C-20a	GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF	\$36.05			\$81.34			\$54.53	\$5.92	\$177.84
C-20b	GENERIC IRON CARBIDE/SAF/EAF 60% SCRAP CHARGE TO EAF	\$14.42			\$32.54	\$17.01	\$76.50	\$45.52	\$6.66	\$192.65
OTHE	OTHER PROCESSES									
C-21	C-21 SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$28.73		\$49.07	\$20.31		\$14.17	\$61.73	\$9.09	\$183.10

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SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES

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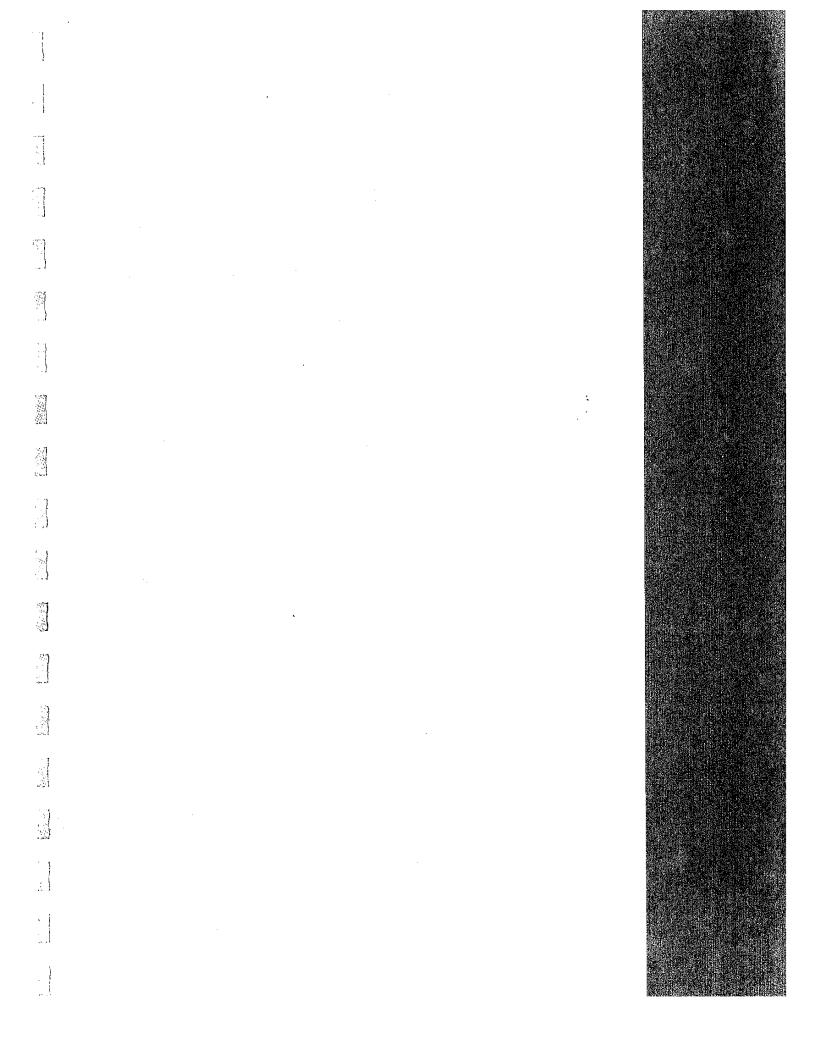
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j S		ORE, OTHER	CONC.	PELLETIZING/	REDUCTION	HOT METAL	PURCHASED	EAF	LADLE	TOTAL
		IRON UNITS	DELIVERED	BRIQUETTING		PROD.	EAF SCRAP	STEELMKG.	REFINING	LIQ. STEEL
SHAF	SHAFT FURNACE DRI PROCESSES:									
ភ	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON		\$64.31	\$24.10	\$49.99			\$60.17	\$6.82	\$205.39
C-2	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON		\$64.39	\$24.13	\$49.99			\$61.09	\$6.82	\$206.42
ပိ	100% STEEL SCRAP CHARGE TO EAF						\$143.92	\$67.21	\$6.82	\$217.95
C-4	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON		\$21.33	\$10.30	\$16.87		\$103.09	\$59.68	\$6.82	\$218.09
C-5	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON		\$21.34	\$10.31	\$17.14		\$103.10	\$60.73	\$6.82	\$219.45
ပ္	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF		\$64.31	\$24.10	\$42.76			\$58.16	\$6.82	\$196.15
HOT	HOT METAL VARIATIONS									
C-7	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	\$3.99	\$18.45			\$32.75	\$103.13	\$53.98	\$6.82	\$219.12
٥ 8-	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	\$4.07	\$10.29			\$29.41	\$103.13	\$53.98	\$6.82	\$207.70
ရ ပ	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	\$3.99	\$18.45			AS PIG \$33.56	\$103.13	\$61.57	\$6.82	\$227.52
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION			\$21.28		\$23.86	\$103.13	\$52.05	\$6.82	\$207.14
C-11	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION			\$21.28		\$37.17	\$103.13	\$52.05	\$6.82	\$220.45
C-12	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF	\$41.73		\$34.17	\$10.67	\$75.27		\$49.51	\$6.82	\$218.17
C-13	HISMELT WITH 32.7% HOT METAL TO CHARGE TO EAF		\$23.46			\$25.96	\$103.13	\$52.06	\$8.31	\$212.92

D.O.E. IRONMAKING - RELATIVE OPERATING COSTS THROUGH LIQUID STEEL PRODUCTION, Rev. 2

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES (BASIS: 1.00 MM mt/yr LIQUID STEEL PRODUCTION)

SENSITIVITY: \$140.00/mt STEEL SCRAP PRICE

SENS	IIVII Y: \$140.00/mt						1			
SEQ.	PROCESS)	– 1	MT LIQUID ST	EEL			
Š		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEELMKG.	LADLE	TOTAL LIQ. STEEL
ROTA	ROTARY HEARTH FURNACES									
C-14	C-14 REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$30.80		\$31.78	\$22.33	\$38.68	\$16.53	\$46.24	\$6.67	\$193.03
C-15	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$32.41		\$41.93	\$32.60			\$60.97	\$9.12	\$177.03
C-16	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$30.80		\$38.46	\$30.90	:	\$16.53	\$58.47	\$8.32	\$183.48
FLUID	FLUID-BED DRI/HBI									
C-17	C-17 CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$37.95		\$7.58	\$78.22			\$55.60	\$5.92	\$185.27
C-18	CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$36.80		\$15.08	\$51.00	\$38.68		\$40.33	\$6.66	\$188.55
C-19	FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$37.11		\$6.77	\$79.72			\$55.60	\$5.92	\$185.12
C-20a	C-20a GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF	\$36.05			\$81.34			\$54.53	\$5.92	\$177.84
C-20b	C-20b GENERIC IRON CARBIDE/SAF/EAF 60% SCRAP CHARGE TO EAF	\$14.42			\$32.54	\$17.01	\$89.25	\$45.52	\$6.66	\$205.40
OTHE	OTHER PROCESSES									
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$28.73		\$49.07	\$20.31		\$16.53	\$61.73	\$9.09	\$185.46



APPENDIX F-5

IRONMAKING PROCESS RELATIVE CAPITAL COSTS (CAPEX)

F-5 Ironmaking Process Relative Capital Costs (CAPEX)

The Relative Capital Cost (CAPEX) estimates for each of the Alternative Ironmaking Processes were developed from appropriate sections of several internal LGE Project Feasibility and Detailed Design Studies. The installed cost estimates were factored using the costs for similar scopes for the plant and processing areas involved with each of the Ironmaking Processes.

The costs used were updated to a year 2000 basis and normalized using the process Mass Balances (Appendix C) to a uniform 1.0 million metric tonnes per year Refined Liquid Steel production basis. Specific differences in scope required for a particular process were accounted for in the individual components considered in the overall process CAPEX estimates. The CAPEX is reported as \$/annual metric tonne of production.

The built-up CAPEX costs are summarized in this section.

COST PER ANNUAL MT LIQUID STEEL PRODUCTION	INSTALLED COST PER mt UNIT/ UNIT CST./ TOTAL COST(1) ANNUAL mt LIQ. ST. mt LIQ. ST. SCOPE				\$135.0 \$40.91 \$155.0 \$44.29 \$175.0 \$41.67 \$300.0 \$60.00 AVERAGE: \$46.72 1.7807 \$83.19	\$670.0 \$148.89 \$565.0 \$141.25 \$655.0 \$145.56 AVERAGE: \$145.23 1.0450 \$151.77	\$410.0 \$83.33 \$385.0 \$78.25 \$400.0 \$81.30 AVERAGE: \$80.96 1.0549 \$85.41	\$180.0 \$45.00 1.0000 \$45.00 \$365.36	\$46.72 1.7826 \$83.27 \$145.23 1.0450 \$151.77 \$80.96 1.0549 \$85.41 \$45.00 1.0000 \$45.00 \$365.45
COST PER ANNUAL	CAPACITY IN:			1.4652	3.3000 3.5000 4.2000 5.0000	4,5000 4,0000 4,5000	4.9200 4.9200 4.9200	4.0000 (L.S.)	1.4670
	BASIS FOR COST			Concentrate delivered to pelletizing plant.	Composite of four Vendor quotations for similar scope.	Composite of three Vendor quotations for similar scope.	Composite of three Vendor quotations for similar scope.	Includes: ore/concentrate storage, water services, waste disposal, off-gas treatment, offices, labs, etc.	Same as C-1. Same as C-1. Same as C-1. Same as C-1. Same as C-1.
PBOCESS		SHAFT FURNACE DRI PROCESSES:	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON	IRON UNIT INPUT:	INDURATED PELLET PRODUCTION: (KOBE/MIDREX SHAFT FURNACE:	ELECTRIC ARC STEELMAKING/L.RF:	OUTSIDE BOUNDARY LIMITS:	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON IRON UNIT INPUT: INDURATED PELLET PRODUCTION: KOBEMIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:
CHO	N S	SHAFT	<u>.</u>						6.2

	PROCESS	BASIS FOR COST	COST PER ANN	COST PER ANNUAL MT LIQUID STEEL PRODUCTION CAPACITY INSTALLED COST PER mt III	STEEL PROD	UCTION mf IJNIT/	IINIT CST /	TOTAL
		1000 1000	(MM mt/yr)	COST(1)	ANNUAL mt	mt LIQ. ST.	mt LfQ. ST.	SCOPE
IL SCRAP CTRIC AR OUTSII	100% STEEL SCRAP CHARGE TO EAF ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-1. Includes: scrap receiving/handling/storage, water services, waste disposal, off-gas treatment, offices, labs, etc. for EAF/LRF only.	4.0000 (L.S.)	\$80.0	\$145.23	1.0543	\$153.12 \$20.56	\$173.68
FURNA WT.% I URATEC COBE/MII CTRIC A OUTS	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON IRON UNIT INPUT: INDURATED PELLET PRODUCTION: KOBE/MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-1. Same as C-1. Same as C-1. Same as C-1. Same as C-1.	0.4860		\$46.72 \$145.23 \$80.96 \$45.00	0.7612 0.3527 1.0541 1.0000 0.7364	\$35.56 \$51.22 \$85.34 \$45.00	\$231.85
FURNA WT.% D URATED OBE/MIC CTRIC A OUTSI	TO EAF, 2.5 WT.% DRI CARBON INDURATED PELLET PRODUCTION: Same as C-1. KOBE/MIDREX SHAFT FURNACE: Same as C-1. ELECTRIC ARC STEELMAKING/LRF: Same as C-1. OUTSIDE BOUNDARY LIMITS: Same as C-1. SCRAP RECEIVING/HANDLING: Same as C-3.	Same as C-1. Same as C-1. Same as C-1. Same as C-1. Same as C-1.	0.4863		\$46.72 \$145.23 \$80.96 \$45.00 \$20.00	0.7615 0.3584 1.0542 1.0000 0.7364	\$35.57 \$52.05 \$85.35 \$45.00 \$14.73	\$232.70
FT FUR , HOT D JRATED HY	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF IRON UNIT INPUT: INDURATED PELLET PRODUCTION: HYLIVM SHAFT FURNACE:	Same as C-1. Same as C-1. Composite of two Vendor quotations for similar scope.	1.4650	\$612.0	\$46.72 \$145.71 \$139.56	1.7807	\$83.19	
CTRIC A OUTSI	ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-1. Same as C-1.		AVERAGE:	\$142.64 \$80.96 \$45.00	1.0450 1.0543 1.0000	\$149.05 \$85.36 \$45.00	\$362.60

İ	PROCESS	BASIS FOR COST	COST PER ANN CAPACITY (MM mt/yr)	COST PER ANNUAL MT LIQUID STEEL PRODUCTION CAPACITY INSTALLED COST PER mt UI (MM mt/yr) COST(1) ANNUAL mt mt LIC	STEEL PRODU COST PER ANNUAL mt	mt UNIT/	UNIT CST./	TOTAL
TAL	HOT METAL VARIATIONS							
30% SCR	ACE HO	DUCT COKE IRON UNIT INPUT: Lump ore, Pellets, Sinter, Scrap, etc. delivered to stockpiles with reclaim and handling systems inclined in OSBI.	0.1054 0.2097 0.2097 0.0337					
	INTEGRATED BLAST FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	ш 0) 0) 0)	2.3100	\$635.00	\$275.00 \$80.96 \$45.00 \$20.00	0.3584 1.0542 1.0000 0.7364	\$98.56 \$85.35 \$45.00 \$14.73	\$243.64
30% SCI	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE (MINI BLAST FURNACE FOR REFERENCE) IRON UNIT INPUT: MINI BLAST FURNACE FACILITY: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-7. Based on Vendor quotation. Same as C-1. Same as C-1.	0.9000	\$133.05	\$147.83 \$80.96 \$45.00 \$20.00	0.3584 1.0540 1.0000 0.7366	\$52.98 \$85.33 \$45.00 \$14.73	\$198.05
30% SC	SCRAP TO EAF, N.R. COKE SCRAP TO EAF, N.R. COKE IRON UNIT INPUT: INTEGRATED BLAST FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-7. Same as C-7. Same as C-1. Same as C-1.			\$275.00 \$80.96 \$45.00 \$20.00	0.3584 1.0540 1.0000 0.7366	\$98.56 \$85.33 \$45.00 \$14.73	\$243.63
30% TO	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG IRON UNIT INPUT: INTEGRATED BLAST FURNACE: PIG IRON CASTING/HANDLING: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-7. Same as C-7. Based on Vendor quotation. Same as C-1. Same as C-1.	3.5600	\$44.0	\$275.00 \$12.36 \$80.96 \$45.00 \$20.00	0.3584 0.3584 1.0540 1.0000 0.7366	\$98.56 \$4.43 \$85.33 \$45.00 \$14.73	\$248.06

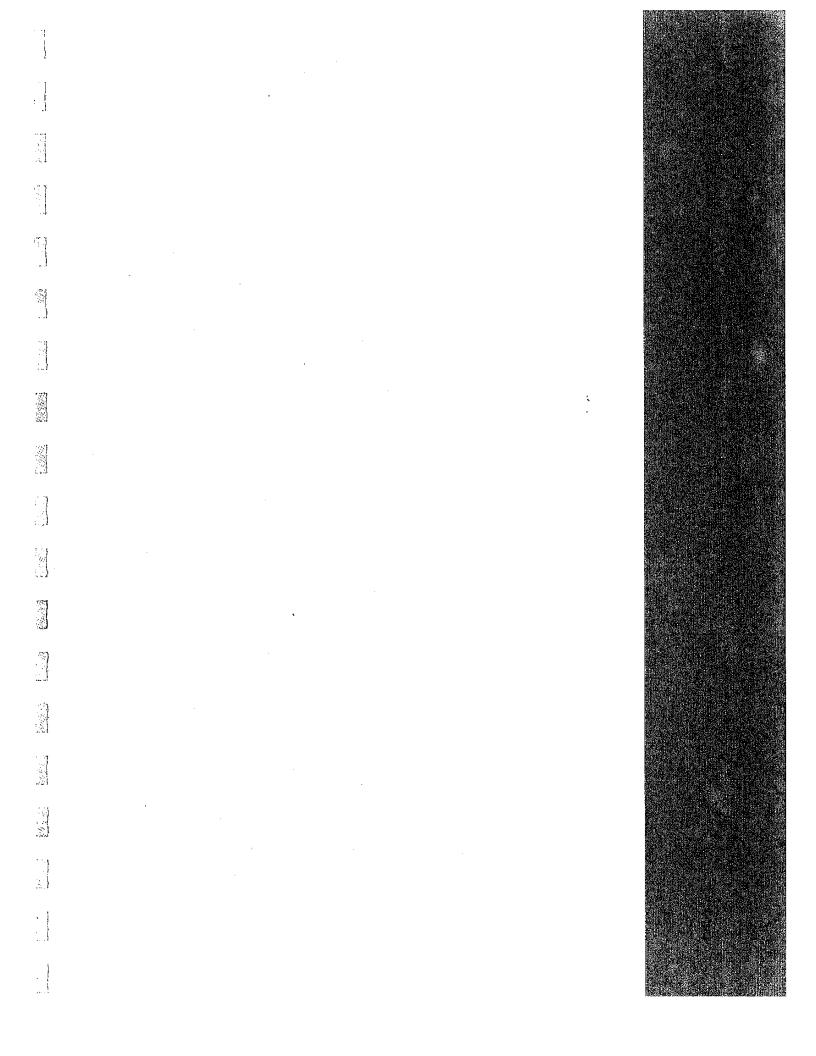
C-10 30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH COGENERATION TO EAF, WITH CO	SEQ.	PROCESS		COST PER ANNUAL MT LIQUID STEEL PRODUCTION	UAL MT LIQUID	STEEL PROD(JCTION		
100 EAF WITH CO-GENERATION 100 one fines received into 100 EACH INPUT (AS FINE ORE) internal LOE cost estimate for 100 GENERATION internal LOE cost estimate for 100 GENERATION internal LOE cost estimate for 100 GENERATION internal LOE cost estimate for 100 GENERATION internal LOE cost estimate for 100 GENERATION internal LOE cost estimate for 100 GENERATION internal LOE estimate. 100 GENERATION internal LOE e	Š.		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	UNIT CST./ mt LIQ. ST.	TOTAL
TECHNORED FURNACE & ANCILLARIES Confidential client.	C-10	30% TECN TO EAF, W	Iron ore fines received into						
TECHNORED FURNACE & ANCILLARIES Internal LGE cost estimate for confidential client. CO-GENERATION Internal LGE cost estimate for confidential client. CO-GENERATION Internal LGE cost estimate for confidential client. 0.3020		MOTONIA COURT TO LIAM MITTON	stockpiles with reclaim systems to green-ball pelletizing.	0.5080					
CO-GENERATION Internal LGE cost estimate for confidential client.		GREEN-BALL PELLE PRODUCTION:	internal LGE cost estimate for confidential client.	0.3020	\$14.1	\$46.62	0.6377	\$29.73	
CO-GENERATION: Internal LGE cost estimate for onfidential client. Confidential client		TECHNORED FURNACE & ANCILLARIES:	Internal LGE cost estimate for confidential client.	0.3020	\$29.5	\$97.59	0.3584	\$34.98	
ELECTRIC ARC STEELMAKING/LRF: Based on internal LGE estimate.		CO-GENERATION:	Internal LGE cost estimate for confidential client.	0.3020	\$7.4	\$24.57	0.3584	\$8.81	
TO EAF, WITHOUT CO-GENERATION TO EAF, WITHOUT CO-GENERATION TO EAF, WITHOUT CO-GENERATION TO EAF, WITHOUT CO-GENERATION TO GREEN WITHOUT CO-GENERATION GREEN SAME as C-10. TECHNORED FURNACE & ANCILLARIES: Same as C-10. TECHNORED FURNACE & ANCILLARIES: Same as C-10. OUTSIDE BOUNDARY LIMITS: Same as C-3. COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX): Iron ore as lump and as pellets are purchased. COREX FURNACE & ANCILLARIES: Based on Vendor quotation. MIDREX SHAFT FURNACE: Same as C-1. MIDREX SHAFT FURNACE: Same as C-1. OUTSIDE BOUNDARY LIMITS: Same as C-1. COREX FURNACE & ANCILLARIES: Based and Vendor quotation. OUTSIDE BOUNDARY LIMITS: Same as C-1. COREX FURNACE & STEELMAKING/LRF: Same as C-1. OUTSIDE BOUNDARY LIMITS: Same as C-1.			Based on internal LGE estimate. Same as C-1. Same as C-3.	1.2500	\$75.0	\$60.00 \$45.00 \$20.00	1.0540 1.0000 0.7366	\$63.24 \$45.00 \$14.73	\$196.48
TECHNORED FURNACE & ANCILLARIES: Same as C-10. ELECTRIC ARC STEELMAKING/LRF: Based on internal LGE estimate. OUTSIDE BOUNDARY LIMITS: Same as C-1. SCRAP RECEIVING/HANDLING: Same as C-3. COREX/MIDREX WITH 60% HOT METAL. 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX): Iron ore as lump and as pellets MIDREX SHAFT FURNACE: Iron ore pellets are purchased. COREX FURNACE & ANCILLARIES: Based on Vendor quotation. MIDREX SHAFT FURNACE: Same as C-1. ELECTRIC ARC STEELMAKING/LRF: Same as C-1. OUTSIDE BOUNDARY LIMITS: Same as C-1.	C-11	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION:	Same as C-10. Same as C-10.	0.5080	& 4.	\$46.62	0.6377	\$29.73	
COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX): Iron ore as lump and as pellets MIDREX SHAFT FURNACE: Iron ore pellets are purchased. COREX FURNACE & ANCILLARIES: Based on Vendor quotation. MIDREX SHAFT FURNACE: Same as C-1. ELECTRIC ARC STEELMAKING/LRF: Same as C-1.			Same as C-10. Based on internal LGE estimate. Same as C-1.	0.3020	\$29.5	\$97.68 \$60.00 \$45.00	0.3584 1.0540	\$55.01	
40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX): Iron ore as lump and as pellets MIDREX SHAFT FURNACE: Iron ore pellets are purchased. COREX FURNACE & ANCILLARIES: Based on Vendor quotation. MIDREX SHAFT FURNACE: Same as C-1. ELECTRIC ARC STEELMAKING/LRF: Same as C-1. OUTSIDE BOUNDARY LIMITS: Same as C-1.	9	SCRAP RECEIVING/HANDLING:	Same as C-3.			\$20.00	0.7366	\$14.73	\$187.71
lron ore pellets are purchased. 0.7124 Based on Vendor quotation. 0.3020 \$104.1 \$ Same as C-1. \$17.8 \$ Same as C-1.	C-12	COREX/MIDREX 40% DRI CHARG	ron ore as lump and as pellets	0.4313					
Same as C-1.		MIDREX SHAFT FURNACE: COREX FURNACE & ANCILLARIES: MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF:	re on a purchased basis. ron ore pellets are purchased. Based on Vendor quotation. Same as C-1.	0.7124 0.3020 0.1480	\$104.1	\$344.83 \$120.00 \$60.00	0.6237 0.4180 1.0545	\$215.07 \$50.16 \$63.27	
			same as C-1.			\$45.00	1.0000	\$45.00	\$373.50

	TOTAL SCOPE	\$259.63						\$334.67	\$292.32
	UNIT CST./ mt LIQ. ST.	\$114.52 \$85.37 \$45.00 \$14.73	_		\$48.16	\$140.03	\$41.28	\$60.19 \$45.00 \$3.09	\$71.42 \$135.54 \$85.36 \$45.00
JCTION	mt UNIT/ mt LIQ. ST.	0.3585 1.0545 1.0000 0.7366			2.0653	1.0261	0.9112	1.0032 1.0000 0.1544	1.9932 1.1217 1.0543 1.0000
STEEL PRODU	COST PER ANNUAL mt	\$319.45 \$80.96 \$45.00 \$20.00			\$23.32	\$139.67 \$136.76 \$132.98 \$136.47	\$46.36 \$47.06 \$42.50 \$45.31	\$60.00 \$45.00 \$20.00	\$35.83 \$120.83 \$80.96 \$45.00
COST PER ANNUAL MT LIQUID STEEL PRODUCTION	INSTALLED COST(1)	\$116.6		.,		\$42.2 \$465.0 \$166.2 AVERAGE:	\$14.0 \$160.0 \$53.1 AVERAGE:	\$75.0	\$4.3
COST PER ANN	CAPACITY (MM mt/yr)	0.5345		1.4545		0.3020 3.4000 1.2500	0.3020 3.4000 1.2500	1,2500	1.5735 0.1200 0.1200
	BASIS FOR COST	Same as C-10. Based on Vendor quotation. Same as C-1. Same as C-1.		Same as C-10.	Same as C-10 with adjustments.	Based on three Vendor quotations.	Based on three Vendor quotations.	Based on internal LGE estimate. Same as C-1. Same as C-3.	Same as C-10. Based on Vendor quotation. Based on Vendor quotation. Same as C-1. Same as C-3.
PROCESS		HISMELT WITH 32.7% HOT METAL. TO CHARGE TO EAF IRON UNIT INPUT (AS FINE ORE): HISMELT SRV FURNACE: HISMELT SRV FURNACE: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	ROTARY HEARTH FURNACES	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (AS FINE ORE): (ROTARY HEARTH REDUCTION FCE.: 1	SUBMERGED ARC MELTING FURNACE: F	ELECTRIC ARC STEELMAKING/LRF: E OUTSIDE BOUNDARY LIMITS: S SCRAP RECEIVING/HANDLING: 5	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): Same as C-10. GREEN BRIQUETTE PRODUCTION: Based on Vendor quotation. ROTARY HEARTH REDUCTION FCE.: Based on Vendor quotation. ELECTRIC ARC STEELMAKING/LRF: Same as C-1. OUTSIDE BOUNDARY LIMITS: Same as C-3.
SEQ.	Š.	C-13	ROTAR	C-14					

ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.); Same as C-10. GREEN BRIQUETTE PRODUCTION; Same as C-10. GREEN BRIQUETTE PRODUCTION FCE.: Based on Vendor quotation. ELECTRIC ARC STEELMAKING/IRF; Same as C-1. OUTSIDE BOUNDARY LIMITS; Same as C-1. CIRCORED/HBICAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.); Same as C-1. OUTSIDE BOUNDARY LIMITS; Same as C-1. CIRCOFER/HBI/SAFIEAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.); Same as C-1. OUTSIDE BOUNDARY LIMITS; Same as C-1. AIRCOFER/HBI/SAFIEAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.); Same as C-1. FLUIDIZED-BED FINES REDUCTION; Same as C-1. FLUIDIZED-BED FINES REDUCTION; Same as C-1. FLUIDIZED-BED FINES REDUCTION; Same as C-1. FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.); Same as C-1. FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.); Same as C-1. HOT BRIQUETTING; Based on Vendor quotation. HOT BRIQUETTING; Based on Vendor quotation. HOT BRIQUETTING; Same as C-1. HOT BRIQUETTING; Same as C-1. HOT BRIQUETTING; Based on Vendor quotation. HOT BRIQUETTING; Same as C-1.	CH2	PROCESS		COST PER ANNUAL MT LIQUID STEEL PRODUCTION	JAL MT LIQUID	STEEL PROD	UCTION		
MM mutyry COST(1) ANNUAL mt mt Lic	Š		BASIS FOR COST	CAPACITY	INSTALLED	COST PER	mt UNIT/	UNIT CST./	TOTAL
### WITH ONLY (FINE ORE, ETC.); Same as C-10. ### RIMEAR TH ONLY (FINE ORE, ETC.); Same as C-10. ### PRICE ARC STEELMAKINGIARE; Same as C-11. ### PRICE ARC STEELMAKINGIARE; Same as C-11. ### PRICE ARC S	į			(MM mt/yr)	COST(1)	ANNUAL mt	mt LIQ. ST.	mt LIQ. ST.	SCOPE
HBI/EAF WITH ONLY CRAP CHARGE TO EAF UNIT INPUT (FINE ORE, ETC.); Same as C-10. MICRO-PELLET PRODUCTION: Based on Vendor quotation. DIZED-BED FINES REDUCTION: Based on Vendor quotation. CTRIC ARC STEELMAKING/IRF: Same as C-1. MICRO-PELLET PRODUCTION: Same as C-1. MICRO-PELLET PRODUCTION: Same as C-1. MICRO-PELLET PRODUCTION: Same as C-1. MICRO-PELLET PRODUCTION: Same as C-1. MICRO-PELLET PRODUCTION: Same as C-1. MICRO-PELLET PRODUCTION: Same as C-1. MICRO-PELLET PRODUCTION: Same as C-1. MICRO-PELLET PRODUCTION: Based on Vendor quotation. MICRO-PE	C-16	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): GREEN BRIQUETTE PRODUCTION: ROTARY HEARTH REDUCTION FCE.: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-10. Same as C-10 with adjustments. Based on Vendor quotation. Same as C-1. Same as C-3.	0.6000	\$100.0	\$23.32 \$166.67 \$80.96 \$45.00	1.8809 1.0261 1.0032 1.0000	\$43.86 \$171.02 \$81.22 \$45.00	\$296.10
HBIREAF WITH ONLY CRAP CHARGE TO EAF UNIT INPUT (FINE ORE, ETC.): Same as C-10. HOT BRIQUETTING: Based on Vendor quotation. HOT BRIQUETTING: Based on Ven	FLUIF	SED DRI/HBI							
CIRCOFER/HBI/SAF/EAF WITH ONLY	C-17	HBIEAF WITH ONLY CRAP CHARGE TO EAF UNIT INPUT (FINE ORE, ETC.): MICRO-PELLET PRODUCTION: DIZED-BED FINES REDUCTION: HOT BRIQUETTING: CTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-10. Based on Vendor quotation. Based on Vendor quotation. Same as C-1.	1.7905 4.0000 4.0000 4.0000	\$40.0 \$420.0 \$120.0	\$10.00 \$105.00 \$30.00 \$80.96 \$45.00	1.5340 1.0890 1.0890 1.0543	\$15.34 \$114.35 \$32.67 \$85.36 \$45.00	\$232.37
FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF 1.7511 \$40.0 \$10.00 RICRO UNIT INPUT (FINE ORE, ETC.): Based on Vendor quotation. 4.0000 \$649.0 \$162.25 FLUIDIZED-BED FINES REDUCTION: Based on Vendor quotation. 4.0000 \$649.0 \$162.25 HOT BRIQUETTING: Based on Vendor quotation. 4.0000 \$180.0 \$45.00 ELECTRIC ARC STEELMAKING/LRF: Same as C-14. \$335.83 OUTSIDE BOUNDARY LIMITS: Same as C-1. \$30.00	C-18	CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): MICRO-PELLET PRODUCTION: FLUIDIZED-BED FINES REDUCTION: SUBMERGED ARC MELTING FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-10. Same as C-17. Based on Vendor quotation. Same as C-14. Same as C-14.	4.0000	\$466.6	\$10.00 \$116.65 \$45.31 \$60.00 \$45.00	1.5340 1.0890 1.0890 1.0543 1.0000	\$15.34 \$127.03 \$49.34 \$63.26 \$45.00	\$239.63
	2 -2	FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): MICRO-PELLET PRODUCTION: FLUIDIZED-BED FINES REDUCTION: HOT BRIQUETTING: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-10. Based on Vendor quotation. Based on Vendor quotation. Based on Vendor quotation. Same as C-14.	1.7511 4.0000 4.0000 4.0000	\$40.0 \$649.0 \$180.0	\$10.00 \$162.25 \$45.00 \$35.83	1.5091 1.0890 1.0890 1.0543 1.0000	\$15.09 \$176.69 \$49.01 \$37.78 \$30.00	\$263.47

SEO	PROCESS		COST PER ANNUAL MT LIQUID STEEL PRODUCTION	UAL MT LIQUID	STEEL PRODI	ICTION		
Ö.		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	UNIT CST./ mt LIQ. ST.	TOTAL SCOPE
C-20a	C-20a GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF (2) IRON UNIT INPUT (FINE ORE, ETC.); Same as C-10. FLUIDIZED-BED FINES REDUCTION; Based on Vendor quotation. ELECTRIC ARC STEELMAKING/LRF; Same as C-14. OUTSIDE BOUNDARY LIMITS: Same as C-1.	Same as C-10. Based on Vendor quotation. Same as C-14. Same as C-1.	1.7011	\$700.0	\$176.77 \$80.96 \$45.00	1.2289 1.0543 1.0000	\$217.23 \$85.36 \$45.00	\$347.59
C-20b	GENERIC IRON CARBIDE/SAF/EAF 60% SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): FLUIDIZED-BED FINES REDUCTION: SUBMERGED ARC MELTING FURNACE: Same as C-14. ELECTRIC ARC STEELMAKING/LRF: Same as C-14. OUTSIDE BOUNDARY LIMITS: Same as C-1. SCRAP RECEIVING/HANDLING: Same as C-1.	Same as C-10. Based on Vendor quotation. Same as C-14. Same as C-14. Same as C-1.	0.6804 3.9600	\$700.0	\$176.77 \$45.31 \$60.00 \$45.00 \$20.00	0.4916 1.0890 1.0543 1.0000	\$86.90 \$49.34 \$63.26 \$45.00 \$12.75	\$257.24
OTHER	OTHER PROCESSES							
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): Same as C-10. GREEN-BALL PELLET PRODUCTION: Same as C-10. FLUIDIZED-BED FINES REDUCTION: Based on Vendor quotation. ELECTRIC ARC STEELMAKING/LRF: Same as C-14. OUTSIDE BOUNDARY LIMITS: Same as C-1. SCRAP RECEIVING/HANDLING: Same as C-3.	Same as C-10. Same as C-10. Based on Vendor quotation. Same as C-14. Same as C-1.	1.3560	\$350.0	\$46.62 \$125.00 \$80.96 \$45.00 \$20.00	2.0137 0.9365 1.0543 1.0000	\$93.88 \$117.06 \$85.36 \$45.00 \$3.09	\$344.39

NOTE: (2) 100% IC CHARGE HAS NOT BEEN PROVEN TO BE FEASIBLE.



APPENDIX F-6 SORTING OF PROCESSES

BY CAPITAL COSTS/ANNUAL MT L.S.

BY IRON UNIT COSTS/MT I.U.

BY OPERATING COST/MT L.S.

BY INTERNAL RATE OF RETURN

BY TOTAL ELECTRICAL POWER REQUIRED

BY TOTAL CUMULATIVE CO₂ EMISSIONS - PROCESS ONLY

BY TOTAL CUMULATIVE CO₂ EMISSIONS - TOTAL INCLUDING ELECTRICAL POWER GENERATION

F-6 Sorting of Processes

In order to compare the merits of each of the Ironmaking Processes considered (i.e. 21 total processes through Refined Liquid Steel production) with each other on an equalized basis, a Sorting and Ranking procedure was utilized. The procedures utilized are described below and in Appendix G:

Sort on Variables

The following specific variables (from the previous Appendix F sections) for each process were utilize to sort and rank the processes:

- Capital Costs (CAPEX, as \$/annual metric tonne Liquid Steel product)
- Operating Costs to produce Iron Units (OPEX I.U. as \$/metric tonne iron product to EAF steelmaking)
- Operating Costs to produce Refined Liquid Steel (OPEX L.S. as \$/metric tonne Refined Liquid Steel product)
- Simple Internal Rate of Return (I.R.R. based on a \$250 in-process value/metric tonne Liquid Steel product, all CAPEX in year 1 and full production for years 2-21)
- Total Electric Power (Cumulative total electric power consumption for all sub-processes to produce the Refined Liquid Steel product for each alternative)
- Total Cumulative CO₂ Emissions for the Process only (all fuel gas and carbon component emissions for all of the sub-processes, expressed as the CO₂ equivalent through the Refined Liquid product)
- Total Cumulative CO₂ Emissions (the sum of the Process CO₂ emissions and the equivalent CO₂ emissions for the Total Electric Power required) (Reference Appendix A3.1 based on North American average generation fuel distributions)

The various Alternative Ironmaking Processes were resequenced such that minor variations of specific processes considered (e.g. 2.5 wt.% carbon DRI, Appendix C-2 and C-4) were not considered in the sorting and ranking. The listings of the processes were sorted by the index variables above based on these resequenced tabulations.

These sorted listings were grouped into three groupings for each variable:

- LOWEST THIRD A grouping of the lowest seven processes by the variable of interest.
- MIDDLE THIRD A grouping of the middle seven processes by the variable of interest.
- HIGHEST THIRD A grouping of the highest seven processes by the variable of interest.

Within each grouping, the processes are in sequence with the lowest first and the highest last. Thus the first process sorted in the Lowest Group (for all variables except the I.R.R.) would be the "best" process by that index variable. Similarly, the last process in the Highest Group (except for the I.R.R.) would be the "worst" process by that index variable. By examining the processes in each grouping some consensus as to the most desirable and perhaps the least desirable Alternative Ironmaking Processes might be gained (based on the index variable sensitivities).

Since the cost-related variables of OPEX L.S. and the I.R.R. are a significant function of the Steel Scrap Price, sensitivities for these variables at \$100, \$120 and \$140 per metric tonnes of steel scrap were done to clarify the impact of this key sub-variable (Reference Appendix F1.10).

The tabulations for each of these sorts are provided in this section.

CAPITAL AND OPERATING COST ESTIMATES - IRONMAKING PROCESSES

NO.	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE
NO.	***************************************	(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN
SHAFT FI	URNACE DRI PROCESSES:				
	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON	\$365.36	\$132.44	\$205.39	10.57%
	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON	\$365.45	\$132.55	\$206.42	10.22%
C-3	100% STEEL SCRAP CHARGE TO EAF	\$173.68	\$0.00	\$197.39	30.14%
1	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON	\$231.85	\$137.51	\$203.36	19.55%
	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON	\$232.70	\$136.14	\$204.72	18.84%
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF	\$362.60	\$125.52	\$196.15	13.72%
HOT ME	TAL VARIATIONS				
C-7	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	\$243.64	\$142.86	\$204.39	18.04%
C-7a	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, MINI BLAST FURNACE	\$198.05	\$142.86	\$204.39	22.64%
C-8	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	\$243.63	\$110.77	\$192.97	23.04%
C-9	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	\$248.06	\$145.12	\$212.79	13.89%
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION	\$196.48	\$125.95	\$192.41	29.14%
C-11	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION	\$187.71	\$163.09	\$205.72	23.23%
C-12	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF	\$373.50	\$208.88	\$228.34	1.46%
C-13	HISMELT WITH 32.7% HOT METAL TO CHARGE TO EAF	\$259.63	\$137.85	\$198.19	19.38%
ROTARY	/ HEARTH FURNACES				
C-14	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$334.67	\$101.83	\$190.67	16.96%
C-15	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$292.32	\$66.44	\$177.03	24.66%

CAPITAL AND OPERATING COST ESTIMATES - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	CAPEX (\$/ANN. mt L.S.)	OPEX FOR I.U. (\$/ANN. mt I.U.)	OPEX FOR L.S. (\$/ANN. mt L.S.)	INTERNAL RATE OF RETURN
C-16	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$296.10	\$67.60	\$181.12	22.89%
FLUID-E	BED DRI/HBI				
C-17	CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$232.37	\$78.79	\$185.27	27.64%
C-18	CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$239.63	\$96.20	\$188.55	25.37%
C-19	FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$263.47	\$79.42	\$185.12	24.31%
C-20a	GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF (2)	\$347.59	\$66.19	\$177.84	20.24%
C-20b	GENERIC IRON CARBIDE/SAF/EAF 60% SCRAP CHARGE TO EAF	\$257.24	\$100.79	\$192.65	21.87%
OTHER	PROCESSES				
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$344.39	\$74.08	\$183.10	18.81%

NOTES: (1) Operating costs based on purchased scrap composite price of \$120/mt.

\$250.00

⁽²⁾ Sales (or transfer) price of Liquid Steel taken to be (\$/mt).

⁽³⁾ Internal Rate of Return Scenario based on 1.00 MM mt/year production of liquid refined steel (as caster feed). Project life is 21 years and all Capital investment is in year 1, with full production and revenue in years 2 through 21.

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - RESEQUENCED (BASIS: 1,00 MM mt Liquid Steel Per Year, \$120/mt Steel Scrap Cost)

		(BASIS: 1.00 MM mt I	.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST	/EAR, \$120/mt S1Et	L SCRAP COST)			
SEO	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Š	· · · · · · · ·	(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
	1 100% DRI 1 0% C. MIDREX	\$365,36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
	2 100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
	3 30% DRI 1 0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
		\$362.60	\$125.52	\$196.15	13.72%	1,267.37	9806'0	2.0646
	5 30% BE H M /70% SCRAP CP COKE	\$243,64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
		\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
		\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
	A 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
		\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
- 7	O 30% TECNORED H M W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	1.1545	1.7799
÷		\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839
- *	9 HISMEI T 32 7% H M	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
- ÷		\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
_		\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
_	I CIRCORED/HBI/FAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
-		\$239,63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
· ~		\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
_		\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
~ ~	0 GENERIC I C (40%)/SAF/EAF*	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
	3 SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
'								

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORTED ON CAPEX

		(BASIS: 1.00 MM mt l	.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST	/EAR, \$120/mt STE	EL SCRAP COST)			
SEQ.	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Š.		(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
LOWES	OWEST THIRD							
	2 100% STEEL SCRAP	\$173.68	\$0.00	8197.39	30.14%	822.45	0.0874	0.8909
	10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	692.69	1.1545	1.7799
	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
	6 30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
	3 30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
~	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
	17 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188,55	25.37%	780.99	1.6404	2.3528
MIDDLE	MIDDLE THIRD							
	7 30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
~	20 GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
-	18 FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
-	14 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
HIGHE	HIGHEST THIRD							
\ <u></u>	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
-	13 REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
2	21 SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
	HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
	1 100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
-	COREX/MIDREX WITH 60% H.M.	\$373.50	\$208.88	\$228.34	1.46%	942.91	3.1398	3.9998

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON I.U. OPEX

SEQ. PROCESS CAP NO. LOWEST THIRD 2 100% STEEL SCRAP 4 MAUMEE BRIQUETTE DRI/EAF 5 ITMK3 DR SHOT TO EAF 5 ITMK3 DR SHOT TO EAF 6 CIRCORED/HBI/EAF 7 CIRCORED/HBI/EAF 8 FINMET/HBI/EAF 1 CIRCOFER/HBI/SAF/EAF 1 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 1 REDSMELT 20 GENERIC I.C. (40%)/SAF/EAF 3 30% DRI, 1.0% C, MIDREX 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX 1 HIGHEST THIRD 3 30% DRI, 1.0% C, MIDREX 1 CIRCORED H.M. GOKRAP 1 CIRCORED H.M. SCRAP CP COKE 3 30% DRI, 1.0% C/70% SCRAP 3 30% COLD PIG IRON/70% SCRAP 5 30% BF H.M.770% SCRAP 6 30% MINI-BF H.M. GOM, H.M. 1 CORFXMIDREX WITH 60% H.M.	CASIS. 1.00 MIN HILL	ואלטוט טובבר רבת ו	JUD MIM MI EIGUID STEEL PER TEAR, \$120/MI STEEL SCRAP COST	L SURAP COST)			
STEEL SCRAP RIC IRON CARBIDE (100%)/EAF EE BRIQUETTE DRI/EAF DR SHOT TO EAF ROTARY KILN RED/HBI/EAF T/HBI/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC III.C. (40%)/FAF/EAF AIC III.C. (40	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
LOWEST THIRD 2 100% STEEL SCRAP 19 GENERIC IRON CARBIDE (100%)/EAF 15 ITMK3 DR SHOT TO EAF 21 SURN ROTARY KILN 16 CIRCORED/HBI/EAF 17 CIRCORED/HBI/SAF/EAF 18 FINMET/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 17 CIRCOFER/HBI/SAF/EAF 21 REDSMELT 22 GENERIC I.C. (40%)/SAF/EAF 23 GENERIC I.C. (40%)/SAF/EAF 14 CIRCOFER/HBI/SAF/EAF 16 GONERIC I.C. (40%)/SAF/EAF 17 GONERIC I.C. (40%)/SAF/EAF 18 REDSMELT 19 REDSMELT 19 GON DRI, 1.0% C/70% SCRAP 11 GOW DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 13 30% DRI, 1.0% C/70% SCRAP 14 GONERIC I.C. (40%)/SCRAP 15 GONE FH.M./70% SCRAP 16 GONE FH.M./70% SCRAP 16 GONE FYMIDREX WITH 60% H.M.	(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
2 100% STEEL SCRAP 19 GENERIC IRON CARBIDE (100%)/EAF 14 MAUMEE BRIQUETTE DRI/EAF 15 ITMK3 DR SHOT TO EAF 21 SL/RN ROTARY KILN 16 CIRCORED/HBI/EAF 17 CIRCORED/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 21 SL/RN FOTARY KILN 17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 21 SL/RN FOTARY KILN 21 REDSMELT 22 GENERIC I.C. (40%)/SAF/EAF 23 GENERIC I.C. (40%)/SAF/EAF 24 HYLSA IVM 25 30% BF H.M./70% SCRAP 27 HIGHEST THIRD 28 30% COLD PIG IRON/70% SCRAP 29 30% MINI-BF H.M. 6 30% MINI-BF H.M. 6 30% MINI-BF H.M. 6 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	į						
19 GENERIC IRON CARBIDE (100%)/EAF 14 MAUMEE BRIQUETTE DRI/EAF 15 ITMK3 DR SHOT TO EAF 21 SL/RN ROTARY KILN 16 CIRCORED/HBI/EAF 17 CIRCORED/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 21 SL/RN FOTARY KILN 17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 21 SL/RN FOTARY KILN 21 CIRCOFER/HBI/SAF/EAF 22 GENERIC I.C. (40%)/SAF/EAF 23 GENERIC I.C. (40%)/SAF/EAF 24 HYLSA IVM 25 30% BF H.M.70% SCRAP 26 30% MINI-BF H.M. 26 30% MINI-BF H.M. 27 30% COLD PIG IRON/70% SCRAP 28 30% COLD PIG IRON/70% SCRAP 29 30% COLD PIG IRON/70% SCRAP 20 30% COLD PIG IRON/70% SCRAP 21 COREX/MIDREX WITH 60% H.M.	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
14 MAUMEE BRIQUETTE DRI/EAF 15 ITMK3 DR SHOT TO EAF 21 SL/RN ROTARY KILN 16 CIRCORED/HBI/EAF 18 FINIMET/HBI/EAF 20 GENERIC I.C. (40%)/SAF/EAF 17 CIRCOFER/HBI/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA NM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C, MIDREX 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
15 ITMK3 DR SHOT TO EAF 21 SL/RN ROTARY KILN 16 CIRCORED/HBI/EAF 18 FINIMET/HBI/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C, MIDREX 12 HISMELT 32.7% H.M. 6 30% MIN-BF H.M. 5 30% BF H.M./70% SCRAP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
21 SL/RN ROTARY KILN 16 CIRCORED/HBI/EAF 18 FINIMET/HBI/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA NW 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
16 CIRCORED/HBI/EAF MIDDLE THIRD 17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
MIDDLE THIRD 17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
MIDDLE THIRD 17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINH-BF H.M. 5 30% BF H.M./70% SCRAP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.							
20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
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HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINLBF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
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VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON L.S. OPEX

i		(BASIS: 1.00 MM mt	BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST	/EAR, \$120/mt STE	EL SCRAP COST)			
SEQ.	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Š.		(\$/ANN. mt L.S.)	(\$/ANN, mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
LOWES	LOWEST THIRD							
7	14 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
<u>~</u>	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
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=	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
1,	17 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
MIDDLE	MIDDLE THIRD							
1	13 REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
7	20 GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
	7 30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
וא	2 100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
12	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
HIGHES	HIGHEST THIRD							
6.3	3 30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
47	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
9		\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
_	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
5	10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	1.1545	1.7799
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
11	11 COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON I.R.R.

		(BASIS: 1.00 MM mt	.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST	'EAR, \$120/mt STE	EL SCRAP COST)			
SEQ.	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
NO.		(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
HIGHES	HIGHEST THIRD							
. 1	2 100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
<u></u>	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
1,	7 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
*	14 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
1	18 FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	97.76	1.0742	1.9022
	7 30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
MIDDLE	MIDDLE THIRD							
16	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
	6 30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
25	20 GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
10	10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	1.1545	1.7799
	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
(1)	3 30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
12	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
LOWES	LOWEST THIRD							
21	21 SIJRN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
-CD	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
13	13 REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
8	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
4	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
_	1 100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
11	11 COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON TOTAL ELECTRICITY (RANGING OF IROUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

		DACIC: 4 00 MM6 mt	ON MARK mut I SOUTH STEEL PER YEAR, \$120/mt STEEL SCRAP COST)	(EAR. \$120/mt STEI	EL SCRAP COST)			14101
		(DASIS, 1.00 mm mic	OPEX FOR 111	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	IOIAL COZ
SEQ.	PROCESS	CAPEX	CPEALORIES:	(\$/ANN, mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
Š		(\$/ANN, IIII L.O.)	(A) WINE THE THE					
S II/VIC	OWEST THIRD			77 0078	30 1/%	307.58	1.1545	1.4350
֡֝֞֝֝֟֝֝֟֝֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֡֓֓֓֓֓֡֓֓֡֓֓֡֓֡֓֡֓	O TONOBED H M W COGEN	\$196.48	\$125.95	\$192.41	29.1470	25 099	0 9594	1.5615
	9 30% LECIONED THIS A COURT	\$243 G3	\$110.77	\$192.97	23.04%	000.00	- 1	4 7700
_	7 30% BF H.M./70% SCKAP NK CONE	\$2.000 \$4.000 14.000	¢163 09	\$205.72	20.25%	685.69	1.1545	6677
_	10 30% TECNORED H.M. W/O COGEN	17.7818	6103.00	\$190.67	16.96%	690.28	1.3624	1.9921
_	13 REDSMELT	\$334.67	Co.101¢	¢188.55	25.37%	780.99	1.6404	2.3528
	17 CIRCOFER/HBI/SAF/EAF	\$239.63	07.98\$	#106.33	18.04%	795.44	0.8974	1.6746
	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39 \$204.39	22.64%	795.44	0.8974	1.6746
	6 30% MINI-BF H.M.	\$198.05	\$142.80	9704:00				
	MINDA E THIRD				707 1 00	822 45	0.0874	0.8909
MIDDE	A ADDA OTER CODAD	\$173.68	\$0.00	82.781	30.1470	07.770	1 5213	2.2742
	Z 100% STEEL SCINAL	\$296.10	\$67.60	\$181.12	77.89%	04.070	0.70.0	1 6418
	15 TMK3 DR SHOT TO EAF	\$1.007 \$1.00	\$137.85	\$198.19	19.38%	847.37	0.8089	1.0410
,	12 HISMELT 32.7% H.M.	\$239.05	478 70			900.84	1.1999	2.0217
	16 CIRCORED/HBI/EAF	\$232.37	910.19			907.76	1.0742	1.9022
	18 FINMET/HBI/EAF	\$263.47	24.874		5 72%		2.9239	3.7839
	11 COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83		24.66%	966.09	1.1498	2.0310
	14 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$00.44					
בונים	HIGHEST THIRD				20 24%	972.95	1.2864	2.1738
	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	#177.04 #183.10		999.74	2.2869	3.1988
	21 SL/RN ROTARY KILN	\$344.39	\$74.08			•	0.9027	1.8170
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12				0.4283	1.3681
	2 30% DRI 1 0% C/70% SCRAP	\$231.85	\$137.51					2.0648
	OCALINED TO AND VISABILITY OF THE AF	\$257.24	\$100.79			,	_	2 0646
_	ZU GENENIC I.C. (40/0/c) ii ref ii	\$362.60	\$125.52	\$196.15		16.102,1	0.0000	7 2817
	4 HYLSA IVM	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2011
	1 100% DRI, 1.0% C, MIDREA							

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON PROCESS CO2 (BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

OH CH	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	PEX OPEX FOR I.U. OPEX FOR L.S. INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Š Š		(\$/ANN. mt L.S.)	(\$/ANN, mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
LOWES	OWEST THIRD							
2	2 100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
	3 30% DRI. 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
15	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%		0.8689	1.6418
. rc	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
. <u>.</u>	6 30% MINEBF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
, 4	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
MIDDLE THIRD	THIRD							
	7 30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
	100% DRI. 1.0% C. MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
- <u>«</u>	18 FINMET/HBI/FAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
7	A MALIMEE BRIGHETTE DRIVEAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
	10 30% TECNOBED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	692.69	1.1545	1.7799
2 0	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1,1545	1.4350
16	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
HIGHES	HIGHEST THIRD							
19	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
20	20 GENERIC LC. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
13	13 REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
17	17 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
	21 SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
-	14 CODEX MIDBEX WITH 60% H M	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - TOTAL CUMULATIVE CO2

2.0217 2.0310 2.0646 2.2742 2.3528 2.1738 3.1988 2.2617 1.4350 1.5615 1.6418 1.6746 1.6746 1.8170 1.9022 1.9921 2.0648 0.8909 1.3681 TOTAL CO2 (mt/mt LS) 1.0514 1.5213 1.6404 2.2869 2.9239 1.1545 0.9027 1.0742 1.3624 1.1999 1.1498 9806.0 .3320 1.2864 PROCESS CO2 1.1545 0.9594 0.8689 0.8974 0.0874 0.4283 0.8974 (mt/mt LS) 780.99 999.74 942.91 972.95 690.28 966.09 795.44 002.39 907.76 900.84 ,267.37 326.73 825.40 795.44 1185.22 822.45 1,030.37 307.58 660.35 847.37 685.69 TOTAL ELEC. (kWhr/mt LS) 18.81% 5.72% 10.57% 25.37% 24.31% 27.64% 24.66% 13.72% 20.24% 22.89% 18.04% 13.89% 16.96% 19.55% 29.14% 19.38% 22.64% 20.25% 23.04% 21.87% INTERNAL RATE 30.14% (BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

CAPEX | OPEX FOR I.U. | OPEX FOR L.S. | INTERNAL RATE OF RETURN \$196.15 \$185.12 \$185.27 \$177.03 \$192.65 \$177.84 \$183.10 \$205.39 \$181.12 \$188.55 \$218.16 \$203.36 \$192.41 \$204.39 \$198.19 \$204.39 \$192.97 \$212.79 \$190.67 (\$/ANN. mt L.S.) \$197.39 \$74.08 \$161.83 \$132.44 \$67.60 \$96.20 \$66.19 \$163.09 \$145.12 \$0.00 \$142.86 \$79.42 \$78.79 \$66.44 \$125.52 \$100.79 \$137.51 \$110.77 \$125.95 \$137.85 \$142.86 \$101.83 (\$/ANN. mt I.U.) \$347.59 \$365.36 \$296.10 \$344.39 \$373.50 \$232.37 \$292.32 \$248.06 \$362.60 \$257.24 \$239.63 \$231.85 \$196.48 \$243.63 \$259.63 \$334.67 (\$/ANN. mt L.S.) \$173.68 \$243.64 \$187.71 \$263.47 \$198.05 GENERIC IRON CARBIDE (100%)/EAF 30% BF H.M./70% SCRAP NR COKE 30% BF H.M./70% SCRAP CP COKE 30% TECNORED H.M. W/O COGEN 30% COLD PIG IRON/70% SCRAP COREX/MIDREX WITH 60% H.M. 9 30% TECNORED H.M. W COGEN MAUMEE BRIQUETTE DRI/EAF GENERIC I.C. (40%)/SAF/EAF 30% DRI, 1.0% C/70% SCRAP 100% DRI, 1.0% C, MIDREX 15 ITMK3 DR SHOT TO EAF CIRCOFER/HBI/SAF/EAF PROCESS SL/RN ROTARY KILN HISMELT 32.7% H.M. CIRCORED/HBI/EAF 100% STEEL SCRAP 30% MINI-BF H.M. FINMET/HBI/EAF HYLSA IVM REDSMELT HIGHEST THIRD LOWEST THIRD MIDDLE THIRD 7 19 20 9 8 3 2 9 8 16 SEQ.

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - RESEQUENCED (BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

		(BASIS: 1.00 MM mt I	(BASIS: 1.00 MM mt LIQUID STEEL PER YEAK, \$100/mt STEEL SCRAP COST)	CEAR, \$100/mt 51E	IL SCRAP COST)			
OH.	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Š		(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
							÷	
•	1 100% DRI 1 0% C. MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
	2 100% STEFI SCRAP	\$173.68	\$0.00	\$176.83	42.09%	822.45	0.0874	0.8909
	3 30% DRI 1 0% C/70% SCRAP	\$231.85	\$137.51	\$188.64	26.21%	1,030.37	0.4283	1.3681
. 7	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	9806.0	2.0646
	5 30% BF H M /70% SCRAP CP COKE	\$243.64	\$142.86	\$189.65	24.46%	795.44	0.8974	1.6746
	6 30% MINI-BF H.M.*	\$198.05	\$142.86	\$189.65	30.32%	795.44	0.8974	1.6746
		\$243.63	\$110.77	\$178.23	29.28%	660.35	0.9594	1.5615
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$198.05	20.43%	1002.39	0.9027	1.8170
	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$177.67	36.74%	307.58	1.1545	1.4350
-	10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$190.98	31.30%	685.69	1.1545	1.7799
		\$373.50	\$161.83	\$218.17	5.72%	942.91	2.9239	3.7839
	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$190.82	22.39%	847.37	0.8689	1.6418
	13 RFDSMELT	\$334.67	\$101.83	\$188.31	17.73%	690.28	1.3624	1.9921
7	14 MAI IMEE BRIOUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
- 1	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$178.76	23.72%	825.40	1.5213	2.2742
	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
- 12	17 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
~	18 FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	92'.106	1.0742	1.9022
	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
~ ~	20 GENERIC I.C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$179.90	27.02%	1185.22	1.3320	2.0648
i &	21 SU'RN ROTARY KILN	\$344.39	\$74.08	\$180.74	19.55%	999.74	2.2869	3.1988

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON L.S. OPEX

1.7799 1.8170 3.7839 1.6746 .6746 2.0310 1.4350 2.1738 1.5615 2.2742 2.0648 1.9022 2.0217 1.9921 2.3528 1.3681 0.8909TOTAL CO2 (mt/mt LS) 0.8689 1.1545 0.9086 1.0514 2.9239 1.1999 1.3624 0.4283 0.8974 0.9027 1.5213 PROCESS CO2 1.1545 .2864 0.9594 1.3320 1.0742 1.1498 2.2869 0.0874 (mt/mt LS) ,326.73 685,69 1002.39 780.99 ,267.37 690.28 1,030.37 795.44 795.44 847.37 907.76 900.84 660.35 825.40 999.74 822.45 966.09 307.58 972.95 TOTAL ELEC. 185.22 (kWhr/mt LS) 30.32% 22.39% 31.30% 20.43% 10.57% 5.72% 27.64% 17.73% 25.37% 26.21% 20.24% 29.28% 23.72% 19.55% 24.31% 24.46% 42.09% 24.66% 27.02% 13.72% 36.74% (BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

CAPEX | OPEX FOR I.U. | OPEX FOR L.S. | INTERNAL RATE OF RETURN \$196.15 \$190.98 \$179.90 \$190.82 \$176.83 \$177.03 \$177.67 \$178.23 \$180.74 \$185.12 \$188.31 \$188.55 \$188.64 \$198.05 \$205.39 \$218.17 \$189.65 \$178.76 \$185.27 \$189.65 \$177.84 (\$/ANN. mt L.S.) \$132.44 \$125.52 \$145.12 \$161.83 \$0.00 \$66.44 \$125.95 \$67.60 \$100.79 \$79.42 \$78.79 \$101.83 \$96.20 \$137.51 \$142.86 \$142.86 \$137.85 \$163.09 \$66.19 \$110.77 (\$/ANN. mt I.U.) \$248.06 \$373.50 \$259.63 \$365.36 \$243.63 \$334.67 \$231.85 \$198.05 \$187.71 \$362.60 \$296.10 \$263.47 \$257.24 \$239.63 \$292.32 \$196.48 \$347.59 \$243.64 \$344.39 \$232.37 \$173.68 (\$/ANN. mt L.S.) CAPEX GENERIC IRON CARBIDE (100%)/EAF 30% BF H.M./70% SCRAP CP COKE 30% BF H.M./70% SCRAP NR COKE 30% TECNORED H.M. W/O COGEN 30% COLD PIG IRON/70% SCRAP COREX/MIDREX WITH 60% H.M. 30% TECNORED H.M. W COGEN MAUMEE BRIQUETTE DRI/EAF GENERIC I.C. (40%)/SAF/EAF* 30% DRI, 1.0% C/70% SCRAP 100% DRI, 1.0% C, MIDREX 15 ITMK3 DR SHOT TO EAF 20 GENERIC I.C. (40%)/SAF/F CIRCOFER/HBI/SAF/EAF PROCESS SL/RN ROTARY KILN HISMELT 32.7% H.M. 100% STEEL SCRAP CIRCORED/HBI/EAF 30% MINI-BF H.M. FINMET/HBI/EAF HYLSA IVM REDSMELT HIGHEST THIRD LOWEST THIRD MIDDLE THIRD 0 9 12 16 19 19 7 8 SEQ. Š

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORTED ON I.R.R. (RASIS: 1 00 MM mt 1 10 UID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

Stannarie Stan	OH.	PROCESS	CAPEX	PEX OPEX FOR I.U. OPEX FOR L.S. INTERNAL RAT	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
STEEL SCRAP \$173.68 \$0.00 \$176.83 ECNORED H.M. W COGEN \$196.48 \$125.95 \$177.67 ECNORED H.M. W COGEN \$196.48 \$125.95 \$177.67 ECNORED H.M. WO COGEN \$187.71 \$180.65 \$180.65 INLIEF H.M.* \$180.05 \$180.65 \$180.65 INLIEF H.M.* \$243.63 \$140.77 \$180.23 REDHBI/EAF \$257.24 \$100.79 \$185.27 RI, 1.0% C/70% SCRAP \$257.24 \$100.79 \$188.64 RI, 1.0% C/70% SCRAP \$233.63 \$66.40 \$170.90 RI, 1.0% C/70% SCRAP \$233.63 \$180.65 \$180.65 RI, 1.0% C/70% SCRAP \$223.63 \$142.86 \$180.65 RI, 1.0% C/70% SCRAP \$243.64 \$177.03 \$180.65 RI, 1.0% C/70% SCRAP \$243.64 \$177.03 \$190.82 LT 32.7% H.M. \$244.39 \$145.12 \$190.82 RIC IRON CARBIDE (100%)/FAF \$34.39 \$10.8 \$180.74 RIC IRON CARBIDE (100%)/FAF \$34.39 \$10.8	N O			(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
STEEL SCRAP \$173.68 \$0.00 \$176.83 FECNORED H.M. W COGEN \$196.48 \$125.96 \$177.67 FECNORED H.M. WO COGEN \$180.71 \$180.98 \$177.67 FINI-BF H.M.* \$180.05 \$180.05 \$180.98 JAIN-BF H.M.* \$180.05 \$180.05 \$180.05 JAIN-BF H.M.* \$243.63 \$142.86 \$180.05 JAIN-BF H.M.* \$223.37 \$70.07 \$182.27 SPED/HBIEAF \$253.23 \$70.79 \$188.64 SIC I.C. (40%)/SAF/EAF* \$223.05 \$186.64 \$170.90 SPEN/HBICAF \$2292.32 \$66.44 \$189.65 SF H.M.70% SCRAP \$229.63 \$186.40 \$186.12 SPER/HBICAF \$229.32 \$66.44 \$180.65 SPER/HBICAF \$229.32 \$66.44 \$180.65 SPER/HBICAF \$229.43 \$180.42 \$180.65 SETT-BL \$229.63 \$132.46 \$190.82 SETT-BL \$180.85 \$190.82 SEGLD PIGI IRONITOW SCRAP \$259.	HGH	ST THIRD							
FECNORED H.M. W COGEN \$196.48 \$125.95 \$177.67 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.98 \$190.77 \$190.65 \$190.77 \$190.57 \$190.82		2 100% STEEL SCRAP	\$173.68	\$0.00	\$176.83	42.09%	822.45	0.0874	0.8909
FECNORED H.M. W/O COGEN		9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$177.67	36.74%	307.58	1.1545	1.4350
### \$198.05 ### \$198.05 ### \$243.63 ### \$10.77 ### \$189.65 ### \$243.63 ### \$10.77 ### \$189.65 ### \$10.77 ### \$189.65 ### \$10.77 ### \$189.65 ### \$10.77 ### \$189.65 ### \$10.77 ### \$189.65 ### \$100.79 ### \$100.79 ### \$100.79 ### \$100.79 ### \$100.79 ### \$100.79 ### \$100.79 ### \$100.79 ### \$100.79 ### \$100.79 ### \$100.70 #### \$100.70 #### \$100.70 #### \$100.70 #### \$100.70 #### \$100.70 #### \$100.70 #### \$100.70 #### \$100.70 #### \$100.70 ##### \$100.70 ##################################		0 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$190.98	31.30%	685.69	1.1545	1.7799
SF H.M./70% SCRAP NR COKE \$243.63 \$110.77 \$178.23 ORED/HBI/EAF \$232.37 \$78.79 \$185.27 FRIC I.C. (40%)/SAF/EAF* \$257.24 \$100.79 \$185.27 SRIC I.C. (40%)/SAF/EAF* \$231.85 \$137.51 \$188.64 DRI, 1.0% C/70% SCRAP \$239.63 \$137.51 \$188.65 SFER/HBI/SAF/EAF \$223.23 \$66.44 \$177.03 SFER/HBI/SAF/EAF \$243.64 \$187.50 \$188.65 SFER/HBI/SAF/EAF \$243.64 \$187.03 \$188.65 SFER/HBI/SAF/EAF \$243.64 \$180.65 \$180.65 SFI/HBI/EAF \$243.64 \$79.42 \$185.12 SDR SHOT TO EAF \$259.63 \$137.85 \$190.82 SOLD PIG IRON/70% SCRAP \$243.66 \$137.85 \$190.82 SICIL IRON CARBIDE (100%)/FAF \$347.59 \$66.19 \$180.74 A ROTARY KILN \$344.39 \$101.83 \$188.31 A IVM \$346.60 \$145.12 \$188.31 A IVM \$346.60 \$146.15 \$166.19<		6 30% MINI-BF H.M.*	\$198.05	\$142.86	\$189.65	30.32%	795.44	0.8974	1.6746
SED/HBI/EAF \$232.37 \$78.79 \$185.27 FRIC I.C. (40%)/SAF/EAF* \$257.24 \$100.79 \$185.27 SRIC I.C. (40%)/SAF/EAF* \$231.85 \$100.79 \$185.27 DRI, 1.0% C/70% SCRAP \$231.85 \$137.51 \$188.64 SFENHBI/SAF/EAF \$239.63 \$64.4 \$177.03 AFE BRIQUETTE DRI/FAF \$243.64 \$177.03 SF H.M./70% SCRAP CP COKE \$243.64 \$185.12 ET/HBI/EAF \$243.64 \$185.12 ST/HBI/EAF \$243.64 \$185.12 SDR SHOT TO EAF \$2596.10 \$67.60 \$178.76 SDR SHOT TO EAF \$243.66 \$137.85 \$190.82 SOLD PIG IRON/70% SCRAP \$243.66 \$145.12 \$190.82 SIC IRON CARBIDE (100%)/FAF \$347.59 \$66.19 \$177.84 A ROTARY KILN \$344.39 \$101.83 \$180.74 A IVM \$346.60 \$145.12 \$180.61 BALL T T T T T T T T T T T T T T T T T T		7 30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$178.23	29.28%	660.35	0.9594	1.5615
RIC I.C. (40%)/SAF/EAF* \$257.24 \$100.79 \$179.90 JRI, 1.0% C/70% SCRAP \$231.85 \$137.51 \$188.64 DFER/HBI/SAF/EAF \$239.63 \$6.44 \$177.03 AFE BRIQUETTE DRI/FAF \$243.64 \$177.03 3F H.M./70% SCRAP CP COKE \$243.64 \$186.55 ET/HBI/FAF \$243.64 \$177.03 SF H.M./70% SCRAP CP COKE \$243.64 \$185.12 SDR SHOT TO EAF \$79.42 \$185.12 SDLD PIG IRON/70% SCRAP \$248.06 \$137.85 \$190.82 SCLD PIG IRON/70% SCRAP \$347.59 \$66.19 \$177.84 N ROTARY KILN \$344.39 \$74.08 \$180.74 A IVM \$346.60 \$186.15 \$180.74 A IVM \$366.39 \$180.45 \$180.15 A IVM \$366.39 \$180.31 \$180.15 \$180.31 \$180.31 \$1		6 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
DRI, 1.0% C/70% SCRAP \$231.85 \$137.51 \$188.64 DFER/HBI/SAF/EAF \$239.63 \$96.20 \$188.55 AFE BRIQUETTE DRI/FAF \$292.32 \$6.44 \$177.03 3F H.M./70% SCRAP CP COKE \$243.64 \$177.03 \$189.65 ET/HBI/FAF \$243.64 \$180.65 \$180.65 ET/HBI/FAF \$79.42 \$180.65 \$178.76 SDR SHOT TO EAF \$259.61 \$137.85 \$190.82 ELT 32.7% H.M. \$243.66 \$145.12 \$190.82 SOLD PIG IRON/70% SCRAP \$243.66 \$145.12 \$198.05 SOLD PIG IRON/70% SCRAP \$347.59 \$66.19 \$180.74 N ROTARY KILN \$344.39 \$74.08 \$180.74 A ROTARY KILN \$346.36 \$125.52 \$196.15 A IVM \$346.36 \$132.44 \$205.39		0 GENERIC I.C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$179.90	27.02%	1185.22	1.3320	2.0648
RI, 1.0% C/70% SCRAP \$231.85 \$137.51 \$188.64 FER/HBI/SAF/EAF \$239.63 \$96.20 \$188.55 EE BRIQUETTE DRI/EAF \$292.32 \$66.44 \$177.03 E BRIQUETTE DRI/EAF \$243.64 \$142.86 \$189.65 FIHM/70% SCRAP CP COKE \$263.47 \$79.42 \$185.12 DR SHOT TO EAF \$296.10 \$67.60 \$178.76 LT 32.7% H.M. \$259.63 \$137.85 \$190.82 DLD PIG IRON/70% SCRAP \$248.06 \$145.12 \$190.82 SIC IRON CARBIDE (100%)/FAF \$344.39 \$66.19 \$177.84 ROTARY KILN \$334.59 \$101.83 \$180.74 IVM \$362.63 \$125.52 \$106.15 SIG IRON CARBIDE (100%)/FAF \$334.59 \$125.52 \$180.74 RELT \$362.63 \$125.52 \$196.15 IVM \$362.63 \$125.24 \$205.39	MIDDL	ETHIRD							
FER/HBI/SAF/EAF \$239.63 \$96.20 \$188.55 EE BRIQUETTE DRI/EAF \$292.32 \$66.44 \$177.03 E BRIQUETTE DRI/EAF \$243.64 \$142.86 \$177.03 F H.M./70% SCRAP CP COKE \$263.47 \$79.42 \$185.12 DR SHOT TO EAF \$296.10 \$67.60 \$178.76 LT 32.7% H.M. \$259.63 \$137.85 \$190.82 DLD PIG IRON/70% SCRAP \$248.06 \$145.12 \$198.05 ROTARY KILN \$344.39 \$66.19 \$177.84 ROTARY KILN \$334.59 \$101.83 \$180.74 IVM \$362.60 \$125.52 \$196.15 RAIL 1.0% C, MIDREX \$265.39 \$245.53 \$245.53		3 30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$188.64	26.21%	1,030.37	0.4283	1.3681
EE BRIQUETTE DRI/EAF \$292.32 \$66.44 \$177.03 F.H.M./70% SCRAP CP COKE \$243.64 \$142.86 \$189.65 T/HBI/EAF \$263.47 \$79.42 \$185.12 DR SHOT TO EAF \$226.10 \$67.60 \$178.76 LT 32.7% H.M. \$259.63 \$137.85 \$190.82 DLD PIG IRON/70% SCRAP \$244.39 \$66.19 \$177.84 ROTARY KILN \$344.39 \$74.08 \$180.74 ROTARY KILN \$334.59 \$101.83 \$188.74 IVM \$362.60 \$125.52 \$196.15 RAIL 1.0% C, MIDREX \$365.63 \$125.52 \$196.15	-	7 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
F.H.M.770% SCRAP CP COKE \$243.64 \$142.86 \$189.65 \$189.65 \$263.47 \$79.42 \$185.12 \$185.12 \$185.12 \$185.12 \$185.12 \$185.12 \$1732.7% H.M. \$2296.10 \$137.85 \$190.82 \$177.84 \$190.82 \$177.84 \$190.82 \$177.84 \$190.82 \$177.84 \$190.82 \$190.82 \$177.84 \$190.82		4 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
T/HBI/EAF \$263.47 \$79.42 \$185.12 DR SHOT TO EAF \$296.10 \$67.60 \$178.76 LT 32.7% H.M. \$259.63 \$137.85 \$190.82 DLD PIG IRON/70% SCRAP \$248.06 \$145.12 \$190.82 RIC IRON CARBIDE (100%)/EAF \$347.59 \$66.19 \$180.74 ROTARY KILN \$334.39 \$74.08 \$186.15 IVM \$365.60 \$125.52 \$196.15 JRI, 1.0% C, MIDREX \$365.36 \$132.44 \$205.39	•	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$189.65	24.46%	795.44	0.8974	1.6746
DR SHOT TO EAF \$296.10 \$67.60 \$178.76 LT 32.7% H.M. \$259.63 \$137.85 \$190.82 DLD PIG IRON/70% SCRAP \$248.06 \$145.12 \$198.05 RIC IRON CARBIDE (100%)/EAF \$347.59 \$66.19 \$177.84 ROTARY KILN \$334.39 \$74.08 \$180.74 MELT \$334.67 \$101.83 \$188.31 NM \$365.60 \$125.52 \$196.15 JRI, 1.0% C, MIDREX \$365.36 \$132.44 \$205.39		8 FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
LT 32.7% H.M. \$259.63 \$137.85 \$190.82 DLD PIG IRON/70% SCRAP \$248.06 \$145.12 \$198.05 RIC IRON CARBIDE (100%)/EAF \$347.59 \$66.19 \$177.84 ROTARY KILN \$344.39 \$74.08 \$180.74 MELT \$334.67 \$10.83 \$125.52 \$196.15 IVM \$365.60 \$132.44 \$205.39		5 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$178.76	23.72%	825.40	1.5213	2.2742
DLD PIG IRON/70% SCRAP \$248.06 \$145.12 \$198.05 RIC IRON CARBIDE (100%)/EAF \$347.59 \$66.19 \$177.84 ROTARY KILN \$344.39 \$74.08 \$180.74 MELT \$334.67 \$101.83 \$188.31 IVM \$365.60 \$132.44 \$205.39 JRI, 1.0% C, MIDREX \$365.36 \$132.44 \$205.39		2 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$190.82	22.39%	847.37	0.8689	1.6418
70% SCRAP \$248.06 \$145.12 \$198.05 \$10E (100%)/EAF \$347.59 \$66.19 \$177.84 \$177.84 \$184.39 \$74.08 \$180.74 \$188.31 \$186.74 \$10E (100%)/EAF \$334.67 \$101.83 \$125.52 \$196.15 \$10E (100%)/EAF \$365.36 \$132.44 \$205.39	LOWE	ST THIRD							
\$10E (100%)/EAF \$347.59 \$66.19 \$177.84 \$134.39 \$734.08 \$180.74 \$180.74 \$136.26 \$10.83 \$125.52 \$196.15 \$10.83 \$135.44 \$205.39		8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$198.05	20.43%	1002.39	0.9027	1.8170
\$344.39 \$74.08 \$180.74 \$334.67 \$101.83 \$188.31 \$362.60 \$125.52 \$196.15 DREX \$365.36 \$132.44 \$205.39		9 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
\$334.67 \$101.83 \$188.31 \$362.60 \$125.52 \$196.15 DREX \$365.36 \$132.44 \$205.39		1 SL/RN ROTARY KILN	\$344.39	\$74.08	\$180.74	19.55%	999.74	2.2869	3.1988
HYLSA IVM \$362.60 \$125.52 \$196.15 100% DRI, 1.0% C, MIDREX \$365.36 \$132.44 \$205.39	_	3 REDSMELT	\$334.67	\$101.83	\$188.31	17.73%	690.28	1.3624	1.9921
\$365.36 \$132.44 \$205.39		4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
Lt 0106		1 100% DRI. 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
45/3.50	_	1 COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.17	5.72%	942.91	2.9239	3,7839

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - RESEQUENCED IRASIS: 1.00 MM mf 1.10uid STEEL PER YEAR, \$140/mt STEEL SCRAP COST)

		/BASIS: 1 00 MM mf LIQUID STEEL PER YEAR, \$140/mt STEEL SCRAP COST)	FOUID STEEL PER	YEAR, \$140/mt STE	IL SCRAP COST)			
		CADEX	OPEX FOR 111	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
SEQ.	PROCESS	(\$/ANN mf L.S.)	(\$/ANN, mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
Š								
	-		AA 0014	\$205 3Q	10.57%	1.326.73	1.0514	2.2617
	1 100% DRI, 1.0% C, MIDREX	\$365.30	\$132.44	₩202.23	17 750	822 45	0.0874	0.8909
	2 100% STEEL SCRAP	\$173.68	\$0.00	\$217.95	0/.5/./1	056.70		1000
- 0	2 100 // OT LLE COTO ".	\$231.85	\$137.51	\$218.09	12.45%	1,030.37	0.4283	1.3081
	5 50% DRI, 1.0% C/10% SCICAL	8362 60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
•	4 HYLSA IVIN	\$243 64	\$142.86	\$219.12	11.14%	795.44	0.8974	1.6746
'	5 30% BF H.M.//U% SCKAP OF CORE	\$108 OF	\$142.86	\$219.12	14.56%	795.44	0.8974	1.6746
	6 30% MINI-BF H.M."	\$130.00 \$243.63	\$110.77	\$207.70	16.55%	660.35	0.9594	1.5615
	7 30% BF H.M.//U% SCKAP NK COKE	00.04.04	¢1.15.1.5	\$227 52	6.48%	1002.39	0.9027	1.8170
	B 30% COLD PIG IRON/70% SCRAP	\$240.00	4-143-14 10-10-10-10-10-10-10-10-10-10-10-10-10-1	\$207.14	21.36%	307.58	1.1545	1.4350
	9 30% TECNORED H.M. W COGEN	\$196.48	\$120.90	#201.14	14 74%	685.69	1,1545	1.7799
	10 30% TECNORED H.M. W/O COGEN	17.7814	\$105.09 \$404.00	CF.0770	7002 4	16 676	2.9239	3.7839
<u>-</u>	1 COREX/MIDREX WITH 60% H.M.	\$373.50	\$101.83	47.01.7	12 050	847.37	0.8689	1,6418
	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$21Z.9Z	0.00.01	10.140	2000.7	1 0003
	40 DEDOMETT	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.99.1
	13 REDOMILL I	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
- ;	# WACINEE BRIGOETTE DIVILLA	\$296.10	\$67.60	\$183.48	22.05%	825.40	1.5213	2.2742
	15 HMKs DK SHOT TO EAR	\$232.37	62 828	\$185.27	27.64%	900.84	1.1999	2.0217
-	16 CIRCORED/HBI/EAF	#232.51	06 96\$	\$188.55	25.37%	780.99	1.6404	2.3528
_	7 CIRCOFER/HBI/SAF/EAF	\$239.05 \$200.05	07.000	\$185.12 \$185.12	24.31%	907.76	1,0742	1.9022
~	8 FINMET/HBI/EAF	4703.47	419.42	#100.12	/07/07/07	A0 C70	1 2864	2 1738
_	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24 70	•	1004	00.000
· ਨੌ	20 GENERIC IC (40%)/SAF/EAF*	\$257.24	\$100.79	\$205.40	16.52%	_	1.3320	2.0040
	24 CLINE CONTARY KII N	\$344.39	\$74.08	\$185.46	18.06%	999.74	2.2869	3.1988
7	I SELICITION TO THE SELICITION							

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON L.S. OPEX (BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$140/mt STEEL SCRAP COST)

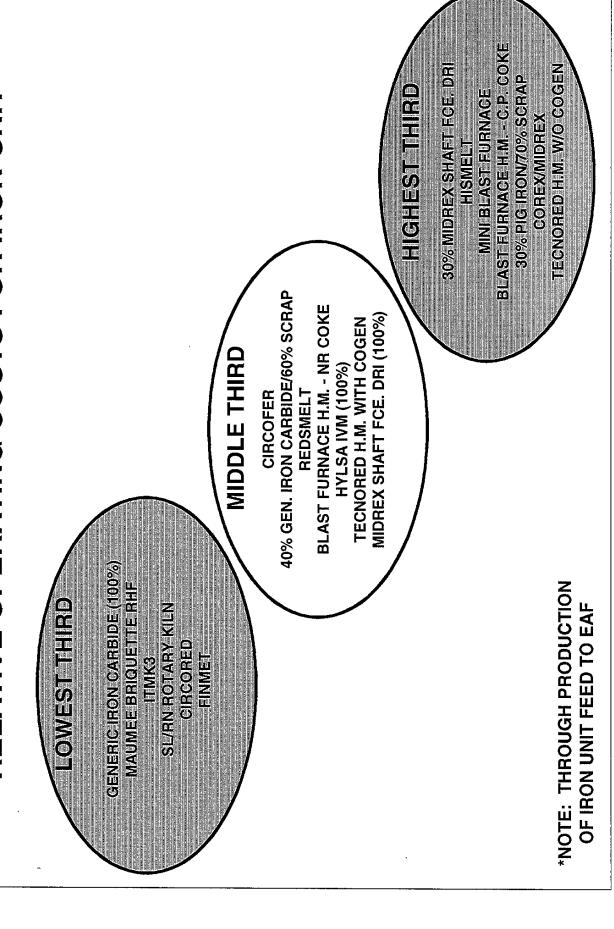
		(BASIS: 1.00 MIN ME	BASIS: 1.00 MM Mt LIQUID STEEL FER TEAR, \$140/III STEEL SCRAF COST	EAR, 4 401111 0 1 Et	L SOLVAL COST)			
SEO	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Q		(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
LOWE	OWEST THIRD							
,	14 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
_	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
_	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$183.48	22.05%	825.40	1.5213	2.2742
	IS FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
	21 SL/RN ROTARY KILN	\$344.39	\$74.08	\$185.46	18.06%	999.74	2.2869	3.1988
	17 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
MIDDL	MIDDLE THIRD							
	13 REDSMELT	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.9921
	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
	1 100% DRI 1 0% C. MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
	20 GENERIC I C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$205.40	16.52%	1185.22	1.3320	2.0648
	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$207.14	21.36%	307.58	1.1545	1.4350
	7 30% BE H M /70% SCRAP NR COKE	\$243.63	\$110.77	\$207.70	16.55%	660.35	0.9594	1.5615
_	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$212.92	13.05%	847.37	0.8689	1.6418
HIGHE	HIGHEST THIRD							
	2 100% STEEL SCRAP	\$173.68	\$0.00	\$217.95	17.75%	822.45	0.0874	0.8909
	3 30% DRI. 1.0% C/70% SCRAP	\$231.85	\$137.51	\$218.09	12.45%	1,030.37	0.4283	1.3681
	COREXMIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.17	5.72%	942.91	2.9239	3.7839
	6 30% MINI-BF H.M.*	\$198.05	\$142.86	\$219.12	14.56%	795.44	0.8974	1.6746
	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$219.12	11.14%	795.44	0.8974	1.6746
	10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$220.45	14.74%	692.69	1.1545	1.7799
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$227.52	6.48%	1002.39	0.9027	1.8170

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORTED ON I.R.R. (BASIS: 1.00 MM mt Liquid steel Per Year. \$140/mt steel scrap cost)

i c	3330000	(BASIS: 1.00 MM mt	DEX OPEX FOR LIL. OPEX FOR L.S. INTERNAL RAT	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
, S		(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
HUGHE	HIGHEST THIRD							
	46 CIRCORED/HBI/FAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
	O CINCONTED TO THE AT	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
	MALIMEE BRIGHETTE DRIVEAF	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
	14 INVESTIGATION OF THE PROPERTY OF THE PROPER	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
_	14 ITMK3 DR SHOT TO FAF	\$296.10	\$67.60	\$183.48	22.05%	825.40	1.5213	2.2742
-	o 30% TECNORED H M W COGEN	\$196.48	\$125.95	\$207.14	21.36%	307.58	1.1545	1.4350
	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
MIDDL	MIDDLE THIRD							1
1	21 SI /RN ROTARY KILN	\$344.39	\$74.08	\$185.46	18.06%	999.74	2.2869	3.1988
1	2) 100% STEEL SCRAP	\$173.68	\$0.00	\$217.95	17.75%	822.45	0.0874	0.8909
	7 30% BE H M 770% SCRAP NR COKE	\$243.63	\$110.77	\$207.70	16.55%	660.35	0.9594	1.5615
-	20 GENERIC IC (40%)/SAE/FAF*	\$257.24	\$100.79	\$205.40	16.52%	1185.22	1.3320	2.0648
4 +	SO CENTENCE TO CONTRACT OF THE	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.9921
- +	40 30% TECNOBED H M W//O COGEN	\$187.71	\$163.09	\$220.45	14.74%	685.69	1.1545	1.7799
	6 30% MIN-BF H.M.*	\$198.05	\$142.86	\$219.12	14.56%	795.44	0.8974	1.6746
LOWES	OWEST THIRD							
	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
	12 HISMFI T 32.7% H.M.	\$259.63	\$137.85	\$212.92	13.05%	847.37	0.8689	1.6418
•	3 30% DRI 1 0% C/70% SCRAP	\$231.85	\$137.51	\$218.09	12.45%	1,030.37	0.4283	1.3681
	A 30% BF H M /70% SCRAP CP COKE	\$243.64	\$142.86	\$219.12	11.14%	795.44	0.8974	1.6746
		\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$227.52	6.48%	1002.39	0.9027	1.8170
	COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.17	5.72%	942.91	2.9239	3.7839

MIDREX SHAFT FURNAGE DRIFTTOOS HWESAUM SHAFIFGE DRI(6100%) GENERICHRON CARBIDE (100%) SEARNEROPERENTALIEN COREX/////IDENEX **ESTIMATED RELATIVE CAPITAL COSTS* IRONMAKING PROCESSES SORTED BY** 40% GEN. IRON CARBIDE/60% SCRAP BLAST FURNACE - C.P. COKE 30% COLD PIG IRON/70% SCRAP BLAST FURNACE - N.R. COKE **MAUMEE BRIQUETTE RHF** MIDDLE THIRD HISMELT FINMET 30%-DRIMO%-SHEEL SORMP HEGHNORREDEWITHEGOREN THECHNOTIBEW/OLCOKIEN - MINI BLAKSH FULHANAGE 100% SHEEL SCRAP *NOTE: THROUGH LIQUID CIRCORED STEEL PRODUCTION

IRONMAKING PROCESSES SORTED BY ESTIMATED **RELATIVE OPERATING COSTS FOR IRON UNIT***



IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL* 30% COLDIPICIRON/70% SCRAP MIDIREX SHAFT FOE. DRI (100%) HEGNORREDHUM WOCCOGEN MINIBLASTHURNAGE **COREX/MIDREX** HWLSANIVM HISMELT \$100/mt STEEL SCRAP COST MIDREX SHAFT FCE. DRI (30%) BLAST FURNACE H.M. - C.P. COKE MIDDLE THIRD SL/RN ROTARY KILN CIRCORED REDSMELT CIRCOFER FINMET BLAST FURNACE HM.- NAR. COKE GENERICHRONEGARBIDIE (F100%) <u>IEECNOPABBHIWEWITHECOGENI</u> CENERICHRONECARBIDE (40%) WANDMEE BRIGNIEDERERHE *NOTE: THROUGH PRODUCTION HOOW STIET SCHAP OF EAF/LRF LIQUID STEEL

BLAKSIT FURNAKÉE HAM--C,P, KOKE IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL* Midraxsinatise drigge HEGNOBISH WHIM WOOLGOGEN 80% MIDHAX SHATELEEDR 30% PIC IRON//0% SCRAP <u>—MINIESI-AKSTITAURINIAKOJE</u> COREXAMIDEEX \$120/mt STEEL SCRAP COST 40% GEN. IRON CARBIDE/60% SCRAP BLAST FURNACE H.M. - NR COKE **TECNORED H.M. WITH COGEN** MIDDLE THIRD 100% STEEL SCRAP HISMELT **HYLSA IVM (100%)** REDSMELT GENERIC RONGARBIDE (100%) *NOTE: THROUGH PRODUCTION S*ei*finetomparkkien OF EAF/LRF LIQUID STEEL CIRCORED. GIRCOFER FINMET ITMK5

<u>BLAKSTE FURNAKÉE HHM.—G.P., GOKE</u> IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL* 30%ECOLDEPICHRON*FORMSCRA*P MIDREX SHAFT FURNACE (30%) NEDXOXONOLLED HAM WAYOUGENCH MINI BIAKHHURNAGE 1100%SITETESCRAP COREXIMIDREX \$140/mt STEEL SCRAP COST BLAST FURNACE H.M. - N.R. COKE HISMELT MIDREX SHAFT FCE. DRI (100%) GENERIC IRON CARBIDE (40%) **TECNORED H.M. WITH COGEN** MIDDLE THIRD HYLSA IVM REDSMELT GENHRICHIONECARBINDE *NOTE: THROUGH PRODUCTION **NAUMHE SRIQUEFFFERIF** SH/BINEKOHPAFAKIEN OF EAF/LRF LIQUID STEEL - CIRCORED **GIRCOFFR** FINNE III W K3

IRONMAKING PROCESSES SORTED BY SIMPLE INTERNAL RATE OF RETURN*

\$100/mt STEEL SCRAP COST

100% STEEL SCRAP
TECNORED HM WITH COGEN
TECNORED HM W/O COGEN
30% MINIBLAST FURNACE HM.
BLAST FCE. H.M. - N.R. COKE

Genericheon Garride (40%)

MIDDLE THIRD

30% MIDREX SHAFT FCE. DRI/70% SCRAP CIRCOFER MAUMEE BRIQUETTE RHF BLAST FURNACE H.M. - C.P. COKE

FINMET ITMK3

HISMELT

30% COLD PIG IRON70% SCRAP GENERIC IRON CARBIDE (100%) SL/RN ROTARY KILN

REDSMELT HYLSA IVM (100%) MIDREX SHAFT FCE, DRI (100%)

EXSTANT FOR DIST.

COREXIMIDAREX

*NOTE: THROUGH PRODUCTION OF EAF/LRF LIQUID STEEL

BHASH EURNAKGE HIM. - GP GOKF 30% COLD PICHRON/70% SCRAP MIDREX-SHAFT FCE. DRI (100%) Corex/Midrex IRONMAKING PROCESSES SORTED BY SIMPLE SE/FIN ROMARY KILN HWLSANWM (1000%) REDSMELT INTERNAL RATE OF RETURN* \$120/mt STEEL SCRAP COST GENERIC IRON CARBIDE (100%) 30% MIDREX SHAFT FCE. DRI/70% SCRAP HISMELT 40% GEN. IRON CARBIDE/60% SCRAP **TECNORED W/O COGEN** MINI BLAST FURNACE MIDDLE THIRD **ITMK3** BITASTIFICE THME NIT GOINE HIGNORIABEIMEWIHEKEICHN -MANUMES BRICKLERHERHE *NOTE: THROUGH PRODUCTION 400%SHEELSGRAP OF EAF/LRF LIQUID STEEL CIRCORED FINNET

IRONMAKING PROCESSES SORTED BY SIMPLE **INTERNAL RATE OF RETURN*** \$140/mt STEEL SCRAP COST 100% STEEL SCRAP BLAST FURNACE H.M. - N.R. COKE GENERIC IRON CARBIDE (40%) TECNORED H.M. W/O COGEN MINI BLAST FURNACE H.M. MIDDLE THIRD SL/RN ROTARY KILN REDSMELT HECONOLITION HAMINET CONCIENE <u>(Centrichrongarbid) = (100%)</u> WAVINI JESTI (A) (VI SELETRITE CHICORED CIRCOFFR ITMK3

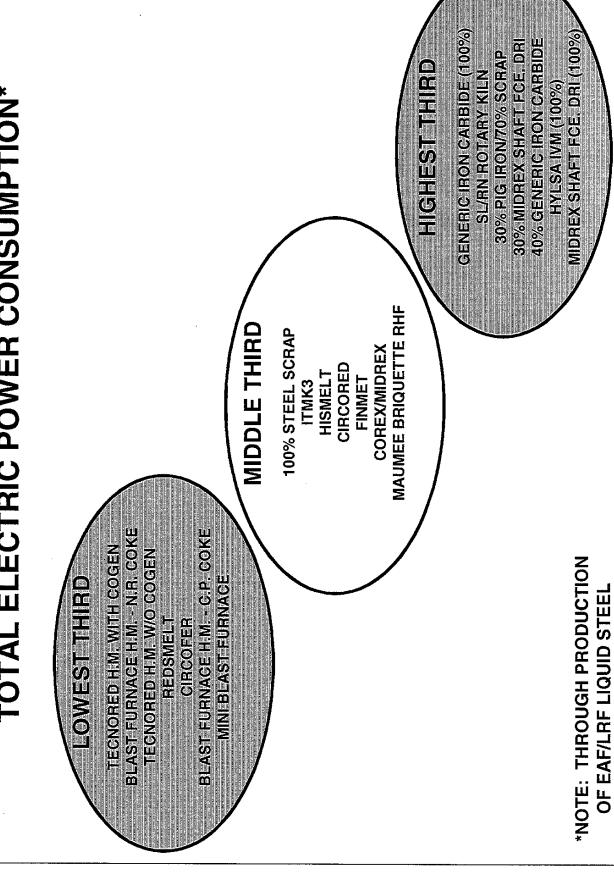
HMESANWE HISMELT

MIDREX SHAFT FURNACE DRI (30%)
BLAST FURNACE H.M. - C.P. COKE
MIDREX SHAFT FURNACE DRI (100%)
30% COLD PIG IRON70% SCRAP

COREX/MIDREX

*NOTE: THROUGH PRODUCTION OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED **TOTAL ELECTRIC POWER CONSUMPTION***



410%GENIERICHRONEGARBIDIE/SGRAP IRONMAKING PROCESSES SORTED BY ESTIMATED GENERICHEON GARBIDE (100%) SE/FINEROHARY KIENE **COREX/MIDREX** REDSMELT CIRCOFER ПМКЗ PROCESS ONLY CO2 EVOLUTION* BLAST FURNACE H.M. - N.R. COKE MIDREX SHAFT FCE. DRI (100%) **TECNORED H.M. WITH COGEN** TECNORED H.M. W/O COGEN MAUMEE BRIQUETTE RHF MIDDLE THIRD CIRCORED FINMET BEASIFIURNAGE HAME GREEKOOKE 30%MIDREXSHAHLEGE DRI 30% COLD PIG IRON/SCRAP HYLSA IVM *NOTE: THROUGH PRODUCTION HAIINIESIEAKSHEEURINAKOE OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED **TOTAL CUMULATIVE CO2 EVOLUTION***

LOWEST THIRD

100% STEEL SCRAP

30% MIDREX SHAPT FCE. DRI

TECNORED H.M. WITH COGEN

BLAST FURNACE H.M. - N.R. COKE

HISMELT

BLAST FURNACE - C.P. COKE

MINIBLAST FURNACE

MIDDLE THIRD

TECNORED H.M. W/O COGEN
30% COLD PIG IRON/70% SCRAP
FINMET
REDSMELT
CIRCORED

MAUMEE BRIQUETTE RHF HYLSA IVM 40% GENERIC IRON CARBIDE/SCRAP
GENERIC IRON CARBIDE (100%)
MIDREX SHAFT FURNACE DRI (100%)
ITMK3
CIRCOFER
SI/RN ROTARY KILN
COREX/MIDREX

*NOTE: INCLUDES ELECTRICAL POWER GENERATION EMISSIONS THROUGH PRODUCTION OF EAF/LRF LIQUID STEEL

= OPERATING COST PER MT LIQUID STEEL 6 = CUMULATIVE PROCESS C02 EMISSIONS = TOTAL CUMULATIVE CO2 EMISSIONS = SIMPLE INTERNAL RATE OF RETURN IRONMAKING PROCESSES SORTED BY RANKING SUM = CUMULATIVE ELECTRICAL POWER = OPERATING COST PER IRON UNIT RANKING VARIABLES MIDREX SHAFFER FOR FINAL (100%) (CINITALICATION (CARABIB) = (E1000) CHNERICHRONECARBIDE (4.09%) - ENERGY & ENVIRONMENTAL VARIABLES 5-7 = INSTALLED CAPITAL COST SIE/FINEROITAREMEKIEN COREXIMIDAEX CIRCOFER COLD PIG IRON (30%)/SCRAP (70%) **TECNORED H.M. - W/O COGEN** MAUMEE BRIQUETTE RHF MIDDLE THIRD HYLSA IVM (100%) CIRCORED REDSMELT FINMET SHASHEUNNAGEHAMENARKEOKE SHASSELLENIAGEHAMEGEPEGOKE HEGNOREDHAMEWINHEGGENE *NOTE: THROUGH PRODUCTION MINIBLAST FURNAGE 1000%STEE SGRAP OF EAF/LRF LIQUID STEEL

= OPERATING COST PER MT LIQUID STEE = CUMULATIVE PROCESS C02 EMISSIONS **= TOTAL CUMULATIVE CO2 EMISSIONS** = SIMPLE INTERNAL RATE OF RETURN IRONMAKING PROCESSES SORTED BY RANKING SUM = CUMULATIVE ELECTRICAL POWER = OPERATING COST PER IRON UNIT GOIDPIGHON(30%)/SGRAP(10%) BLASHEURNAGEHHM = GPEGOKE RANKING VARIABLES MIDREX SHAFT FCE DRI (100%) = INSTALLED CAPITAL COST HIEVSAGIVANTÉ1009/6 GOBI=X//MIDREX REDSMEET - COST-RELATED VARIABLES 1-4 MINI BLAST FURNACE H.M. (30%) GENERIC IRON CARBIDE (100%) MIDREX SHAFT FCE. DRI (30%) TECNORED H.M. - W/O COGEN \$100/mt STEEL MIDDLE THIRD SL/RN ROTARY KILN **SCRAP COST** FINMET ITMK3 BIFASHELURNAGEHIMENREGOKE GENERIC IRON GARBIDE (40%) HECNORED HIM, WHIH COGEN *NOTE: THROUGH PRODUCTION MANUMEE BRIQUISHEERHE HOOFASTERESCRAP OF EAF/LRF LIQUID STEEL CIRCOLER

= OPERATING COST PER MT LIQUID STEEL = CUMULATIVE PROCESS C02 EMISSIONS 7 = TOTAL CUMULATIVE CO2 EMISSIONS = SIMPLE INTERNAL RATE OF RETURN IRONMAKING PROCESSES SORTED BY RANKING SUM = CUMULATIVE ELECTRICAL POWER = OPERATING COST PER IRON UNIT GOILDFPIGHRON (80%)/ISCRAP (70%) BLASHFURNAGEHIM - G.P. COKE RANKING VARIABLES NEGNOTOR HURE WOLCOKEN MIDREX SHAFFEGE DRI(600%) = INSTALLED CAPITAL COST HWESAWWE(61009%) **€0HEX/MIDREX** HISMELL - COST-RELATED VARIABLES 1-4 BLAST FURNACE H.M. - N.R. COKE MINI BLAST FURNACE H.M. (30%) GENERIC IRON CARBIDE (100%) GENERIC IRON CARBIDE (40%) MIDREX SHAFT FCE. DRI (30%) REDSMELT \$120/mt STEEL MIDDLE THIRD SL/RN ROTARY KILN **SCRAP COST** HEGNOREDHUMFWHHEGOGEN *NOTE: THROUGH PRODUCTION HOWESHIE 100%STEEESGRAP (OIRCOHER CIRCORED FINMET III W K3

OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY RANKING SUM - COST-RELATED VARIABLES 1-4

\$140/mt STEEL SCRAP COST

RANKING VARIABLES

= INSTALLED CAPITAL COST

= OPERATING COST PER IRON UNIT

= OPERATING COST PER MT LIQUID STEEL

= SIMPLE INTERNAL RATE OF RETURN

= CUMULATIVE ELECTRICAL POWER

6 = CUMULATIVE PROCESS C02 EMISSIONS

8 = COMOLATIVE PROCESS COZ EMISSION 7 = TOTAL CUMULATIVE CO2 EMISSIONS

MIDDLE THIRD

GENERICHRON-CARBIDIE (100%)

MANUMETERS (QUETHE PRIE

CIRCORED

GIRCOLER

TINKS TIMET

TECNORED H.M. WITH COGEN SL/RN ROTARY KILN GENERIC IRON CARBIDE (40%) BLAST FURNACE H.M. - N.R. COKE REDSMELT

MIDREX SHAFT FCE. DRI (30%) MINI BLAST FURNACE H. M. (30%) TECHNORED H.M. - W/O COGEN HISMELT HYLSA IVM (100%)
BLAST FURNAGE H.M. - C.P. COKE
MIDREX SHAFT FCE. DRI (100%)

COLD PIG IRON (30%)/-SCRAP-(70%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION OF EAF/LRF LIQUID STEEL

= OPERATING COST PER MT LIQUID STEEI = CUMULATIVE PROCESS C02 EMISSIONS = TOTAL CUMULATIVE CO2 EMISSIONS = SIMPLE INTERNAL RATE OF RETURN IRONMAKING PROCESSES SORTED BY RANKING SUM = CUMULATIVE ELECTRICAL POWER = OPERATING COST PER IRON UNIT GOLD PIGHFON (30%)/SCHAP (70%) RANKING VARIABLES Generic-Iron Carridde (100%) MIDREX SHAFT FOR DRIGGOW) = INSTALLED CAPITAL COST SIJ/RN IROTARY-KIEN HWESZEWINE 61009/8 CORIEX/MIDREX REDSMELT - ALL VARIABLES SUMMED 1-7 BLAST FURNACE H.M. - C.P. COKE GENERIC IRON CARBIDE (40%) **MAUMEE BRIQUETTE RHF** \$100/mt STEEL MIDDLE THIRD SCRAP COST CIRCOFER HISMELT FINMET BLAST FURNACE HIM -- N.R. COKE THE GNORS DE LEMEWANTER COLCIEN MIDREX SHAFFECE, DRI (30%) HECNORED HMEW/O COCEN *NOTE: THROUGH PRODUCTION ---MINIERFARSH-FULRINAKGE 100%SAIDEESGRAP OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY RANKING SUM - ALL VARIABLES SUMMED 1-7

\$120/mt STEEL **SCRAP COST**

RANKING VARIABLES

= INSTALLED CAPITAL COST

= OPERATING COST PER IRON UNIT

= OPERATING COST PER MT LIQUID STEEL = SIMPLE INTERNAL RATE OF RETURN

BLAST FURNACE HIM - NR. COKE

CIRCORED

TEGNORED HAMEWHILE COGEN

MINIES FASTE EURNAGE HAME (80%)

WAUMEE BRIGHE HERHIE

= CUMULATIVE ELECTRICAL POWER = CUMULATIVE PROCESS C02 EMISSIONS = TOTAL CUMULATIVE C02 EMISSIONS

MIDDLE THIRD

MIDREX SHAFT FCE. DRI (30%) HISMELT CIRCOFER

BLAST FURNACE H.M. - C.P. COKE

TECNORED H.M. - W/O COGEN ITMK3

GENERIC IRON CARBIDE (100%)

REDSMELT

COLDIPICITION (30%)/SCRAP (70%) SHARNHRONDARWENIEN #WESZEIVW#(61000%)

MIDREX SHAFT FEE DIRI (100%) KORZYMIDRY

> *NOTE: THROUGH PRODUCTION OF EAF/LRF LIQUID STEEL

3 = OPERATING COST PER MT LIQUID STEEL 6 = CUMULATIVE PROCESS C02 EMISSIONS 7 = TOTAL CUMULATIVE CO2 EMISSIONS 4 = SIMPLE INTERNAL RATE OF RETURN 5 = CUMULATIVE ELECTRICAL POWER IRONMAKING PROCESSES SORTED BY RANKING SUM 2 = OPERATING COST PER IRON UNIT (COLEDIZICE EXON (COCA) EXCENTED (FOR) RANKING VARIABLES GENERICIFONECARBIDE (1002%) Midrix Shalleseath (100%) TECNORED HAM -- W/O COCEN = INSTALLED CAPITAL COST SEARINGTEAN COREXIMIDREX - ALL VARIABLES SUMMED 1-7 BLAST FURNACE H.M. - C.P. COKE HISMELT MINI BLAST FURNACE H.M. (30%) GENERIC IRON CARBIDE (100%) MIDREX SHAFT FCE. DRI (30%) \$140/mt STEEL MIDDLE THIRD **SCRAP COST** REDSMELT **ITMK3** BHASTFEURINAGEHRM=-NRF-GOKE HEGNOTHED HAM WITH GOIGH *NOTE: THROUGH PRODUCTION WALINIS SHOUSENEETHE 100%STEELSCEAP OF EAF/LRF LIQUID STEEL CIRCOFER

APPENDIX F-4

IRONMAKING PROCESS RELATIVE OPERATING COSTS (OPEX)

F-4 Ironmaking Process Relative Operating Costs (OPEX)

Operating costs for each Ironmaking Process (OPEX) were developed and built up from breakdowns of the operating cost components for each process unit operation in the sequence. That is, from the mines (for iron ore or other components) through ore preparation, the ironmaking process steps and the EAF/LRF to produce the refined liquid steel product. All costs are normalized on the 1.0 million annual metric tonnes of Refined Liquid Steel product basis.

Since the same procedures and common elements, where appropriate, were utilized in developing the estimates of the OPEX for each process, the relative accuracy and precision of these estimates when utilized for comparing the processes is believed to be very good. The built-up OPEX estimates produced in this manner were also compared to historical reported operating costs for the processes, to Vendor-supplied estimates and to internal detailed feasibility estimates prepared by Lockwood Greene for various commercial clients. The built-up estimates, considering differences in commodity and energy cost components, compared closely with those more detailed internal estimates.

The key methodology followed for the Operating Cost Estimates (OPEX) for each process were:

- The primary basis for consumables were the Energy and Mass Balance Spreadsheets (Appendix C).
- Commodity or consumable costs were either local (i.e. Upper Mid-West U.S.A. location) or built up from the individual commodity process components (Appendix F-1).
- Labor rates utilized was from a recent LGE Feasibility Study. It is an allin rate (including supervision component, overhead and burden) for the Upper Mid-West location.
- Labor man-hours (as man-hours/mt of product) for each of the Process unit operations or steps were either based on Vendor inputs for those process steps or were factored from LGE internal, detailed feasibility studies.

- Other considerations, including: allowances for Outside Boundary Limit (OSBL) facilities and ancillaries, Vendor or Licensing Fees, maintenance spare parts and supplies, etc. were also factored from the recent LGE feasibility studies for the similar process unit operations or steps.
- The factors, as required, were defined utilizing the operating cost components of the detailed internal LGE feasibility studies for the appropriate process operation (i.e. mining, concentration, pelletizing, ironmaking process, EAF, LRF, etc.).

The OPEX spreadsheets for the individual Ironmaking Processes are provided in Appendix F-2. The results are summarized in the tables in this Appendix Section.

LIQUID STEEL PRODUCTION COSTS - STEEL SCRAP SENSITIVITY

Early in the Alternative Ironmaking Process Study it was realized that two factors in developing the OPEX costs needed to be addressed:

- The processes for producing iron units needed to be compared on an equalized basis. That is, processes producing molten iron products needed to be compared to processes producing solid, direct-reduced iron products.
- In addition, a normalized ultimate product (i.e. refined liquid steel from an EAF/LRF process) at a consistent rate of production (i.e. 1.0 million metric tonnes per year of L.S.) was the uniform target rate for all ironmaking processes.

The problem with this, however, is that some of the Ironmaking processes require (or typically are used) with a specified amount of steel scrap as the charge to an EAF. In some cases also, the optimal utilization of the Ironmaking process or the technically-feasible process is <u>not</u> to charge 100% of the iron units from the ironmaking process to the EAF. The balance of the iron units (or requirements for coolant, or product purity, etc.) would come from a combination of recycled and purchased steel scrap.

The cost of steel scrap (a composite scrap charge is assumed as the basis for these EAF processes) has widely fluctuated during the past 2 or 3 years (see Appendix F1.10). As a consequence, when developing an OPEX through the liquid steel production or when trying to compare the relative economic

viability of the overall processes (i.e. as a simple Internal Rate of Return calculation), the scrap price (or cost) is a <u>significant variable</u> in this analysis. Therefore, the OPEX costs for production of Liquid Steel are sensitized on the steel scrap price. For the basis of this analysis, costs for steel scrap of \$100, \$120 and \$140 per metric tonne of steel scrap are sensitized in the Summary OPEX tables in this section.

Subsequent financial analyses comparisons of the Alternative Ironmaking Processes (by utilizing a simple Internal Rate of Return calculation) utilized the operating costs reflecting each of the above steel scrap price (i.e. \$100, \$120 and \$140 per metric tonne) sensitivities. The value of the refined Liquid Steel produced, after EAF steelmaking and LRF treatment, was taken to be \$250 per metric tonne for all of the Internal Rate of Return calculations. This assumed value of the Liquid Steel (prior to continuous casting and/or hot band production) was consistent for all Alternative Ironmaking Processes. Thus, a relative financial comparison between the various processes could be made,

The OPEX estimates for each process evaluated are summarized and tabulated for each of the steel scrap prices in this Section.

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES SENSITIVITY: \$100.00/mt STEEL SCRAP PRICE

		LE TOTAL	-	\$6.82 \$205.39	\$6.82 \$206.42	\$6.82 \$176.83	\$6.82 \$188.64	\$6.82 \$189.99	.82 \$196.15	82 \$189.65	82 \$178.23	82 \$198.05	82 \$177.67	82 \$190.98	32 \$228.34	•
		LADLE	4						6 \$6.82	8 \$6.82	8 \$6.82	7 \$6.82	\$6.82	\$6.82	\$6.82	
		STEEL MKG		\$60.17	\$61.09	\$67.21	\$59.68	\$60.73	\$58.16	\$53.98	\$53.98	\$61.57	\$52.05	\$52.05	\$49.51	
	TEEL	PURCHASED EAF SCRAP				\$102.80	\$73.64	\$73.64		\$73.66	\$73.66	\$73.66	\$73.66	\$73.66		
	COST PER NET MT LIQUID STEEL	HOT METAL PROD.								\$32.75	\$29.41	AS PIG \$33.56	\$23.86	\$37.17	\$75.27	
	COST PER NE	REDUCTION		\$49.99	\$49.99		\$16.87	\$17.14	\$42.76						\$20.84	
		PELLETIZING/ BRIQUETTING		\$24.10	\$24.13		\$10.30	\$10.31	\$24.10			· · · · · · · · · · · · · · · · · · ·	\$21.28	\$21.28	\$34.17	
	0,100	CONC. DELIVERED		\$64.31	\$64.39		\$21.33	\$21.34	\$64.31	\$18.45	\$10.29	\$18.45	,			
	111111111111111111111111111111111111111	ORE, OTHER IRON UNITS								\$3.99	\$4.07	\$3.99			\$41.73	
SENSITIVITY: \$100.00/mt STEEL SCRAP PRICE	-		_	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON	100% STEEL SCRAP CHARGE TO EAF	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON	C-6 HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF	
SENSI	j ⊆	j Z	SHAFI	<u>.</u>	C-5	6.3	2	C-5	C-6	C-7	C-8	6-0	C-10	C-11	C-12	

D.O.E. IRONMAKING - RELATIVE OPERATING COSTS THROUGH LIQUID STEEL PRODUCTION

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES (BASIS: 1.00 MM mt/yr LIQUID STEEL PRODUCTION)

SENSITIVITY: \$100,00/mt STEEL SCRAP PRICE

SEQ.	NO.	ROTARY HEARTH FURNACES	C-14 REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	C-15 MAUMEE BRIQUE ONLY RECYCLE S	C-16 ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE	FLUID-BED DRI/HBI	C-17 CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO E	C-18 CIRCOFER/HBI/SA RECYCLE SCRAP	C-19 FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE T	C-20a GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF	C-20b GENERIC IRON CARBIDE/SAF/EAF 60% SCRAP CHARGE TO EAF	OTHER PROCESSES	NO TOO HOLD TO CO
PROCESS		CES	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF		CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	ARBIDE/EAF CHARGE TO EAF	ARBIDE/SAF/EAF (GE TO EAF		V INC HTMM IN IN VOLTA ON INC. 19
	ORE, OTHER IRON UNITS		\$30.80	\$32.41	\$30.80		\$37.95	\$36.80	\$37.11	\$36.05	\$14.42		¢28 73
	CONC. DELIVERED												
	PELLETIZING/ BRIQUETTING		\$31.78	\$41.93	\$38.46		\$7.58	\$15.08	\$6.77				20.040
COST PER NET MT LIQUID STEEL	REDUCTION		\$22.33	\$32.60	\$30.90		\$78.22	\$51.00	\$79.72	\$81.34	\$32.54		140000
MT LIQUID ST	HOT METAL PROD.		\$38.68					\$38.68			\$17.01		
reel	PURCHASED EAF SCRAP		\$11.81	_ -	\$11.81						\$63.75		70770
	EAF STEELMKG.		\$46.24	\$60.97	\$58.47		\$55.60	\$40.33	\$55.60	\$54.53	\$45.52		004 70
	LADLE		\$6.67	\$9.12	\$8.32		\$5.92	\$6.66	\$5.92	\$5.92	\$6.66		00 00
;	TOTAL LIQ. STEEL		\$188.31	\$177.03	\$178.76		\$185.27	\$188.55	\$185.12	\$177.84	\$179.90		6400.74

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES

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SENS	TIVITY: \$120.00/mt									
SEQ.	PROCESS				COST PER NET MT LIQUID STEEL	MT LIQUID ST	EEL			
<u>.</u>		ORE, OTHER	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	STEEL MKG.	LADLE	TOTAL
SHAF	SHAFT FURNACE DRI PROCESSES:									
2	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON		\$64.31	\$24.10	\$49.99			\$60.17	\$6.82	\$205.39
C-5	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON		\$64.39	\$24.13	\$49.99			\$61.09	\$6.82	\$206.42
<u>ਤ</u>	100% STEEL SCRAP CHARGE TO EAF						\$123.36	\$67.21	\$6.82	\$197.39
0.44	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON		\$21.33	\$10.30	\$16.87	·	\$88.36	\$59.68	\$6.82	\$203.36
	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON		\$21.34	\$10.31	\$17.14		\$88.37	\$60.73	\$6.82	\$204.72
9-O	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF		\$64.31	\$24.10	\$42.76			\$58.16	\$6.82	\$196.15
C-7	C-7 30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	\$3.99	\$18.45			\$32.75	\$88.40	\$53.98	\$6.82	\$204.39
ဗီ ———	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	\$4.07	\$10.29			\$29.41	\$88.40	\$53.98	\$6.82	\$192.97
ဝို	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	\$3.99	\$18.45			\$33.56	\$88.40	\$61.57	\$6.82	\$212.79
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION			\$21.28		\$23.86	\$88.40	\$52.05	\$6.82	\$192.41
C-1	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION			\$21.28		\$37.17	\$88.40	\$52.05	\$6.82	\$205.72
C-12	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF	\$41.73		\$34.17	\$20.84	\$75.27	— ··· • · · · · · · · · · · · · · · · ·	\$49.51	\$6.82	\$228.34
C-13	HISMELT WITH 32.7% HOT METAL. TO CHARGE TO EAF		\$23.46			\$25.96	\$88.40	\$52.06	\$8.31	\$198.19

D.O.E. IRONMAKING - RELATIVE OPERATING COSTS THROUGH LIQUID STEEL PRODUCTION

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES

(BASIS: 1.00 MM mt/yr LIQUID STEEL PRODUCTION)

SENSITIVITY: \$120.00/mt STEEL SCRAP PRICE

SENS	SENSITIVITY: \$120.00/mt STEEL SCRAP PRICE									
SEQ.	PROCESS	,			COST PER NET MT LIQUID STEEL	MT LIQUID ST	EEL			
NO.		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEELMKG.	LADLE REFINING	TOTAL LIQ. STEEL
ROTA	ROTARY HEARTH FURNACES									
C-14	C-14 REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$30.80		\$31.78	\$22.33	\$38.68	\$14.17	\$46.24	29.9\$	\$190.67
C-15	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$32.41		\$41.93	\$32.60			\$60.97	\$9.12	\$177.03
C-16	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$30.80		\$38.46	\$30.90		\$14.17	\$58.47	\$8.32	\$181.12
FLUID	FLUID-BED DRI/HBI									
C-17	C-17 CIRCORED/HBI/FAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$37.95		\$7.58	\$78.22			\$55.60	\$5.92	\$185.27
C-18	CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$36.80		\$15.08	\$51.00	\$38.68		\$40.33	\$6.66	\$188.55
C-19	FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$37.11		\$6.77	\$79.72			\$55.60	\$5.92	\$185.12
C-20a	GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF	\$36.05			\$81.34		,	\$54.53	\$5.92	\$177.84
C-20b	GENERIC IRON CARBIDE/SAF/EAF 60% SCRAP CHARGE TO EAF	\$14.42			\$32.54	\$17.01	\$76.50	\$45.52	\$6.66	\$192.65
OTHE	OTHER PROCESSES									
C-21	C-21 SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$28.73		\$49.07	\$20.31		\$14.17	\$61.73	\$9.09	\$183.10

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SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES

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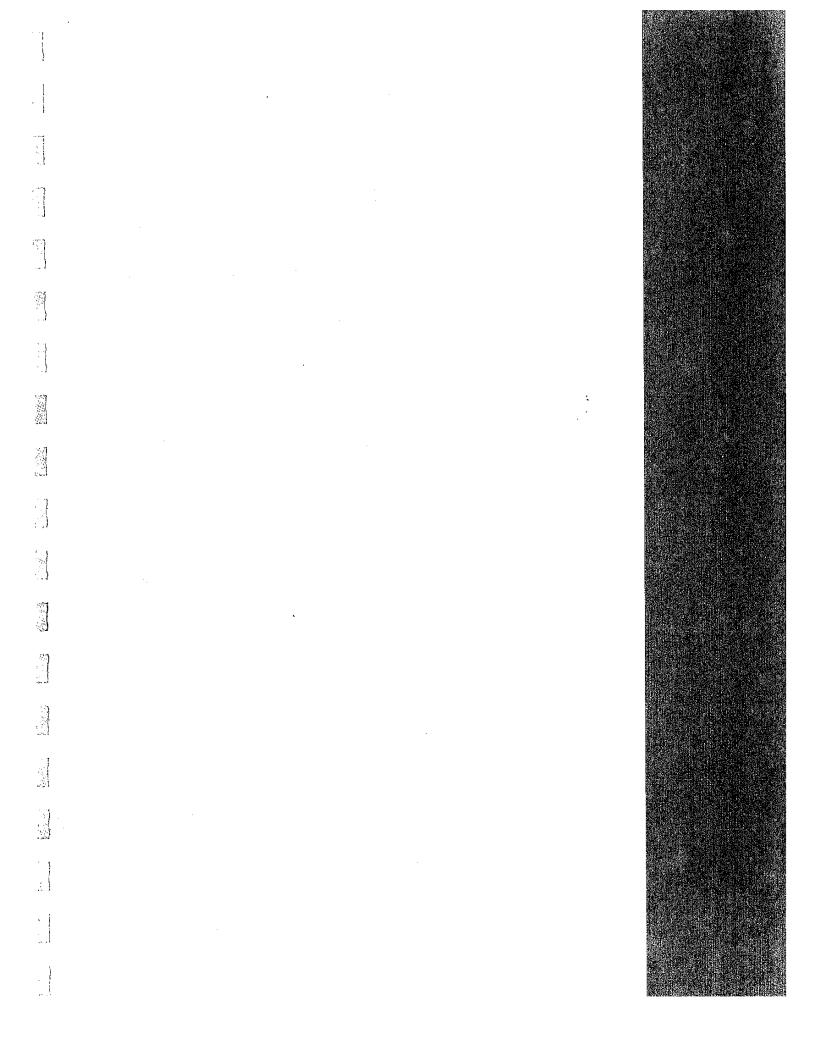
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ğ S S		ORE, OTHER	CONC.	PELLETIZING/	REDUCTION	HOT METAL	PURCHASED	EAF	LADLE	TOTAL
		IRON UNITS	DELIVERED	BRIQUETTING		PROD.	EAF SCRAP	STEELMKG.	REFINING	LIQ. STEEL
SHAF	SHAFT FURNACE DRI PROCESSES:									
2	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON		\$64.31	\$24.10	\$49.99			\$60.17	\$6.82	\$205.39
C-5	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON		\$64.39	\$24.13	\$49.99			\$61.09	\$6.82	\$206.42
ပို	100% STEEL SCRAP CHARGE TO EAF						\$143.92	\$67.21	\$6.82	\$217.95
C-4	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON		\$21.33	\$10.30	\$16.87		\$103.09	\$59.68	\$6.82	\$218.09
C-5	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON		\$21.34	\$10.31	\$17.14		\$103.10	\$60.73	\$6.82	\$219.45
ပ္	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF		\$64.31	\$24.10	\$42.76			\$58.16	\$6.82	\$196.15
HOT	HOT METAL VARIATIONS									
C-7	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	\$3.99	\$18.45			\$32.75	\$103.13	\$53.98	\$6.82	\$219.12
ပ် 8	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	\$4.07	\$10.29			\$29.41	\$103.13	\$53.98	\$6.82	\$207.70
ရ ပ	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	\$3.99	\$18.45		77 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 - 1 -	AS PIG \$33.56	\$103.13	\$61.57	\$6.82	\$227.52
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION			\$21.28		\$23.86	\$103.13	\$52.05	\$6.82	\$207.14
C-11	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION			\$21.28		\$37.17	\$103.13	\$52.05	\$6.82	\$220.45
C-12	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF	\$41.73		\$34.17	\$10.67	\$75.27		\$49.51	\$6.82	\$218.17
C-13	HISMELT WITH 32.7% HOT METAL TO CHARGE TO EAF		\$23.46			\$25.96	\$103.13	\$52.06	\$8.31	\$212.92

D.O.E. IRONMAKING - RELATIVE OPERATING COSTS THROUGH LIQUID STEEL PRODUCTION, Rev. 2

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES (BASIS: 1.00 MM mt/yr LIQUID STEEL PRODUCTION)

SENSITIVITY: \$140.00/mt STEEL SCRAP PRICE

SENSI	IIVII Y: \$140.00/mt									
SEQ.	PROCESS)	– 1	MT LIQUID SI	EEL			
Ŏ.		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEELMKG.	LADLE	TOTAL LIQ. STEEL
ROTA	ROTARY HEARTH FURNACES									
C-14	C-14 REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$30.80		\$31.78	\$22.33	\$38.68	\$16.53	\$46.24	\$6.67	\$193.03
C-15	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$32.41		\$41.93	\$32.60			\$60.97	\$9.12	\$177.03
C-16	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$30.80		\$38.46	\$30.90		\$16.53	\$58.47	\$8.32	\$183.48
FLUID	FLUID-BED DRI/HBI									
C-17	C-17 CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$37.95		\$7.58	\$78.22			\$55.60	\$5.92	\$185.27
C-18	CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$36.80		\$15.08	\$51.00	\$38.68		\$40.33	\$6.66	\$188.55
C-19	FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$37.11		\$6.77	\$79.72			\$55.60	\$5.92	\$185.12
C-20a	C-20a GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF	\$36.05			\$81.34			\$54,53	\$5.92	\$177.84
C-20b	C-20b GENERIC IRON CARBIDE/SAF/EAF 60% SCRAP CHARGE TO EAF	\$14.42			\$32.54	\$17.01	\$89.25	\$45.52	\$6.66	\$205.40
OTHE	OTHER PROCESSES									
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$28.73		\$49.07	\$20.31		\$16.53	\$61.73	\$9.09	\$185.46



APPENDIX F-5

IRONMAKING PROCESS RELATIVE CAPITAL COSTS (CAPEX)

F-5 Ironmaking Process Relative Capital Costs (CAPEX)

The Relative Capital Cost (CAPEX) estimates for each of the Alternative Ironmaking Processes were developed from appropriate sections of several internal LGE Project Feasibility and Detailed Design Studies. The installed cost estimates were factored using the costs for similar scopes for the plant and processing areas involved with each of the Ironmaking Processes.

The costs used were updated to a year 2000 basis and normalized using the process Mass Balances (Appendix C) to a uniform 1.0 million metric tonnes per year Refined Liquid Steel production basis. Specific differences in scope required for a particular process were accounted for in the individual components considered in the overall process CAPEX estimates. The CAPEX is reported as \$/annual metric tonne of production.

The built-up CAPEX costs are summarized in this section.

COST PER ANNUAL MT LIQUID STEEL PRODUCTION	INSTALLED COST PER mt UNIT/ UNIT CST./ TOTAL COST(1) ANNUAL mt LIQ. ST. mt LIQ. ST. SCOPE				\$135.0 \$40.91 \$155.0 \$44.29 \$175.0 \$41.67 \$300.0 \$60.00 AVERAGE: \$46.72 1.7807 \$83.19	\$670.0 \$148.89 \$565.0 \$141.25 \$655.0 \$145.56 AVERAGE: \$145.23 1.0450 \$151.77	\$410.0 \$83.33 \$385.0 \$78.25 \$400.0 \$81.30 AVERAGE: \$80.96 1.0549 \$85.41	\$180.0 \$45.00 1.0000 \$45.00 \$365.36	\$46.72 1.7826 \$83.27 \$145.23 1.0450 \$151.77 \$80.96 1.0549 \$85.41 \$45.00 1.0000 \$45.00 \$365.45
COST PER ANNUAL	CAPACITY INS			1.4652	3.3000 3.5000 4.2000 5.0000	4.5000 4.5000 4.5000	4.9200 4.9200 4.9200	4.0000 (L.S.)	1.4670
	BASIS FOR COST			Concentrate delivered to pelletizing plant.	Composite of four Vendor quotations for similar scope.	Composite of three Vendor quotations for similar scope.	Composite of three Vendor quotations for similar scope.	Includes: ore/concentrate storage, water services, waste disposal, off-gas treatment, offices, labs, etc.	Same as C-1. Same as C-1. Same as C-1. Same as C-1.
PBOCESS		SHAFT FURNACE DRI PROCESSES:	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON	IRON UNIT INPUT:	INDURATED PELLET PRODUCTION:	KOBE/MIDREX SHAFT FURNACE:	ELECTRIC ARC STEELMAKING/L.RF:	OUTSIDE BOUNDARY LIMITS:	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON IRON UNIT INPUT: 4 INDURATED PELLET PRODUCTION: 4 KOBEMIDREX SHAFT FURNACE: 4 ELECTRIC ARC STEELMAKING/LRF: 4 OUTSIDE BOUNDARY LIMITS: 5
CEO	Š O.	SHAFT	Ç.		· · · · · · · · · · · · · · · · · · ·				C-2

PROCESS	ESS	BASIS FOR COST	COST PER ANN	COST PER ANNUAL MT LIQUID STEEL PRODUCTION CAPACITY INSTALLED COST PER mt U	STEEL PROD	UCTION mf IJNIT/	IINIT CST /	TOTAL
ı			(MM mt/yr)	COST(1)	ANNUAL mt	mt LIQ. ST.	mt LfQ. ST.	SCOPE
으었품	100% STEEL SCRAP CHARGE TO EAF ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-1. Includes: scrap receiving/ handling/storage, water services, waste disposal, off-gas treatment, offices, labs, etc. for EAF/LRF only.	4.0000 (L.S.)	\$80.0	\$145.23 \$20.00	1.0543	\$153.12 \$20.56	\$173.68
CE ORE DRE IDE	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON IRON UNIT INPUT: INDURATED PELLET PRODUCTION: KOBE/MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-1. Same as C-1. Same as C-1. Same as C-1. Same as C-1.	0.4860		\$46.72 \$145.23 \$80.96 \$45.00	0.7612 0.3527 1.0541 1.0000 0.7364	\$35.56 \$51.22 \$85.34 \$45.00 \$14.73	\$231.85
유 교 교 교 교 교 교 교 교 교 교 교 교 교 교 교 교 교 교 교	TO EAF, 2.5 WT.% DRI CARBON IRON UNIT INPUT: INDURATED PELLET PRODUCTION: Same as C-1. KOBE/MIDREX SHAFT FURNACE: Same as C-1. ELECTRIC ARC STEELMAKING/LRF: Same as C-1. OUTSIDE BOUNDARY LIMITS: Same as C-1. SCRAP RECEIVING/HANDLING: Same as C-3.	Same as C-1. Same as C-1. Same as C-1. Same as C-1. Same as C-1.	0.4863		\$46.72 \$145.23 \$80.96 \$45.00 \$20.00	0.7615 0.3584 1.0542 1.0000 0.7364	\$35.57 \$52.05 \$85.35 \$45.00 \$14.73	\$232.70
NAC PEI	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF IRON UNIT INPUT: INDURATED PELLET PRODUCTION: HYLIVM SHAFT FURNACE:	Same as C-1. Same as C-1. Composite of two Vendor quotations for similar scope.	1.4650	\$612.0 \$390.8	\$46.72 \$145.71 \$139.56	1.7807	\$83.19	
SS E	ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-1. Same as C-1.			\$80.96	1.0000	\$85.36 \$45.00	\$362.60

	PROCESS	BASIS FOR COST	COST PER ANN CAPACITY (MM mt/yr)	COST PER ANNUAL MT LIQUID STEEL PRODUCTION CAPACITY INSTALLED COST PER mt UI (MM mt/yr) COST(1) ANNUAL mt mt LIC	STEEL PRODU	mt UNIT/	UNIT CST./	TOTAL
TAL	HOT METAL VARIATIONS							
30% SCR/	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE IRON UNIT INPUT:	DIT METAL/70% DUCT COKE IRON UNIT INPUT: Lump ore, Pellets, Sinter, Scrap, etc. delivered to stockpiles with rectain and handling systems included in OSBL.	0.1054 0.2097 0.2097 0.0337					
	INTEGRATED BLAST FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	ш 0) 0) 0)	2.3100	\$635.00	\$275.00 \$80.96 \$45.00 \$20.00	0.3584 1.0542 1.0000 0.7364	\$98.56 \$85.35 \$45.00 \$14.73	\$243.64
30% SCI	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE (MINI BLAST FURNACE FOR REFERENCE) IRON UNIT INPUT: MINI BLAST FURNACE FACILITY: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-7. Based on Vendor quotation. Same as C-1. Same as C-1.	0.9000	\$133.05	\$147.83 \$80.96 \$45.00 \$20.00	0.3584 1.0540 1.0000 0.7366	\$52.98 \$85.33 \$45.00 \$14.73	\$198.05
30% SC	SCRAP TO EAF, N.R. COKE SCRAP TO EAF, N.R. COKE IRON UNIT INPUT: INTEGRATED BLAST FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-7. Same as C-7. Same as C-1. Same as C-1.			\$275.00 \$80.96 \$45.00 \$20.00	0.3584 1.0540 1.0000 0.7366	\$98.56 \$85.33 \$45.00 \$14.73	\$243.63
30% TO	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG IRON UNIT INPUT: INTEGRATED BLAST FURNACE: PIG IRON CASTING/HANDLING: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-7. Same as C-7. Based on Vendor quotation. Same as C-1. Same as C-1.	3.5600	\$44.0	\$275.00 \$12.36 \$80.96 \$45.00 \$20.00	0.3584 0.3584 1.0540 1.0000 0.7366	\$98.56 \$4.43 \$85.33 \$45.00 \$14.73	\$248.06

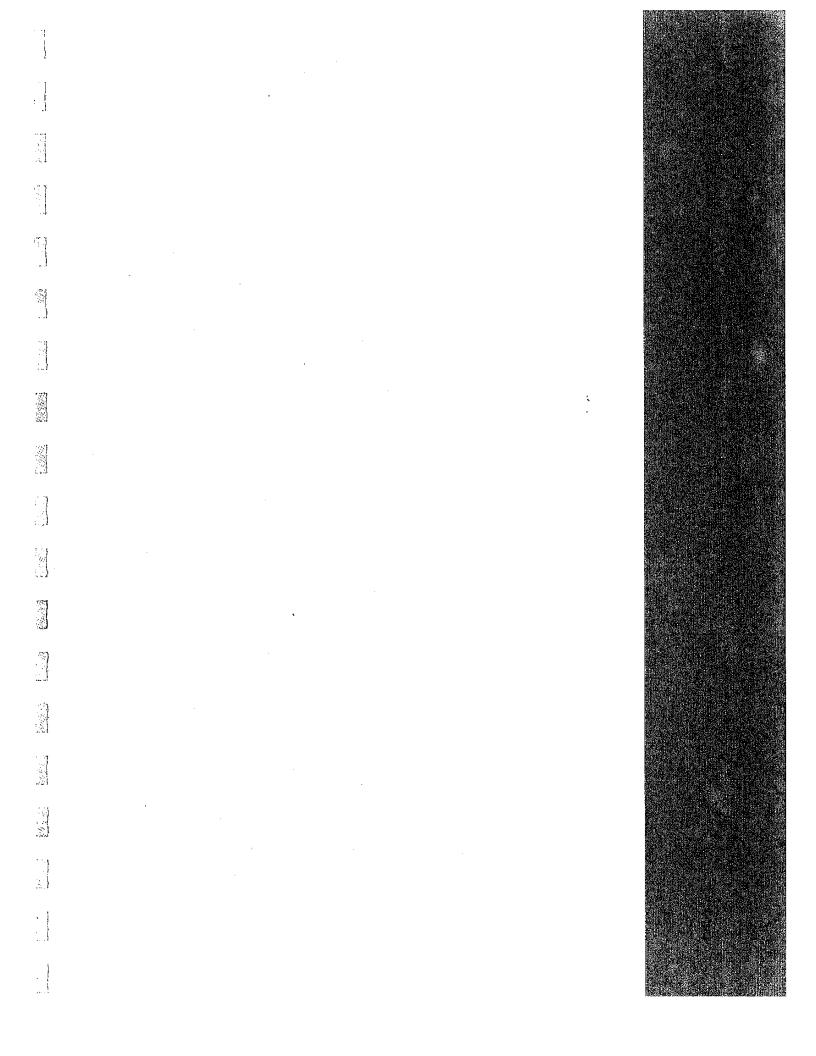
C-10 30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION IRON UNIT INPUT (AS FINE ORE): Iron ore fines received into stockpless with reclaim system to green-ball pelletizing. GREEN-BALL PELLET PRODUCTION: Internal LGE cost estimate for confidential client. CO-GENERATION: Internal LGE cost estimate for confidential client. CO-GENERATION: Internal LGE cost estimate for confidential client. CO-GENERATION: Internal LGE cost estimate for confidential client. CO-GENERATION: Internal LGE cost estimate for confidential client. SCRAP RECEIVING/HANDLING: Same as C-1. GREEN-BALL PELLET PRODUCTION: Same as C-10. GREEN-BALL PELLET PRODUCTION: Same as C-10. TECHNORED FURNACE & ANCILLARIES: Same as C-10. GREEN-BALL PELLET PRODUCTION: Same as C-10. GREEN-BALL PELLET PRODUC	SEQ.	PROCESS		COST PER ANNUAL MT LIQUID STEEL PRODUCTION	UAL MT LIQUID	STEEL PRODU	JCTION		
30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION: TECHNORED FURNACE & ANCILLARIES: CO-GENERATION: CO-GENERATION: SCRAP RECEIVING/HANDLING: SCRAP RECEIVING/HANDLING: GREEN-BALL PELLET PRODUCTION: TECHNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION: TECHNORED FURNACE & ANCILLARIES: SCRAP RECEIVING/HANDLING: COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX): MIDREX SHAFT FURNACE: COREX FURNACE & ANCILLARIES: MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Ö.		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	UNIT CST./ mt L.IQ. ST.	TOTAL
GREEN-BALL PELLET PRODUCTION: TECHNORED FURNACE & ANCILLARIES: CO-GENERATION: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION: TECHNORED FURNACE & ANCILLARIES: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: RON UNIT INPUT (COREX): MIDREX SHAFT FURNACE: COREX/MIDREX SHAFT FURNACE: COREX FURNACE & ANCILLARIES: MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	C-10	30% TECN TO EAF, W	Iron ore fines received into						
TECHNORED FURNACE & ANCILLARIES: CO-GENERATION: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: 30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION: TECHNORED FURNACE & ANCILLARIES: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX): MIDREX SHAFT FURNACE: COREX FURNACE & ANCILLARIES: MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:		CBEEN BALL DELLET DDODLICTION.	stockpiles with reclaim systems to green-ball pelletizing.	0.5080	ě	6			
CO-GENERATION: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: 30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION: TECHNORED FURNACE & ANCILLARIES: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX): MIDREX SHAFT FURNACE: COREX FURNACE & ANCILLARIES: MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:		TECHNORED FIRMACE & ANCILLADIES	internal LGE cost estimate for confidential client. Internal LGE goot entimate for	0.3020	4.4.	\$46.62	0.6377	\$29.73	
ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: SCRAP TO EAF, WITHOUT CO-GENERATION IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION: TECHNORED FURNACE & ANCILLARIES: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX): MIDREX SHAFT FURNACE: COREX FURNACE & ANCILLARIES: MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:		CO-GENERATION:	confidential client. Internal LGE cost estimate for	0.3020	\$29.9	\$97.59	0.3584	\$34.98	
OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: SCRAP RECEIVING/HANDLING: TO EAF, WITHOUT CO-GENERATION IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION: TECHNORED FURNACE & ANCILLARIES: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: RON UNIT INPUT (COREX): MIDREX SHAFT FURNACE: COREX FURNACE & ANCILLARIES: MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:			confidential client. Based on internal LGE estimate.	1.2500	\$75.0	\$60.00	1.0540	\$63.24	
30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION: TECHNORED FURNACE & ANCILLARIES: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX): MIDREX SHAFT FURNACE: COREX FURNACE & ANCILLARIES: MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:			Same as C-1. Same as C-3.			\$45.00	1.0000	\$45.00 \$14.73	\$196.48
TECHNORED FURNACE & ANCILLARIES: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING: COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX): MIDREX SHAFT FURNACE: COREX FURNACE & ANCILLARIES: MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	C-1	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION:	Same as C-10. Same as C-10.	0.5080	\$ 1.4	\$46.62	0.6377	\$29.73	
COREX/MIDREX 40% DRI CHARG COREX ELECTRI			Same as C-10. Based on internal LGE estimate.	0.3020	\$29.5 \$75.0	\$97.68	0.3584	\$35.01 \$63.24	
COREX/MIDREX 40% DRI CHARG COREX ELECTRI			same as C-1. Same as C-3.			\$45.00	1.0000	\$45.00	\$187.71
AIDREX SHAFT FURNACE: Iron ore pellets are purc COREX FURNACE & ANCILLARIES: Based on Vendor quota MIDREX SHAFT FURNACE: Same as C-1. ELECTRIC ARC STEELMAKING/LRF: Same as C-1. OUTSIDE BOUNDARY LIMITS: Same as C-1.	C-12	COREX/MIDREX 40% DRI CHARG	ron ore as lump and as pellets	0.4313					
		MIDREX SHAFT FURNACE: COREX FURNACE & ANCILLARIES: MIDREX SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF:	are on a purchased basis. ron ore pellets are purchased. Based on Vendor quotation. Same as C-1.	0.4313 0.7124 0.3020 0.1480	\$104.1	\$344.83 \$120.00 \$60.00	0.6237 0.4180 1.0545	\$215.07 \$50.16 \$63.27	
			same as C-1.			\$45.00	1.0000	\$45.00	\$373.50

	TOTAL SCOPE	\$259.63						\$334.67	\$292.32
	UNIT CST./ mt LIQ. ST.	\$114.52 \$85.37 \$45.00 \$14.73			\$48.16	\$140.03	\$41.28	\$60.19 \$45.00 \$3.09	\$71.42 \$135.54 \$85.36 \$45.00
JCTION	mt UNIT/ mt LIQ. ST.	0.3585 1.0545 1.0000 0.7366			2.0653	1.0261	0.9112	1.0032 1.0000 0.1544	1.9932 1.1217 1.0543 1.0000
STEEL PRODU	COST PER ANNUAL mt	\$319.45 \$80.96 \$45.00 \$20.00			\$23.32	\$139.67 \$136.76 \$132.98 \$136.47	\$46.36 \$47.06 \$42.50 \$45.31	\$60.00 \$45.00 \$20.00	\$35.83 \$120.83 \$80.96 \$45.00
UAL MT LIQUID	INSTALLED COST(1)	\$116.6				\$42.2 \$465.0 \$166.2 AVERAGE:	\$14.0 \$160.0 \$53.1 AVERAGE:	\$75.0	\$4.3
COST PER ANNUAL MT LIQUID STEEL PRODUCTION	CAPACITY (MM mt/yr)	0.5345		1.4545	•	0.3020 3.4000 1.2500	0.3020 3.4000 1.2500	1.2500	1.5735 0.1200 0.1200
	BASIS FOR COST	Same as C-10. Based on Vendor quotation. Same as C-1. Same as C-1.		Same as C-10.	Same as C-10 with adjustments.	Based on three Vendor quotations.	Based on three Vendor quotations.	Based on internal LGE estimate. Same as C-1. Same as C-3.	Same as C-10. Based on Vendor quotation. Based on Vendor quotation. Same as C-1. Same as C-3.
PROCESS		HISMELT WITH 32.7% HOT METAL TO CHARGE TO EAF IRON UNIT INPUT (AS FINE ORE): HISMELT SRV FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	ROTARY HEARTH FURNACES	RECYCLE SCRAP CHARGE TO EAF RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (AS FINE ORE):		ROTARY HEARTH REDUCTION FCE.:	SUBMERGED ARC MEL'TING FURNACE:	ELECTRIC ARC STEELMAKING/LRF: E OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING;	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): Same as C-10. GREEN BRIQUETTE PRODUCTION: Based on Vendor quotation. ROTARY HEARTH REDUCTION FCE.: Based on Vendor quotation. ELECTRIC ARC STEELMAKING/LRF: Same as C-1. OUTSIDE BOUNDARY LIMITS: Same as C-3.
SEQ.	o O	C-13	ROTAR	C-14				•	C-13

C-16 ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, GREEN BRIQUETTE PRODU ROTARY HEARTH REDUCTION ELECTRIC ARC STEELMAKIN OUTSIDE BOUNDARY I C-17 CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, MICRO-PELLET PRODU FLUIDIZED-BED FINES REDU HOT BRIQUE ELECTRIC ARC STEELMAKIN OUTSIDE BOUNDARY I C-18 CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, MICRO-PELLET PRODU FLUIDIZED-BED FINES REDU ANGRO-PELLET PRODU FLUIDIZED-BED FINES REDU SUBMERGED ARC MELITING FUR		BASIS FOR COST	CAPACITY INSTALLED COST PER mt U	INCTALLED	COST BED	ATIMITY'		
C-16 ITMK3 TO EAF WITH O RECYCLE SCRAP CHA RECYCLE SCRAP CHA ROTARY HEART ELECTRIC ARC OUTSIDE C-17 CIRCORED/HBI/EAF W RECYCLE SCRAP CHA R					201		UNIT CST./	TOTAL
C-16 ITMK3 TO EAF WITH O RECYCLE SCRAP CHA IRON UNIT INPU GREEN BRIQU ROTARY HEART ELECTRIC ARC OUTSIDE C-17 CIRCORED/HBI/EAF W RECYCLE SCRAP CHA IRON UNIT INPU MICRO-PE FLUID/SED-BED FLUID/ZED-BED C-18 CIRCOFER/HBI/SAF/EA RECYCLE SCRAP CHA IRON UNIT INPU MICRO-PE FLUID/ZED-BED SUBMERGED-BED			(MM mt/yr)	COST(1)	ANNUAL mt	mt LIQ. ST.	mt LIQ. ST.	SCOPE
C-17 CIRCORED/HBI/EAF W RECYCLE SCRAP CHA RECYCLE SCRAP CHA MICRO-PE FLUIDIZED-BED FLUIDIZED-BED OUTSIDE C-18 CIRCOFER/HBI/SAF/EA RECYCLE SCRAP CHA IRON UNIT INPU RICO-PE FLUIDIZED-BED SUBMERGED-BED SUBMERGED-BED SUBMERGED-BED SUBMERGED-BED	E TO EAF FINE ORE, ETC.): E PRODUCTION: EDUCTION FCE.: EELMAKING/LRF: UNDARY LIMITS:	Same as C-10. Same as C-10 with adjustments. Based on Vendor quotation. Same as C-1.	0.6000	\$100.0	\$23.32 \$166.67 \$80.96 \$45.00	1.8809 1.0261 1.0032 1.0000	\$43.86 \$171.02 \$81.22 \$45.00	\$296.10
C-17 CIRCORED/HBI/EAF W RECYCLE SCRAP CHA IRON UNIT INPU MICRO-PE FLUIDIZED-BED FLUIDIZED-BED OUTSIDE C-18 CIRCOFER/HBI/SAF/EA RECYCLE SCRAP CHA IRON UNIT INPU MICRO-PE FLUIDIZED-BED SUBMERGED-BED SUBMERGED-BED SUBMERGED-BED								
CIRCOR	SAF DRE, ETC.): DDUCTION: SUBTTING: AKING/LRF: RY LIMITS:	Same as C-10. Based on Vendor quotation. Based on Vendor quotation. Based on Vendor quotation. Same as C-1.	1.7905 4.0000 4.0000 4.0000	\$40.0 \$420.0 \$120.0	\$10.00 \$105.00 \$30.00 \$80.96 \$45.00	1.5340 1.0890 1.0890 1.0543	\$15.34 \$114.35 \$32.67 \$85.36 \$45.00	\$232.37
OUTSIDE	ETC.): CTION: CTION: INACE: G/LRF:	Same as C-10. Same as C-17. Based on Vendor quotation. Same as C-14. Same as C-14.	4.0000	\$466.6	\$10.00 \$116.65 \$45.31 \$60.00 \$45.00	1.5340 1.0890 1.0890 1.0543 1.0000	\$15.34 \$127.03 \$49.34 \$63.26 \$45.00	\$239.63
C-19 RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE MICRO-PELLET PRODU FLUIDIZED-BED FINES REDU HOT BRIQUE ELECTRIC ARC STEELMAKIN OUTSIDE BOUNDARY	O EAF JE ORE, ETC.): PRODUCTION: S REDUCTION: SRIQUETTING: LMAKING/LRF: JDARY LIMITS:	Same as C-10. Based on Vendor quotation. Based on Vendor quotation. Based on Vendor quotation. Same as C-14.	1.7511 4.0000 4.0000	\$40.0 \$649.0 \$180.0	\$10.00 \$162.25 \$45.00 \$35.83	1.5091 1.0890 1.0890 1.0543 1.0000	\$15.09 \$176.69 \$49.01 \$37.78 \$30.00	\$263.47

SEO	PROCESS		COST PER ANNUAL MT LIQUID STEEL PRODUCTION	UAL MT LIQUID	STEEL PRODU	JCTION		
ON.		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	UNIT CST./ mt LIQ. ST.	TOTAL SCOPE
C-20a	C-20a GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF (2) IRON UNIT INPUT (FINE ORE, ETC.); Same as C-10. FLUIDIZED-BED FINES REDUCTION; Based on Vendor quotation. ELECTRIC ARC STEELMAKING/LRF; Same as C-14. OUTSIDE BOUNDARY LIMITS: Same as C-1.	Same as C-10. 3ased on Vendor quotation. Same as C-14. Same as C-1.	1.7011	\$700.0	\$176.77 \$80.96 \$45.00	1.2289 1.0543 1.0000	\$217.23 \$85.36 \$45.00	\$347.59
C-20b	GENERIC IRON CARBIDE/SAF/EAF 60% SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): Same as C-10. FLUIDIZED-BED FINES REDUCTION: Based on Vendor quotation. SUBMERGED ARC MELTING FURNACE: Same as C-14. ELECTRIC ARC STEELMAKING/LRF: Same as C-14. OUTSIDE BOUNDARY LIMITS: Same as C-1. SCRAP RECEIVING/HANDLING: Same as C-3.	Same as C-10. Sased on Vendor quotation. Same as C-14. Same as C-14. Same as C-1.	0.6804 3.9600	\$700.0	\$176.77 \$45.31 \$60.00 \$45.00	0.4916 1.0890 1.0543 1.0000 0.6375	\$86.90 \$49.34 \$63.26 \$45.00 \$12.75	\$257.24
OTHER	OTHER PROCESSES							
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): Same as C-10. GREEN-BALL PELLET PRODUCTION: Same as C-10. FLUIDIZED-BED FINES REDUCTION: Based on Vendor quotation. ELECTRIC ARC STEELMAKING/LRF: Same as C-14. OUTSIDE BOUNDARY LIMITS: Same as C-1. SCRAP RECEIVING/HANDLING: Same as C-3.	Same as C-10. Same as C-10. Based on Vendor quotation. Same as C-14. Same as C-1.	1.3560	\$350.0	\$46.62 \$125.00 \$80.96 \$45.00 \$20.00	2.0137 0.9365 1.0543 1.0000 0.1544	\$93.88 \$117.06 \$85.36 \$45.00 \$3.09	\$344.39

NOTE: (2) 100% IC CHARGE HAS NOT BEEN PROVEN TO BE FEASIBLE.



APPENDIX F-6 SORTING OF PROCESSES

BY CAPITAL COSTS/ANNUAL MT L.S.

BY IRON UNIT COSTS/MT I.U.

BY OPERATING COST/MT L.S.

BY INTERNAL RATE OF RETURN

BY TOTAL ELECTRICAL POWER REQUIRED

BY TOTAL CUMULATIVE CO₂ EMISSIONS - PROCESS ONLY

BY TOTAL CUMULATIVE CO₂ EMISSIONS - TOTAL INCLUDING ELECTRICAL POWER GENERATION

F-6 Sorting of Processes

In order to compare the merits of each of the Ironmaking Processes considered (i.e. 21 total processes through Refined Liquid Steel production) with each other on an equalized basis, a Sorting and Ranking procedure was utilized. The procedures utilized are described below and in Appendix G:

Sort on Variables

The following specific variables (from the previous Appendix F sections) for each process were utilize to sort and rank the processes:

- Capital Costs (CAPEX, as \$/annual metric tonne Liquid Steel product)
- Operating Costs to produce Iron Units (OPEX I.U. as \$/metric tonne iron product to EAF steelmaking)
- Operating Costs to produce Refined Liquid Steel (OPEX L.S. as \$/metric tonne Refined Liquid Steel product)
- Simple Internal Rate of Return (I.R.R. based on a \$250 in-process value/metric tonne Liquid Steel product, all CAPEX in year 1 and full production for years 2-21)
- Total Electric Power (Cumulative total electric power consumption for all sub-processes to produce the Refined Liquid Steel product for each alternative)
- Total Cumulative CO₂ Emissions for the Process only (all fuel gas and carbon component emissions for all of the sub-processes, expressed as the CO₂ equivalent through the Refined Liquid product)
- Total Cumulative CO₂ Emissions (the sum of the Process CO₂ emissions and the equivalent CO₂ emissions for the Total Electric Power required) (Reference Appendix A3.1 based on North American average generation fuel distributions)

The various Alternative Ironmaking Processes were resequenced such that minor variations of specific processes considered (e.g. 2.5 wt.% carbon DRI, Appendix C-2 and C-4) were not considered in the sorting and ranking. The listings of the processes were sorted by the index variables above based on these resequenced tabulations.

These sorted listings were grouped into three groupings for each variable:

- LOWEST THIRD A grouping of the lowest seven processes by the variable of interest.
- MIDDLE THIRD A grouping of the middle seven processes by the variable of interest.
- HIGHEST THIRD A grouping of the highest seven processes by the variable of interest.

Within each grouping, the processes are in sequence with the lowest first and the highest last. Thus the first process sorted in the Lowest Group (for all variables except the I.R.R.) would be the "best" process by that index variable. Similarly, the last process in the Highest Group (except for the I.R.R.) would be the "worst" process by that index variable. By examining the processes in each grouping some consensus as to the most desirable and perhaps the least desirable Alternative Ironmaking Processes might be gained (based on the index variable sensitivities).

Since the cost-related variables of OPEX L.S. and the I.R.R. are a significant function of the Steel Scrap Price, sensitivities for these variables at \$100, \$120 and \$140 per metric tonnes of steel scrap were done to clarify the impact of this key sub-variable (Reference Appendix F1.10).

The tabulations for each of these sorts are provided in this section.

CAPITAL AND OPERATING COST ESTIMATES - IRONMAKING PROCESSES

NO.	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE
NO.	***************************************	(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN
SHAFT FI	URNACE DRI PROCESSES:				
	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON	\$365.36	\$132.44	\$205.39	10.57%
1	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON	\$365.45	\$132.55	\$206.42	10.22%
C-3	100% STEEL SCRAP CHARGE TO EAF	\$173.68	\$0.00	\$197.39	30.14%
1	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON	\$231.85	\$137.51	\$203.36	19.55%
	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON	\$232.70	\$136.14	\$204.72	18.84%
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF	\$362.60	\$125.52	\$196.15	13.72%
HOT ME	TAL VARIATIONS				
C-7	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	\$243.64	\$142.86	\$204.39	18.04%
C-7a	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, MINI BLAST FURNACE	\$198.05	\$142.86	\$204.39	22.64%
C-8	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	\$243.63	\$110.77	\$192.97	23.04%
C-9	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	\$248.06	\$145.12	\$212.79	13.89%
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION	\$196.48	\$125.95	\$192.41	29.14%
C-11	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION	\$187.71	\$163.09	\$205.72	23.23%
C-12	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF	\$373.50	\$208.88	\$228.34	1.46%
C-13	HISMELT WITH 32.7% HOT METAL TO CHARGE TO EAF	\$259.63	\$137.85	\$198.19	19.38%
ROTARY	/ HEARTH FURNACES				
C-14	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$334.67	\$101.83	\$190.67	16.96%
C-15	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$292.32	\$66.44	\$177.03	24.66%

CAPITAL AND OPERATING COST ESTIMATES - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	CAPEX (\$/ANN. mt L.S.)	OPEX FOR I.U. (\$/ANN. mt I.U.)	OPEX FOR L.S. (\$/ANN. mt L.S.)	INTERNAL RATE OF RETURN
C-16	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$296.10	\$67.60	\$181.12	22.89%
FLUID-E	BED DRI/HBI				
C-17	CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$232.37	\$78.79	\$185.27	27.64%
C-18	CIRCOFER/HBI/SAF/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$239.63	\$96.20	\$188.55	25.37%
C-19	FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$263.47	\$79.42	\$185.12	24.31%
C-20a	GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF (2)	\$347.59	\$66.19	\$177.84	20.24%
C-20b	GENERIC IRON CARBIDE/SAF/EAF 60% SCRAP CHARGE TO EAF	\$257.24	\$100.79	\$192.65	21.87%
OTHER	PROCESSES				
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$344.39	\$74.08	\$183.10	18.81%

NOTES: (1) Operating costs based on purchased scrap composite price of \$120/mt.

\$250.00

⁽²⁾ Sales (or transfer) price of Liquid Steel taken to be (\$/mt).

⁽³⁾ Internal Rate of Return Scenario based on 1.00 MM mt/year production of liquid refined steel (as caster feed). Project life is 21 years and all Capital investment is in year 1, with full production and revenue in years 2 through 21.

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - RESEQUENCED (BASIS: 1,00 MM mt Liquid Steel Per Year, \$120/mt Steel Scrap Cost)

		(BASIS: 1.00 MM mt I	.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST	/EAR, \$120/mt S1Et	L SCRAP COST)			
SEO	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Š	· · · · · · · ·	(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
	1 100% DRI 1 0% C. MIDREX	\$365,36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
	2 100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
	3 30% DRI 1 0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
		\$362.60	\$125.52	\$196.15	13.72%	1,267.37	9806'0	2.0646
	5 30% BE H M /70% SCRAP CP COKE	\$243,64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
		\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
		\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
	A 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
		\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
- 7	O 30% TECNORED H M W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	1.1545	1.7799
÷		\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839
- *	9 HISMEI T 32 7% H M	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
- *		\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
_		\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
_	I CIRCORED/HBI/FAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
-		\$239,63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
· ~		\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
_		\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
~ ~	0 GENERIC I C (40%)/SAF/EAF*	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
	3 SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
'								

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORTED ON CAPEX

		(BASIS: 1.00 MM mt l	.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST	/EAR, \$120/mt STE	EL SCRAP COST)			
SEQ.	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Š.		(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
LOWES	OWEST THIRD							
	2 100% STEEL SCRAP	\$173.68	\$0.00	8197.39	30.14%	822.45	0.0874	0.8909
	10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	692.69	1.1545	1.7799
	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
	6 30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
	3 30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
~	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
	17 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188,55	25.37%	780.99	1.6404	2.3528
MIDDLE	MIDDLE THIRD							
	7 30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
~	20 GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
-	18 FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
-	14 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
HIGHE	HIGHEST THIRD							
<u> </u>	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
-	13 REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
2	21 SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
	1 100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
-	COREX/MIDREX WITH 60% H.M.	\$373.50	\$208.88	\$228.34	1.46%	942.91	3.1398	3.9998

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON I.U. OPEX

SEQ. PROCESS CAP NO. LOWEST THIRD 2 100% STEEL SCRAP 4 MAUMEE BRIQUETTE DRI/EAF 5 ITMK3 DR SHOT TO EAF 5 ITMK3 DR SHOT TO EAF 6 CIRCORED/HBI/EAF 7 CIRCORED/HBI/EAF 8 FINMET/HBI/EAF 1 CIRCOFER/HBI/SAF/EAF 1 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 1 REDSMELT 20 GENERIC I.C. (40%)/SAF/EAF 3 30% DRI, 1.0% C, MIDREX 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX 1 HIGHEST THIRD 3 30% DRI, 1.0% C, MIDREX 1 CIRCORED H.M. GOKRAP 1 CIRCORED H.M. SCRAP CP COKE 3 30% DRI, 1.0% C/70% SCRAP 3 30% COLD PIG IRON/70% SCRAP 5 30% BF H.M.770% SCRAP 6 30% MINI-BF H.M. GO% H.M. 1 CORFXMIDREX WITH 60% H.M.	CASIS. 1.00 MIN HILL	ואלטוט טובבר רבת ו	JUD MIM MI EIGUID STEEL PER TEAR, \$120/MI STEEL SCRAP COST	L SURAP COST)			
STEEL SCRAP RIC IRON CARBIDE (100%)/EAF EE BRIQUETTE DRI/EAF DR SHOT TO EAF ROTARY KILN RED/HBI/EAF T/HBI/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC I.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC II.C. (40%)/SAF/EAF AIC III.C. (40%)/FAF/EAF AIC III.C. (40	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
LOWEST THIRD 2 100% STEEL SCRAP 19 GENERIC IRON CARBIDE (100%)/EAF 15 ITMK3 DR SHOT TO EAF 21 SURN ROTARY KILN 16 CIRCORED/HBI/EAF 17 CIRCORED/HBI/SAF/EAF 18 FINMET/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 17 CIRCOFER/HBI/SAF/EAF 21 REDSMELT 22 GENERIC I.C. (40%)/SAF/EAF 23 GENERIC I.C. (40%)/SAF/EAF 14 CIRCOFER/HBI/SAF/EAF 16 GONERIC I.C. (40%)/SAF/EAF 17 GONERIC I.C. (40%)/SAF/EAF 18 REDSMELT 19 REDSMELT 19 GON DRI, 1.0% C/70% SCRAP 11 GOW DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 13 30% DRI, 1.0% C/70% SCRAP 14 GONERIC I.C. (40%)/SCRAP 15 GONE FH.M./70% SCRAP 16 GONE FH.M./70% SCRAP 16 GONE FYMIDREX WITH 60% H.M.	(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
2 100% STEEL SCRAP 19 GENERIC IRON CARBIDE (100%)/EAF 14 MAUMEE BRIQUETTE DRI/EAF 15 ITMK3 DR SHOT TO EAF 21 SL/RN ROTARY KILN 16 CIRCORED/HBI/EAF 17 CIRCORED/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 21 SL/RN FOTARY KILN 17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 21 SL/RN FOTARY KILN 21 REDSMELT 22 GENERIC I.C. (40%)/SAF/EAF 23 GENERIC I.C. (40%)/SAF/EAF 24 HYLSA IVM 25 30% BF H.M./70% SCRAP 27 HIGHEST THIRD 28 30% COLD PIG IRON/70% SCRAP 29 30% MINI-BF H.M. 6 30% MINI-BF H.M. 6 30% MINI-BF H.M. 6 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	į						
19 GENERIC IRON CARBIDE (100%)/EAF 14 MAUMEE BRIQUETTE DRI/EAF 15 ITMK3 DR SHOT TO EAF 21 SL/RN ROTARY KILN 16 CIRCORED/HBI/EAF 17 CIRCORED/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 21 SL/RN FOTARY KILN 17 CIRCOFER/HBI/SAF/EAF 22 GENERIC I.C. (40%)/SAF/EAF 23 GENERIC I.C. (40%)/SAF/EAF 24 HYLSA IVM 25 30% BF H.M.70% SCRAP NR COKE 26 TECNORED H.M. W COGEN 27 30% DRI, 1.0% C/70% SCRAP 28 30% COLD PIG IRON/70% SCRAP 29 30% COLD PIG IRON/70% SCRAP 20 30% MINI-BF H.M. 21 SOW COLD PIG IRON/70% SCRAP 21 COREX/MIDREX WITH 60% H.M.	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
14 MAUMEE BRIQUETTE DRI/EAF 15 ITMK3 DR SHOT TO EAF 21 SL/RN ROTARY KILN 16 CIRCORED/HBI/EAF 18 FINIMET/HBI/EAF 20 GENERIC I.C. (40%)/SAF/EAF 17 CIRCOFER/HBI/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA NM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C, MIDREX 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
15 ITMK3 DR SHOT TO EAF 21 SL/RN ROTARY KILN 16 CIRCORED/HBI/EAF 18 FINIMET/HBI/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C, MIDREX 12 HISMELT 32.7% H.M. 6 30% MIN-BF H.M. 5 30% BF H.M./70% SCRAP C COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
21 SL/RN ROTARY KILN 16 CIRCORED/HBI/EAF 18 FINIMET/HBI/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA NW 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
16 CIRCORED/HBI/EAF MIDDLE THIRD 17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
MIDDLE THIRD 17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
MIDDLE THIRD 17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINH-BF H.M. 5 30% BF H.M./70% SCRAP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
17 CIRCOFER/HBI/SAF/EAF 20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.							
20 GENERIC I.C. (40%)/SAF/EAF 13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
13 REDSMELT 7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MIN-BF H.M. 5 30% BF H.M./70% SCRAP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
7 30% BF H.M./70% SCRAP NR COKE 4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
4 HYLSA IVM 9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINHBF H.M. 5 30% BF H.M./70% SCRAP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
9 30% TECNORED H.M. W COGEN 1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MIN-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
1 100% DRI, 1.0% C, MIDREX HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREXMIDREX WITH 60% H.M.	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
HIGHEST THIRD 3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINLBF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
3 30% DRI, 1.0% C/70% SCRAP 12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.							
12 HISMELT 32.7% H.M. 6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
6 30% MINI-BF H.M. 5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
5 30% BF H.M./70% SCRAP CP COKE 8 30% COLD PIG IRON/70% SCRAP 11 COREX/MIDREX WITH 60% H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
8 30% COLD PIG IRON/70% SCRAP	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
11 COREX/MIDREX WITH 60% H.M.	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839
10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	69:289	1.1545	1.7799

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON L.S. OPEX

i		(BASIS: 1.00 MM mt	BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST	/EAR, \$120/mt STE	EL SCRAP COST)			
SEQ.	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Š.		(\$/ANN. mt L.S.)	(\$/ANN, mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
LOWES	LOWEST THIRD							
7	14 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
<u>~</u>	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
2	21 SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
3	18 FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
=	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
1,	17 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
MIDDLE	MIDDLE THIRD							
1	13 REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
7	20 GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
	7 30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
וא	2 100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
12	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
HIGHES	HIGHEST THIRD							
6.3	3 30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
47	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
9		\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
_	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
5	10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	1.1545	1.7799
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
11	11 COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON I.R.R.

		(BASIS: 1.00 MM mt	.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST	'EAR, \$120/mt STE	EL SCRAP COST)			
SEQ.	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
NO.		(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
HIGHES	HIGHEST THIRD							
. 1	2 100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
<u></u>	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
1,	7 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
*	14 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
18	18 FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	97.76	1.0742	1.9022
	7 30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
MIDDLE	MIDDLE THIRD							
16	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
	6 30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
25	20 GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
10	10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	1.1545	1.7799
	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
(1)	3 30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
12	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
LOWES	LOWEST THIRD							
21	21 SIJRN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
-CD	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
13	13 REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
8	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
4	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
_	1 100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
11	11 COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON TOTAL ELECTRICITY (RANGING OF IROUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

		DACIC: 4 00 MM6 mt	ON MARK met I SOUTH STEEL PER YEAR, \$120/mt STEEL SCRAP COST)	(EAR. \$120/mt STEI	EL SCRAP COST)			14101
		(DASIS, 1.00 mm mic	OPEX FOR 111	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	IOIAL COZ
SEQ.	PROCESS	CAPEX	CPEALORIES:	(\$/ANN, mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
Š		(\$/ANN, IIII L.O.)	(4) VIVIE					
S II/VIC	OWEST THIRD			77 0078	30 1/%	307.58	1.1545	1.4350
֡֝֞֝֝֟֝֝֟֝֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֓֡֓֓֓֓֓֡֓֓֓֡	O TONOBED H M W COGEN	\$196.48	\$125.95	\$192.41	29.1470	25 099	0 9594	1.5615
	9 30% LECIONED THIS A COURT	\$243 G3	\$110.77	\$192.97	23.04%	000.00	- 1	4 7700
_	7 30% BF H.M./70% SCKAP NK CONE	\$2.000 \$4.000 14.000	¢163 09	\$205.72	20.25%	685.69	1.1545	6677
_	10 30% TECNORED H.M. W/O COGEN	17.7818	6103.00	\$190.67	16.96%	690.28	1.3624	1.9921
_	13 REDSMELT	\$334.67	Co.101¢	¢188.55	25.37%	780.99	1.6404	2.3528
	17 CIRCOFER/HBI/SAF/EAF	\$239.63	07.98\$	#106.33	18.04%	795.44	0.8974	1.6746
	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39 \$204.39	22.64%	795.44	0.8974	1.6746
	6 30% MINI-BF H.M.	\$198.05	\$142.80	9704:02				
	MINDA E THIRD				707 1 00	822 45	0.0874	0.8909
MIDDE	A ADDA OTEM CODAD	\$173.68	\$0.00	82.781	30.1470	07.770	1 5213	2.2742
	Z 100% STEEL SCINAL	\$296.10	\$67.60	\$181.12	77.89%	04.020	0.70.0	1 6418
	15 TMK3 DR SHOT TO EAF	\$1.007 \$1.00	\$137.85	\$198.19	19.38%	847.37	0.8089	1.0410
,	12 HISMELT 32.7% H.M.	\$239.05	478 70			900.84	1.1999	2.0217
	16 CIRCORED/HBI/EAF	\$232.37	910.19			907.76	1.0742	1.9022
	18 FINMET/HBI/EAF	\$263.47	24.874		5 72%		2.9239	3.7839
	11 COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83		24.66%	966.09	1.1498	2.0310
•	14 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$00.44					
בונים	HIGHEST THIRD				20 24%	972.95	1.2864	2.1738
	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	#177.04 #183.10		999.74	2.2869	3.1988
	21 SL/RN ROTARY KILN	\$344.39	\$74.08			•	0.9027	1.8170
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12				0.4283	1.3681
	2 30% DRI 1 0% C/70% SCRAP	\$231.85	\$137.51					2.0648
	OCALINED TO AND VISABILITY OF THE AF	\$257.24	\$100.79			,	_	2 0646
_	ZU GENENIC I.C. (40/0/c) ii ref	\$362.60	\$125.52	\$196.15		16.102,1	0.0000	7 2817
	4 HYLSA IVM	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2011
	1 100% DRI, 1.0% C, MIDREA							

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON PROCESS CO2 (BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

OH CH	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	PEX OPEX FOR I.U. OPEX FOR L.S. INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Š Š		(\$/ANN. mt L.S.)	(\$/ANN, mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
LOWES	OWEST THIRD							
2	2 100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
	3 30% DRI. 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
15	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%		0.8689	1.6418
. rc	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
. <u>.</u>	6 30% MINEBF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
, 4	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
MIDDLE THIRD	THIRD							
	7 30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
	100% DRI 1.0% C. MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
- <u>«</u>	18 FINMET/HBI/FAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
7	A MALIMEE BRIGHETTE DRIVEAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
	10 30% TECNOBED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	692.69	1.1545	1.7799
2 0	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1,1545	1.4350
16	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
HIGHES	HIGHEST THIRD							
19	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
20	20 GENERIC LC. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
13	13 REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
17	17 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
	21 SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
-	14 CODEX MIDBEX WITH 60% H M	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - TOTAL CUMULATIVE CO2

2.0217 2.0310 2.0646 2.2742 2.3528 2.1738 3.1988 2.2617 1.4350 1.5615 1.6418 1.6746 1.6746 1.8170 1.9022 1.9921 2.0648 0.8909 1.3681 TOTAL CO2 (mt/mt LS) 1.0514 1.5213 1.6404 2.2869 2.9239 1.1545 0.9027 1.0742 1.3624 1.1999 1.1498 9806.0 .3320 1.2864 PROCESS CO2 1.1545 0.9594 0.8689 0.8974 0.0874 0.4283 0.8974 (mt/mt LS) 780.99 999.74 942.91 972.95 690.28 60.996 795.44 002.39 907.76 900.84 ,267.37 326.73 825.40 795.44 1185.22 822.45 1,030.37 307.58 660.35 847.37 685.69 TOTAL ELEC. (kWhr/mt LS) 18.81% 5.72% 10.57% 25.37% 24.31% 27.64% 24.66% 13.72% 20.24% 22.89% 18.04% 13.89% 16.96% 19.55% 29.14% 19.38% 22.64% 20.25% 23.04% 21.87% INTERNAL RATE 30.14% (BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

CAPEX | OPEX FOR I.U. | OPEX FOR L.S. | INTERNAL RATE OF RETURN \$196.15 \$185.12 \$185.27 \$177.03 \$192.65 \$177.84 \$183.10 \$205.39 \$181.12 \$188.55 \$218.16 \$203.36 \$192.41 \$204.39 \$198.19 \$204.39 \$192.97 \$212.79 \$190.67 (\$/ANN. mt L.S.) \$197.39 \$74.08 \$161.83 \$132.44 \$67.60 \$96.20 \$66.19 \$163.09 \$145.12 \$0.00 \$142.86 \$79.42 \$78.79 \$66.44 \$125.52 \$100.79 \$137.51 \$110.77 \$125.95 \$137.85 \$142.86 \$101.83 (\$/ANN. mt I.U.) \$347.59 \$365.36 \$296.10 \$344.39 \$373.50 \$232.37 \$292.32 \$248.06 \$362.60 \$257.24 \$239.63 \$231.85 \$196.48 \$243.63 \$259.63 \$334.67 (\$/ANN. mt L.S.) \$173.68 \$243.64 \$187.71 \$263.47 \$198.05 GENERIC IRON CARBIDE (100%)/EAF 30% BF H.M./70% SCRAP NR COKE 30% BF H.M./70% SCRAP CP COKE 30% TECNORED H.M. W/O COGEN 30% COLD PIG IRON/70% SCRAP COREX/MIDREX WITH 60% H.M. 9 30% TECNORED H.M. W COGEN MAUMEE BRIQUETTE DRI/EAF GENERIC I.C. (40%)/SAF/EAF 30% DRI, 1.0% C/70% SCRAP 100% DRI, 1.0% C, MIDREX 15 ITMK3 DR SHOT TO EAF CIRCOFER/HBI/SAF/EAF PROCESS SL/RN ROTARY KILN HISMELT 32.7% H.M. CIRCORED/HBI/EAF 100% STEEL SCRAP 30% MINI-BF H.M. FINMET/HBI/EAF HYLSA IVM REDSMELT HIGHEST THIRD LOWEST THIRD MIDDLE THIRD 7 19 20 9 8 3 2 9 8 16 SEQ.

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - RESEQUENCED (BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$1000/mt STEEL SCRAP COST)

		(BASIS: 1.00 MM mt	(BASIS: 1.00 MM mt LIQUID STEEL PER YEAK, \$100/mt STEEL SCRAP COST)	CEAR, \$100/mt 51E	IL SCRAP COST)			
OH.	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Š		(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
							÷	
•	1 100% DRI 1 0% C. MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
	2 100% STEFI SCRAP	\$173.68	\$0.00	\$176.83	42.09%	822.45	0.0874	0.8909
	3 30% DRI 1 0% C/70% SCRAP	\$231.85	\$137.51	\$188.64	26.21%	1,030.37	0.4283	1.3681
. 7	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	9806.0	2.0646
	5 30% BF H M /70% SCRAP CP COKE	\$243.64	\$142.86	\$189.65	24.46%	795.44	0.8974	1.6746
	6 30% MINI-BF H.M.*	\$198.05	\$142.86	\$189.65	30.32%	795.44	0.8974	1.6746
		\$243.63	\$110.77	\$178.23	29.28%	660.35	0.9594	1.5615
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$198.05	20.43%	1002.39	0.9027	1.8170
	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$177.67	36.74%	307.58	1.1545	1.4350
-	10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$190.98	31.30%	685.69	1.1545	1.7799
		\$373.50	\$161.83	\$218.17	5.72%	942.91	2.9239	3.7839
	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$190.82	22.39%	847.37	0.8689	1.6418
	13 RFDSMELT	\$334.67	\$101.83	\$188.31	17.73%	690.28	1.3624	1.9921
7	14 MAI IMEE BRIOUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
- 1 -	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$178.76	23.72%	825.40	1.5213	2.2742
	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
- 12	17 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
~	18 FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	92'.106	1.0742	1.9022
- ~	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
~ ~	20 GENERIC I.C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$179.90	27.02%	1185.22	1.3320	2.0648
i &	21 SL/RN ROTARY KILN	\$344.39	\$74.08	\$180.74	19.55%	999.74	2.2869	3.1988

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON L.S. OPEX

1.7799 1.8170 3.7839 1.6746 .6746 2.0310 1.4350 2.1738 1.5615 2.2742 2.0648 1.9022 2.0217 1.9921 2.3528 1.3681 0.8909TOTAL CO2 (mt/mt LS) 0.8689 1.1545 0.9086 1.0514 2.9239 1.1999 1.3624 0.4283 0.8974 0.9027 1.5213 PROCESS CO2 1.1545 .2864 0.9594 1.3320 1.0742 1.1498 2.2869 0.0874 (mt/mt LS) ,326.73 685,69 1002.39 780.99 ,267.37 690.28 1,030.37 795.44 795.44 847.37 907.76 900.84 660.35 825.40 999.74 822.45 966.09 307.58 972.95 TOTAL ELEC. 185.22 (kWhr/mt LS) 30.32% 22.39% 31.30% 20.43% 10.57% 5.72% 27.64% 17.73% 25.37% 26.21% 20.24% 29.28% 23.72% 19.55% 24.31% 24.46% 42.09% 24.66% 27.02% 13.72% 36.74% (BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

CAPEX | OPEX FOR I.U. | OPEX FOR L.S. | INTERNAL RATE OF RETURN \$196.15 \$190.98 \$179.90 \$190.82 \$176.83 \$177.03 \$177.67 \$178.23 \$180.74 \$185.12 \$188.31 \$188.55 \$188.64 \$198.05 \$205.39 \$218.17 \$189.65 \$178.76 \$185.27 \$189.65 \$177.84 (\$/ANN. mt L.S.) \$132.44 \$125.52 \$145.12 \$161.83 \$0.00 \$66.44 \$125.95 \$67.60 \$100.79 \$79.42 \$78.79 \$101.83 \$96.20 \$137.51 \$142.86 \$142.86 \$137.85 \$163.09 \$66.19 \$110.77 (\$/ANN. mt I.U.) \$248.06 \$373.50 \$259.63 \$365.36 \$243.63 \$334.67 \$231.85 \$198.05 \$187.71 \$362.60 \$296.10 \$263.47 \$257.24 \$344.39 \$239.63 \$292.32 \$196.48 \$347.59 \$243.64 \$232.37 \$173.68 (\$/ANN. mt L.S.) CAPEX GENERIC IRON CARBIDE (100%)/EAF 30% BF H.M./70% SCRAP CP COKE 30% BF H.M./70% SCRAP NR COKE 30% TECNORED H.M. W/O COGEN 30% COLD PIG IRON/70% SCRAP COREX/MIDREX WITH 60% H.M. 30% TECNORED H.M. W COGEN MAUMEE BRIQUETTE DRI/EAF GENERIC I.C. (40%)/SAF/EAF* 30% DRI, 1.0% C/70% SCRAP 100% DRI, 1.0% C, MIDREX 15 ITMK3 DR SHOT TO EAF 20 GENERIC I.C. (40%)/SAF/F CIRCOFER/HBI/SAF/EAF PROCESS SL/RN ROTARY KILN HISMELT 32.7% H.M. 100% STEEL SCRAP CIRCORED/HBI/EAF 30% MINI-BF H.M. FINMET/HBI/EAF HYLSA IVM REDSMELT HIGHEST THIRD LOWEST THIRD MIDDLE THIRD 0 9 12 16 19 19 7 8 SEQ. Š

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORTED ON I.R.R. (RASIS: 1 00 MM mt 1 10 UID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

ST THIRD (\$/ANN. mt L.S.) (\$/ANN. mt L.S.) (\$/ANN. mt L.S.) 2 100% STEEL SCRAP \$173.68 \$0.00 \$176.83 2 100% STEEL SCRAP \$196.48 \$125.95 \$177.67 9 30% TECNORED H.M. WO COGEN \$180.48 \$125.95 \$177.67 1 30% MINI-BF H.M. \$180.05 \$142.86 \$189.65 1 30% MINI-BF H.M. \$232.37 \$78.79 \$188.23 1 00 GENERIC I.C. (40%)SAFIEAF* \$232.37 \$100.79 \$188.65 2 GENERIC I.C. (40%)SAFIEAF* \$237.36 \$137.51 \$188.65 3 30% DRI, 1.0% C/70% SCRAP \$233.85 \$137.51 \$179.90 2 GENERIC I.C. (40%)SAFIEAF* \$230.85 \$143.66 \$177.03 3 30% DRI, 1.0% C/70% SCRAP \$233.63 \$137.51 \$188.55 4 MAUMEE BRIQUETTE DRIFEAF \$243.64 \$142.86 \$186.51 5 ITMK3 DR SHOT TO EAF \$230.61 \$143.86 \$190.82 5 ITMK3 DR SHOT TO EAF \$243.64 \$143.86 \$190.85 5 ITMRS DR SHOLT TO EAF \$243.64 \$145.08 \$146.39 <th>SEO</th> <th>PROCESS</th> <th>CAPEX OPEX FOR I.U. OPEX FOR L.S. INTERNAL RAT</th> <th>OPEX FOR I.U.</th> <th>OPEX FOR L.S.</th> <th>INTERNAL RATE</th> <th>TOTAL ELEC.</th> <th>PROCESS CO2</th> <th>TOTAL CO2</th>	SEO	PROCESS	CAPEX OPEX FOR I.U. OPEX FOR L.S. INTERNAL RAT	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
\$173.68 \$0.00 \$125.95 \$125.95 \$120 \$180.05 \$180.00 \$186.48 \$125.95 \$125.09 \$180.05 \$180.05 \$180.05 \$180.05 \$142.86 \$142.86 \$142.86 \$140.77 \$232.37 \$180.79 \$19	j Ö			(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
\$173.68 \$0.00 \$125.95 \$173.08 \$100.00 \$196.48 \$125.95 \$125.95 \$125.00 \$198.05 \$198.05 \$142.86 \$142.86 \$142.86 \$142.86 \$140.79 \$198.05 \$199.05	HEST THIRD								
FECNORED H.M. W COGEN	2 100% ST	EEL SCRAP	\$173.68	\$0.00	\$176.83	42.09%	822.45	0.0874	0.8909
STATE STAT	9 30% TE	SNORED H.M. W COGEN	\$196.48	\$125.95	\$177.67	36.74%	307.58	1.1545	1.4350
### \$198.05 \$142.86 \$110.77 \$243.63 \$110.77 \$243.63 \$110.77 \$243.63 \$110.77 \$243.63 \$110.77 \$243.63 \$110.77 \$243.63 \$110.77 \$100.79 \$110.77 \$100.79 \$110.79 \$1	10 30% TE	NORED H.M. W/O COGEN	\$187.71	\$163.09	\$190.98	31.30%	685.69	1.1545	1.7799
\$243.63 \$110.77 \$10.77 \$10.77 \$10.77 \$10.77 \$10.77 \$10.77 \$10.70 \$10.79	6 30% MIN	II-BF H.M.*	\$198.05	\$142.86	\$189.65	30.32%	795.44	0.8974	1.6746
\$232.37 \$78.79 \$100.79 \$100.79 \$100.79 \$100.10	7 30% BF	H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$178.23	29.28%	660.35	0.9594	1.5615
RIC I.C. (40%)/SAF/EAF* \$257.24 \$100.79 JRI, 1.0% C/70% SCRAP \$231.85 \$137.51 DFER/HBI/SAF/EAF \$292.32 \$66.44 ALE BRIQUETTE DRI/EAF \$292.32 \$66.44 BF H.M./70% SCRAP CP COKE \$292.32 \$66.44 BF H.M./70% SCRAP CP COKE \$296.10 \$79.42 BT/HBI/EAF \$296.10 \$67.60 SELT 32.7% H.M. \$259.63 \$137.85 D \$248.06 \$137.85 SOLD PIG IRON/70% SCRAP \$248.06 \$145.12 SIRIC IRON CARBIDE (100%)/FAF \$344.39 \$74.08 \$334.67 \$344.39 \$101.83 A IVM \$365.36 \$132.44 DRI, 1.0% C, MIDREX \$365.36 \$132.44	16 CIRCOR	ED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
\$231.86 \$137.51 DRI, 1.0% C/70% SCRAP \$239.63 \$80.20 \$40.20 \$292.32 \$66.44 \$66.44 \$F6.44 \$F6.44 \$F6.44 \$F6.44 \$F6.44 \$F79.42 \$F79.43	20 GENERI	CI.C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$179.90	27.02%	1185.22	1.3320	2.0648
RI, 1.0% C/70% SCRAP \$231.85 \$137.51 FER/HBI/SAF/EAF \$239.63 \$96.20 EE BRIQUETTE DRI/EAF \$292.32 \$66.44 E BRIQUETTE DRI/EAF \$243.64 \$142.86 FH.M./70% SCRAP CP COKE \$263.47 \$79.42 DR SHOT TO EAF \$296.10 \$67.60 LT 32.7% H.M. \$259.63 \$137.85 SIC IRON CARBIDE (100%)/FAF \$347.59 \$66.19 ROTARY KILN \$344.39 \$145.12 NM \$334.67 \$101.83 IVM \$365.60 \$132.44 SIC, 1.0% C, MIDREX \$365.36 \$132.44	ODLE THIRD								
FER/HBI/SAF/EAF \$239.63 \$96.20 EE BRIQUETTE DRI/EAF \$292.32 \$66.44 EE BRIQUETTE DRI/EAF \$243.64 \$142.86 T/HBI/EAF \$263.47 \$79.42 DR SHOT TO EAF \$296.10 \$67.60 LT 32.7% H.M. \$259.63 \$137.85 DLD PIG IRON/70% SCRAP \$248.06 \$145.12 RIC IRON CARBIDE (100%)/FAF \$347.59 \$66.19 ROTARY KILN \$334.67 \$101.83 IVM \$365.60 \$125.52 IVM \$365.36 \$132.44	3 30% DR	. 1.0% C/70% SCRAP	\$231.85	\$137.51	\$188.64	26.21%	1,030.37	0.4283	1.3681
EE BRIQUETTE DRI/EAF \$292.32 \$66.44 F.H.M./70% SCRAP CP COKE \$243.64 \$142.86 F.H.M./70% SCRAP \$263.47 \$79.42 DR SHOT TO EAF \$296.10 \$67.60 LT 32.7% H.M. \$259.63 \$137.85 DLD PIG IRON/70% SCRAP \$248.06 \$145.12 RIC IRON CARBIDE (100%)/EAF \$347.59 \$66.19 ROTARY KILN \$334.67 \$101.83 IVM \$365.60 \$125.52 NRI 1.0% C, MIDREX \$365.36 \$132.44	17 CIRCOF	ER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
### ### ### ### ### ### ### ### ### ##	14 MAUME	BRIQUETTE DRIVEAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
T/HBI/EAF \$263.47 \$79.42 DR SHOT TO EAF \$296.10 \$67.60 LT 32.7% H.M. \$259.63 \$137.85 DLD PIG IRON/70% SCRAP \$248.06 \$145.12 RIC IRON CARBIDE (100%)/FAF \$347.59 \$66.19 ROTARY KILN \$334.67 \$101.83 IVM \$36.50 \$125.52 DRI, 1.0% C, MIDREX \$365.36 \$132.44	5 30% BF	H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$189.65	24.46%	795.44	0.8974	1.6746
DR SHOT TO EAF \$296.10 \$67.60 LT 32.7% H.M. \$259.63 \$137.85 SLD DIG IRON/70% SCRAP \$248.06 \$145.12 RIC IRON CARBIDE (100%)/FAF \$347.59 \$66.19 ROTARY KILN \$344.39 \$1401.83 IVM \$36.00 \$125.52 NRI 1.0% C, MIDREX \$365.36 \$132.44	18 FINMET	HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
LT 32.7% H.M. \$259.63 \$137.85 DLD PIG IRON/70% SCRAP \$248.06 \$145.12 ROTARY KILN \$347.59 \$56.19 \$66.19 ROTARY KILN \$334.67 \$137.08 \$101.83 IVM \$36.00 \$125.52 S10.1.0% C, MIDREX \$365.36 \$132.44	15 ITMK3 D	R SHOT TO EAF	\$296.10	\$67.60	\$178.76	23.72%	825.40	1.5213	2.2742
SLD PIG IRON/70% SCRAP \$248.06 \$145.12 RIC IRON CARBIDE (100%)/EAF \$347.59 \$66.19 ROTARY KILN \$344.39 \$74.08 IVM \$36.10 \$125.52 IVM \$36.10 \$132.44	12 HISMEL	T 32.7% H.M.	\$259.63	\$137.85	\$190.82	22.39%	847.37	0.8689	1.6418
70% SCRAP \$248.06 \$145.12 SIDE (100%)/EAF \$347.59 \$66.19 \$344.39 \$74.08 \$334.67 \$101.83 BREX \$365.36 \$125.52	WEST THIRD								
### \$347.59 \$66.19 \$66.19 \$344.39 \$54.08 \$74.08 \$334.67 \$101.83 \$165.50 \$165.24 \$165.24 \$165.24	8 30% CO	LD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$198.05	20.43%	1002.39	0.9027	1.8170
\$34.39 \$74.08 \$334.67 \$101.83 \$362.60 \$125.52 DREX \$365.36 \$132.44	19 GENERI	C IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
\$334.67 \$101.83 \$362.60 \$125.52 DREX \$365.36 \$132.44	21 SL/RN F	OTARY KILN	\$344.39	\$74.08	\$180.74	19.55%	999.74	2.2869	3.1988
\$362.60 \$125.52 100% DRI, 1.0% C, MIDREX \$365.36 \$132.44	13 REDSMI		\$334.67	\$101.83	\$188.31	17.73%	690.28	1.3624	1.9921
\$365.36 \$132.44	4 HYLSA I	- E	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
	1 100% D	RI. 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
\$161.83	11 COREX	MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.17	5.72%	942.91	2.9239	3,7839

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - RESEQUENCED IRASIS: 1.00 MM mf 1.10uid STEEL PER YEAR, \$140/mt STEEL SCRAP COST)

		/BASIS: 1 00 MM mf LIQUID STEEL PER YEAR, \$140/mt STEEL SCRAP COST)	FOUID STEEL PER	YEAR, \$140/mt STE	IL SCRAP COST)			
		CADEY	OPEX FOR 111	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
SEQ.	PROCESS	(\$/ANN mf L.S.)	(\$/ANN, mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
Š								
	-		AA 0014	\$205 3Q	10.57%	1.326.73	1.0514	2.2617
	1 100% DRI, 1.0% C, MIDREX	\$365.30	\$132.44	₩202.53	17 750	822 45	0.0874	0.8909
	2 100% STEEL SCRAP	\$173.68	\$0.00	\$217.95	0/.0/./1	056.70		1000
- 0	2 100 // OT LLE COTO	\$231.85	\$137.51	\$218.09	12.45%	1,030.37	0.4283	1.3081
	5 50% DRI, 1.0% C/10% SCICAL	8362 60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
•	4 HYLSA IVIN	\$243 64	\$142.86	\$219.12	11.14%	795.44	0.8974	1.6746
'	5 30% BF H.M.//U% SCKAP OF CORE	\$108 OF	\$142.86	\$219.12	14.56%	795.44	0.8974	1.6746
	6 30% MINI-BF H.M."	\$130.00 \$243.63	\$110.77	\$207.70	16.55%	660.35	0.9594	1.5615
	7 30% BF H.M.//U% SCKAP NK COKE	00.04.04	¢1.15.17	\$227 52	6.48%	1002.39	0.9027	1.8170
	B 30% COLD PIG IRON/70% SCRAP	\$240.00	4-143.14 10.10.10.10.10.10.10.10.10.10.10.10.10.1	\$207.14	21.36%	307.58	1.1545	1.4350
	9 30% TECNORED H.M. W COGEN	\$196.48	\$120.90	#201.14 #200.45	14 74%	685.69	1,1545	1.7799
	10 30% TECNORED H.M. W/O COGEN	17.7814	#105.09	CF.0770	7002 4	16 676	2.9239	3.7839
<u>-</u>	1 COREX/MIDREX WITH 60% H.M.	\$373.50	\$101.83	47.01.7	12 050	847.37	0.8689	1,6418
	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$21Z.9Z	13,03%	10.140	2000.7	1 0003
	40 DEDOMETT	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.99.1
	13 REDOMILL I	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
- ;	# WACINEE BRIGOETTE DIVILLA	\$296.10	\$67.60	\$183.48	22.05%	825.40	1.5213	2.2742
	15 HMKs DK SHOT TO EAR	\$232.37	62 828	\$185.27	27.64%	900.84	1.1999	2.0217
-	16 CIRCORED/HBI/EAF	#232.51	06 96\$	\$188.55	25.37%	780.99	1.6404	2.3528
_	7 CIRCOFER/HBI/SAP/EAP	\$239.05 \$200.05	07.000	\$185.12 \$185.12	24 31%	907.76	1.0742	1.9022
~	8 FINMET/HBI/EAF	4703.47	419.42	#100.12	20 240	A0 C70	1 2864	2 1738
_	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.2470	•	1004	00.000
· ਨੌ	20 GENERIC IC (40%)/SAF/EAF*	\$257.24	\$100.79	\$205.40	16.52%	_	1.3320	2.0040
	24 CLINE CONTARY KII N	\$344.39	\$74.08	\$185.46	18.06%	999.74	2.2869	3.1988
7	I SELICITION TO THE SELICITION							

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON L.S. OPEX (BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$140/mt STEEL SCRAP COST)

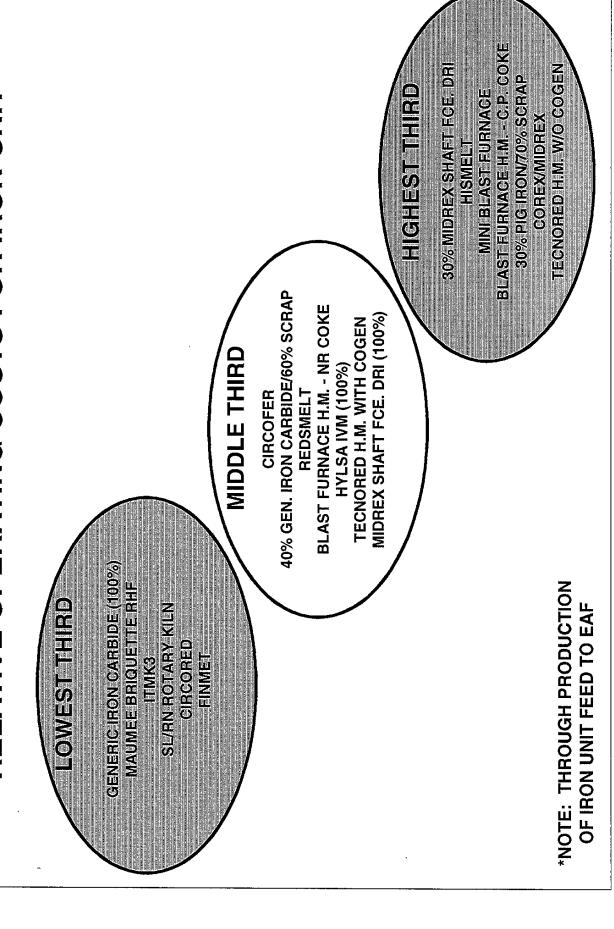
		(BASIS: 1.00 MIN ME	BASIS: 1.00 MM Mt LIQUID STEEL FER TEAR, \$140/III STEEL SCRAF COST	EAR, 4 401111 0 1 Et	L SOLVAL COST)			
SEO	PROCESS	CAPEX	OPEX FOR I.U.	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
Q		(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
LOWE	OWEST THIRD							
,	14 MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
_	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
_	15 ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$183.48	22.05%	825.40	1.5213	2.2742
	IS FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
	16 CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
	21 SL/RN ROTARY KILN	\$344.39	\$74.08	\$185.46	18.06%	999.74	2.2869	3.1988
	17 CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
MIDDL	MIDDLE THIRD							
	13 REDSMELT	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.9921
	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
	1 100% DRI 1 0% C. MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
	20 GENERIC I C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$205.40	16.52%	1185.22	1.3320	2.0648
	9 30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$207.14	21.36%	307.58	1.1545	1.4350
	7 30% BE H M /70% SCRAP NR COKE	\$243.63	\$110.77	\$207.70	16.55%	660.35	0.9594	1.5615
_	12 HISMELT 32.7% H.M.	\$259.63	\$137.85	\$212.92	13.05%	847.37	0.8689	1.6418
HIGHE	HIGHEST THIRD							
	2 100% STEEL SCRAP	\$173.68	\$0.00	\$217.95	17.75%	822.45	0.0874	0.8909
	3 30% DRI. 1.0% C/70% SCRAP	\$231.85	\$137.51	\$218.09	12.45%	1,030.37	0.4283	1.3681
	COREXMIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.17	5.72%	942.91	2.9239	3.7839
	6 30% MINI-BF H.M.*	\$198.05	\$142.86	\$219.12	14.56%	795.44	0.8974	1.6746
	5 30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$219.12	11.14%	795.44	0.8974	1.6746
	10 30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$220.45	14.74%	692.69	1.1545	1.7799
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$227.52	6.48%	1002.39	0.9027	1.8170

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORTED ON I.R.R. (BASIS: 1.00 MM mt Liquid steel Per Year. \$140/mt steel scrap cost)

i c	3330000	(BASIS: 1.00 MM mt	DEX OPEX FOR LIL. OPEX FOR L.S. INTERNAL RAT	OPEX FOR L.S.	INTERNAL RATE	TOTAL ELEC.	PROCESS CO2	TOTAL CO2
, S		(\$/ANN. mt L.S.)	(\$/ANN. mt I.U.)	(\$/ANN. mt L.S.)	OF RETURN	(kWhr/mt LS)	(mt/mt LS)	(mt/mt LS)
HUGHE	HIGHEST THIRD							
	46 CIRCORED/HBI/FAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
	O CINCONTED TO THE AT	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
	MALIMEE BRIGHETTE DRIVEAF	\$292.32	\$66.44	\$177.03	24.66%	60.996	1.1498	2.0310
	14 INVESTIGATION OF THE PROPERTY OF THE PROPER	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
_	14 ITMK3 DR SHOT TO FAF	\$296.10	\$67.60	\$183.48	22.05%	825.40	1.5213	2.2742
-	o 30% TECNORED H M W COGEN	\$196.48	\$125.95	\$207.14	21.36%	307.58	1.1545	1.4350
	19 GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
MIDDL	MIDDLE THIRD							1
1	21 SI /RN ROTARY KILN	\$344.39	\$74.08	\$185.46	18.06%	999.74	2.2869	3.1988
1	2) 100% STEEL SCRAP	\$173.68	\$0.00	\$217.95	17.75%	822.45	0.0874	0.8909
	7 30% BE H M 770% SCRAP NR COKE	\$243.63	\$110.77	\$207.70	16.55%	660.35	0.9594	1.5615
-	20 GENERIC IC (40%)/SAE/FAF*	\$257.24	\$100.79	\$205.40	16.52%	1185.22	1.3320	2.0648
4 +	SO CENTENCE TO CONTRACT OF THE	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.9921
- +	40 30% TECNOBED H M W//O COGEN	\$187.71	\$163.09	\$220.45	14.74%	685.69	1.1545	1.7799
	6 30% MIN-BF H.M.*	\$198.05	\$142.86	\$219.12	14.56%	795.44	0.8974	1.6746
LOWES	OWEST THIRD							
	4 HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
	12 HISMFI T 32.7% H.M.	\$259.63	\$137.85	\$212.92	13.05%	847.37	0.8689	1.6418
•	3 30% DRI 1 0% C/70% SCRAP	\$231.85	\$137.51	\$218.09	12.45%	1,030.37	0.4283	1.3681
	A 30% BF H M /70% SCRAP CP COKE	\$243.64	\$142.86	\$219.12	11.14%	795.44	0.8974	1.6746
		\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
	8 30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$227.52	6.48%	1002.39	0.9027	1.8170
	COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.17	5.72%	942.91	2.9239	3.7839

MIDREX SHAFT FURNAGE DRIFT (100%) HWESAUM SHAFIFGE DRI(6100%) GENERICHRON CARBIDE (100%) SEARNEROPERENTALIEN COREX/////IDENEX **ESTIMATED RELATIVE CAPITAL COSTS* IRONMAKING PROCESSES SORTED BY** 40% GEN. IRON CARBIDE/60% SCRAP BLAST FURNACE - C.P. COKE 30% COLD PIG IRON/70% SCRAP BLAST FURNACE - N.R. COKE **MAUMEE BRIQUETTE RHF** MIDDLE THIRD HISMELT FINMET 30%-DRIMO%-SHEEL SORMP HEGHNORREDEWITHEGOREN THECHNOTIBEW/OLCOCHN - MINI BLAKSH FULHANAGE 100% SHEEL SCRAP *NOTE: THROUGH LIQUID CIRCORED STEEL PRODUCTION

IRONMAKING PROCESSES SORTED BY ESTIMATED **RELATIVE OPERATING COSTS FOR IRON UNIT***



IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL* 30% COLDIPICIRON/70% SCRAP MIDIREX SHAFT FOE. DRI (100%) HEGNORREDHUM WOCCOGEN MINIBLASTHURNAGE **COREX/MIDREX** HWLSANM HISMELT \$100/mt STEEL SCRAP COST MIDREX SHAFT FCE. DRI (30%) BLAST FURNACE H.M. - C.P. COKE MIDDLE THIRD SL/RN ROTARY KILN CIRCORED REDSMELT CIRCOFER FINMET BLAST FURNACE HM.- NAR. COKE GENERICHRONEGARBIDIE (F100%) <u>IEECNOPABBHIWEWITHECOGENI</u> CENERICHRONECARBIDE (40%) WANDMEE BRIGNIEDERERHE *NOTE: THROUGH PRODUCTION HOOW STIET SCHAP OF EAF/LRF LIQUID STEEL

BLAKSIT FURNAKÉE HAM--C,P, KOKE IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL* Midraxsinatise drigge HEGNOBISH WHIM WOOLGOGEN 80% MIDHAX SHATELEEDR 30% PIC IRON//0% SCRAP <u>—MINIESI-AKSTITAURINIAKOJE</u> COREXAMIDEEX \$120/mt STEEL SCRAP COST 40% GEN. IRON CARBIDE/60% SCRAP BLAST FURNACE H.M. - NR COKE **TECNORED H.M. WITH COGEN** MIDDLE THIRD 100% STEEL SCRAP HISMELT **HYLSA IVM (100%)** REDSMELT GENERIC RONGARBIDE (100%) *NOTE: THROUGH PRODUCTION S*ei*finetompaekaien OF EAF/LRF LIQUID STEEL CIRCORED. GIRCOFER FINMET ITMK5

<u>BLAKSTE FURNAKÉE HHM.—G.P., GOKE</u> IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL* 30%ECOLDEPICHRONIZOS/ESCRAP MIDREX SHAFT FURNACE (30%) NEDXOXONOLLED HAM WAYOUGENCH MINI BIAKHHURNAGE 1100%SITETESCRAP COREXIMIDREX \$140/mt STEEL SCRAP COST BLAST FURNACE H.M. - N.R. COKE HISMELT MIDREX SHAFT FCE. DRI (100%) GENERIC IRON CARBIDE (40%) **TECNORED H.M. WITH COGEN** MIDDLE THIRD HYLSA IVM REDSMELT GENHRIGHRONKoarbeidheigio*da* *NOTE: THROUGH PRODUCTION **NAUMHE SRIQUEFFFERIF** SH/BINEKOHPAFAKIEN OF EAF/LRF LIQUID STEEL CIRCORED **GIRCOFFR** FINNE III W K3

IRONMAKING PROCESSES SORTED BY SIMPLE INTERNAL RATE OF RETURN*

\$100/mt STEEL SCRAP COST

100% STEEL SCRAP
TECNORED HM WITH COGEN
TECNORED HM W/O COGEN
30% MINIBLAST FURNACE HM.
BLAST FCE. H.M. - N.R. COKE

Genericheon Garride (40%)

MIDDLE THIRD

30% MIDREX SHAFT FCE. DRI/70% SCRAP CIRCOFER MAUMEE BRIQUETTE RHF BLAST FURNACE H.M. - C.P. COKE

FINMET ITMK3

HISMELT

30% COLD PIG IRON70% SCRAP GENERIC IRON CARBIDE (100%) SL/RN ROTARY KILN

REDSMELT HYLSA IVM (100%) MIDREX SHAFT FCE, DRI (100%)

EXSTANT FOR DIST.

*NOTE: THROUGH PRODUCTION OF EAF/LRF LIQUID STEEL

BHASH EURNAKGE HIM. - GP GOKF 30% COLD PICHRON/70% SCRAP MIDREX-SHAFT FCE. DRI (100%) COREX/MIDREX IRONMAKING PROCESSES SORTED BY SIMPLE SE/FIN ROMARY KILN HWLSANWM (1000%) REDSMELT INTERNAL RATE OF RETURN* \$120/mt STEEL SCRAP COST GENERIC IRON CARBIDE (100%) 30% MIDREX SHAFT FCE. DRI/70% SCRAP HISMELT 40% GEN. IRON CARBIDE/60% SCRAP **TECNORED W/O COGEN** MINI BLAST FURNACE MIDDLE THIRD **ITMK3** BITASTIFICE THME NIT GOINE HIGNORIABEIMEWIHEKEICHN -MANUMES BRICKLERHERHE *NOTE: THROUGH PRODUCTION 400%SHEELSGRAP OF EAF/LRF LIQUID STEEL CIRCORED FINNET

IRONMAKING PROCESSES SORTED BY SIMPLE **INTERNAL RATE OF RETURN*** \$140/mt STEEL SCRAP COST 100% STEEL SCRAP BLAST FURNACE H.M. - N.R. COKE GENERIC IRON CARBIDE (40%) TECNORED H.M. W/O COGEN MINI BLAST FURNACE H.M. MIDDLE THIRD SL/RN ROTARY KILN REDSMELT HECONOLITION HAMINET CONCIENE <u>(Centrichrongarbid) = (100%)</u> WAUNISESSIOUSEISINE CHICORED CIRCOFFR ITMK3

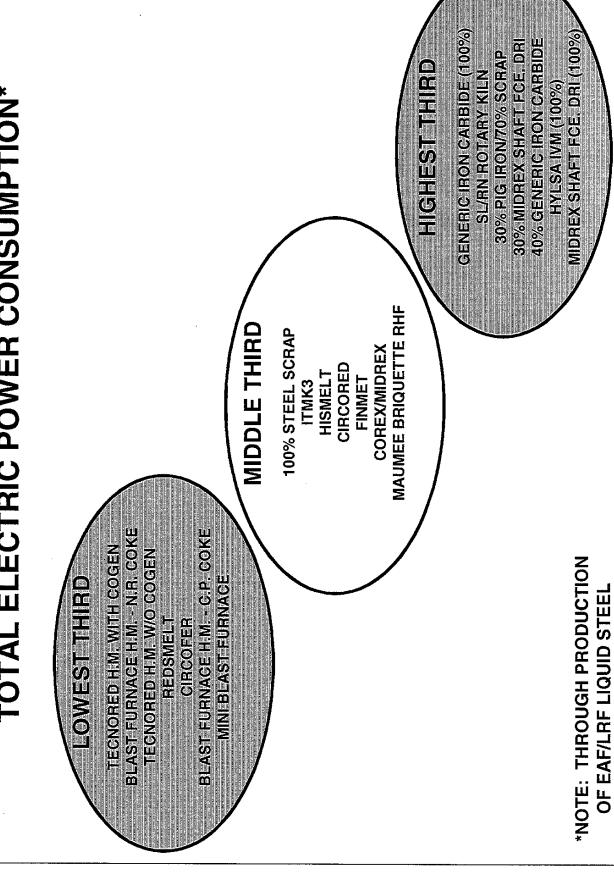
HMESANWE HISMELT

MIDREX SHAFT FURNACE DRI (30%)
BLAST FURNACE H.M. - C.P. COKE
MIDREX SHAFT FURNACE DRI (100%)
30% COLD PIG IRON70% SCRAP

COREX/MIDREX

*NOTE: THROUGH PRODUCTION OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED **TOTAL ELECTRIC POWER CONSUMPTION***



410%GENIERICHRONEGARBIDIE/SGRAP IRONMAKING PROCESSES SORTED BY ESTIMATED GENERICHEON GARBIDE (100%) SE/FINEROHARY KIENE **COREX/MIDREX** REDSMELT CIRCOFER ПМКЗ PROCESS ONLY CO2 EVOLUTION* BLAST FURNACE H.M. - N.R. COKE MIDREX SHAFT FCE. DRI (100%) **TECNORED H.M. WITH COGEN** TECNORED H.M. W/O COGEN MAUMEE BRIQUETTE RHF MIDDLE THIRD CIRCORED FINMET BEASIFIURNAGE HAME GREEKOOKE 30%MIDREXSHAHLEGE DRI 30% COLD PIG IRON/SCRAP HYLSA IVM *NOTE: THROUGH PRODUCTION HAIINIESIEAKSHEEUIRINAKOE OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED **TOTAL CUMULATIVE CO2 EVOLUTION***

LOWEST THIRD

100% STEEL SCRAP

30% MIDREX SHAPT FCE. DRI

TECNORED H.M. WITH COGEN

BLAST FURNACE H.M. - N.R. COKE

HISMELT

BLAST FURNACE - C.P. COKE

MINIBLAST FURNACE

MIDDLE THIRD

TECNORED H.M. W/O COGEN
30% COLD PIG IRON/70% SCRAP
FINMET
REDSMELT
CIRCORED

MAUMEE BRIQUETTE RHF HYLSA IVM 40% GENERIC IRON CARBIDE/SCRAP
GENERIC IRON CARBIDE (100%)
MIDREX SHAFT FURNACE DRI (100%)
ITMK3
CIRCOFER
SI/RN ROTARY KILN
COREX/MIDREX

*NOTE: INCLUDES ELECTRICAL POWER GENERATION EMISSIONS THROUGH PRODUCTION OF EAF/LRF LIQUID STEEL

= OPERATING COST PER MT LIQUID STEEL 6 = CUMULATIVE PROCESS C02 EMISSIONS = TOTAL CUMULATIVE CO2 EMISSIONS = SIMPLE INTERNAL RATE OF RETURN IRONMAKING PROCESSES SORTED BY RANKING SUM = CUMULATIVE ELECTRICAL POWER = OPERATING COST PER IRON UNIT RANKING VARIABLES MIDREX SHAFFER FOR FINAL (100%) (CINITALICATION (CARABIB) = (E1009%) CHNERICHRONECARBIDE (4.09%) - ENERGY & ENVIRONMENTAL VARIABLES 5-7 = INSTALLED CAPITAL COST SIE/FINEROITAREMEKIEN COREXIMIDAEX CIRCOFER COLD PIG IRON (30%)/SCRAP (70%) **TECNORED H.M. - W/O COGEN** MAUMEE BRIQUETTE RHF MIDDLE THIRD HYLSA IVM (100%) CIRCORED REDSMELT FINMET SHASHEUNNAGEHAMENARKEOKE SHASSELLENIAGEHAMEGEPEGOKE HEGNORED HAMEWITH COKEN *NOTE: THROUGH PRODUCTION MINIBLAST FURNAGE 1000%STEE SGRAP OF EAF/LRF LIQUID STEEL

= OPERATING COST PER MT LIQUID STEE = CUMULATIVE PROCESS C02 EMISSIONS **= TOTAL CUMULATIVE CO2 EMISSIONS** = SIMPLE INTERNAL RATE OF RETURN IRONMAKING PROCESSES SORTED BY RANKING SUM = CUMULATIVE ELECTRICAL POWER = OPERATING COST PER IRON UNIT GOIDPIGHON(30%)/SGRAP(10%) BLASHEURNAGEHHM = GPEGOKE RANKING VARIABLES MIDREX SHAFT FCE DRI (100%) = INSTALLED CAPITAL COST HIEVSAGIVANTÉ1009/6 GOBI=X//MIDREX REDSMEET - COST-RELATED VARIABLES 1-4 MINI BLAST FURNACE H.M. (30%) GENERIC IRON CARBIDE (100%) MIDREX SHAFT FCE. DRI (30%) TECNORED H.M. - W/O COGEN \$100/mt STEEL MIDDLE THIRD SL/RN ROTARY KILN **SCRAP COST** FINMET ITMK3 BIFASHELURNAGEHIMENREGOKE GENERIC IRON GARBIDE (40%) HECNORED HIM, WHIH COGEN *NOTE: THROUGH PRODUCTION MANUMEE BRIQUISHEERHE HOOSENEES OF APP OF EAF/LRF LIQUID STEEL CIRCOLER

= OPERATING COST PER MT LIQUID STEEL = CUMULATIVE PROCESS C02 EMISSIONS 7 = TOTAL CUMULATIVE CO2 EMISSIONS = SIMPLE INTERNAL RATE OF RETURN IRONMAKING PROCESSES SORTED BY RANKING SUM = CUMULATIVE ELECTRICAL POWER = OPERATING COST PER IRON UNIT GOILDFPIGHRON (80%)/ISCRAP (70%) BLASHFURNAGEHIM - G.P. COKE RANKING VARIABLES NEGNOTOR HURE WOLCOCEN MIDREX SHAFF FOE DRI(600%) = INSTALLED CAPITAL COST HWESAWWE(61009%) **€0HEX/MIDREX** HISMEH - COST-RELATED VARIABLES 1-4 BLAST FURNACE H.M. - N.R. COKE MINI BLAST FURNACE H.M. (30%) GENERIC IRON CARBIDE (100%) GENERIC IRON CARBIDE (40%) MIDREX SHAFT FCE. DRI (30%) REDSMELT \$120/mt STEEL MIDDLE THIRD SL/RN ROTARY KILN **SCRAP COST** HEGNOREDHUMFWHHEGOGEN *NOTE: THROUGH PRODUCTION HOWESHIE 100%STEEESGRAP (OIRCOHER CIRCORED FINMET III W K3

OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY RANKING SUM - COST-RELATED VARIABLES 1-4

\$140/mt STEEL SCRAP COST

RANKING VARIABLES

= INSTALLED CAPITAL COST

= OPERATING COST PER IRON UNIT

= OPERATING COST PER MT LIQUID STEEL

= SIMPLE INTERNAL RATE OF RETURN

= CUMULATIVE ELECTRICAL POWER

6 = CUMULATIVE PROCESS C02 EMISSIONS

8 = COMOLATIVE PROCESS COZ EMISSION 7 = TOTAL CUMULATIVE CO2 EMISSIONS

MIDDLE THIRD

GENERICHRON-CARBIDIE (100%)

MANUMETERS (QUETHE PRIE

CIRCORED

GIRCOLER

TINKS TINKS

TECNORED H.M. WITH COGEN SL/RN ROTARY KILN GENERIC IRON CARBIDE (40%) BLAST FURNACE H.M. - N.R. COKE REDSMELT

MIDREX SHAFT FCE. DRI (30%) MINI BLAST FURNACE H. M. (30%) TECHNORED H.M. - W/O COGEN HISMELT HYLSA IVM (100%)
BLAST FURNAGE H.M. - C.P. COKE
MIDREX SHAFT FCE. DRI (100%)

COLD PIG IRON (30%)/-SCRAP-(70%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION OF EAF/LRF LIQUID STEEL

= OPERATING COST PER MT LIQUID STEEI = CUMULATIVE PROCESS C02 EMISSIONS = TOTAL CUMULATIVE CO2 EMISSIONS = SIMPLE INTERNAL RATE OF RETURN IRONMAKING PROCESSES SORTED BY RANKING SUM = CUMULATIVE ELECTRICAL POWER = OPERATING COST PER IRON UNIT GOLD PIGHFON (30%)/SCHAP (70%) RANKING VARIABLES Generic-Iron Carridde (100%) MIDREX SHAFT FOR DRIGGOW) = INSTALLED CAPITAL COST SIJ/RN IROTARY-KIEN HWESZEWINE 61009/8 CORIEX/MIDREX REDSMELT - ALL VARIABLES SUMMED 1-7 BLAST FURNACE H.M. - C.P. COKE GENERIC IRON CARBIDE (40%) MAUMEE BRIQUETTE RHF \$100/mt STEEL MIDDLE THIRD SCRAP COST CIRCOFER HISMELT FINMET BLAST FURNACE HIM -- N.R. COKE THE GNORS DE LEMEWANTER COLCIEN MIDREX SHAFFECE, DRI (30%) HECNORED HMEW/O COCEN *NOTE: THROUGH PRODUCTION ---MINI BLASH FURNAGE 100%SAIDEESGRAP OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY RANKING SUM - ALL VARIABLES SUMMED 1-7

\$120/mt STEEL **SCRAP COST**

RANKING VARIABLES

= INSTALLED CAPITAL COST

= OPERATING COST PER IRON UNIT

= OPERATING COST PER MT LIQUID STEEL = SIMPLE INTERNAL RATE OF RETURN

BLAST FURNACE HIM - NR. COKE

CIRCORED

TEGNORED HAMEWHILE COGEN

MINIES FASTE EURNAGE HAME (80%)

WAUMEE BRIGHE HERHIE

= CUMULATIVE ELECTRICAL POWER = CUMULATIVE PROCESS C02 EMISSIONS = TOTAL CUMULATIVE C02 EMISSIONS

MIDDLE THIRD

MIDREX SHAFT FCE. DRI (30%) HISMELT CIRCOFER

BLAST FURNACE H.M. - C.P. COKE

TECNORED H.M. - W/O COGEN ITMK3

GENERIC IRON CARBIDE (100%)

REDSMELT

COLDIPICITION (30%)/SCRAP (70%) SHARNHRONDARWENIEN #WESZEIVW#(61000%)

MIDREX SHAFT FEE DIRI (100%) KORZYMIDRY

> *NOTE: THROUGH PRODUCTION OF EAF/LRF LIQUID STEEL

3 = OPERATING COST PER MT LIQUID STEEL 6 = CUMULATIVE PROCESS C02 EMISSIONS 7 = TOTAL CUMULATIVE CO2 EMISSIONS 4 = SIMPLE INTERNAL RATE OF RETURN 5 = CUMULATIVE ELECTRICAL POWER IRONMAKING PROCESSES SORTED BY RANKING SUM 2 = OPERATING COST PER IRON UNIT (COLEDIZICE EXON (COCA) EXCENTED (FOR) RANKING VARIABLES GENERICIFONECARBIDE (1002%) Midrix Shalleseath (100%) TECNORED HAM -- W/O COCEN = INSTALLED CAPITAL COST SEARINGTEAN COREXIMIDREX - ALL VARIABLES SUMMED 1-7 BLAST FURNACE H.M. - C.P. COKE HISMELT MINI BLAST FURNACE H.M. (30%) GENERIC IRON CARBIDE (100%) MIDREX SHAFT FCE. DRI (30%) \$140/mt STEEL MIDDLE THIRD **SCRAP COST** REDSMELT **ITMK3** BHASTFEURINAGEHRM=-NRF-GOKE HEGNOTHED HAM WITH GOIGH *NOTE: THROUGH PRODUCTION WAUME ESPICIOENEETHE 100%-STEEL SCRAP OF EAF/LRF LIQUID STEEL CIRCOFER