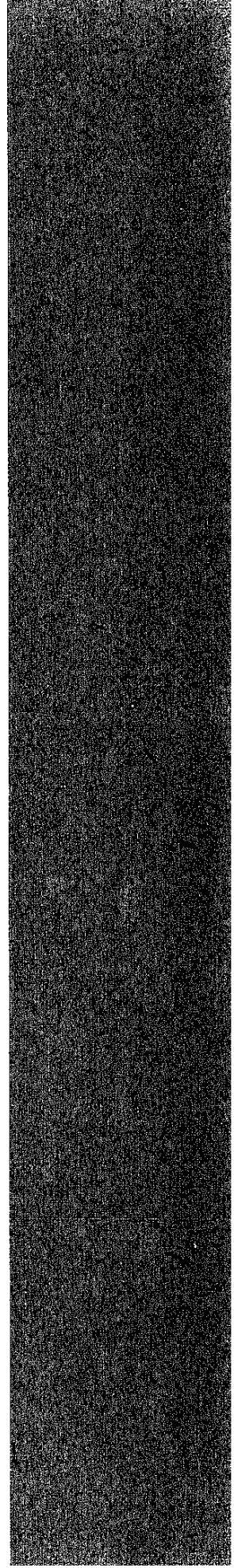


APPENDIX F

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**

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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

12-June-2000

Rev. 2

BASIS:

1.0000 MM MT/YEAR PELLETTIZING BINDER (BENTONITE)

SUMMARY CONSUMABLES BENTONITE BINDER PREPARATION

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 POWER COSTS - (\$/kWhr)

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
BINDER MINING:				
	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 PELLETT PLANT	1.0000	0.0300	1.0300
	REJECT TAILINGS TO DISPOSAL	0.0526	0.0016	0.0542
	PREP. P ELECTRICAL POWER REQ'D (MM kWhr/yr)	14.9275		
	NET PREPPED BENTONITE TO PELLETT PLANT	1.0000	0.0300	1.0300
TRANSPORT TO PELLETTIZING:				
	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

12-June-2000

Rev. 2

BASIS:

1.000 MM MT/YR COAL DELIVERED

SUMMARY CONSUMABLES COAL ONLY - DELIVERED TO USE

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

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (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
TRANSPORTATION 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

13-June-2000

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BASIS:

1.0001 MM MT/YEAR BURNT LIME/DOLOMITE

SUMMARY CONSUMABLES BURNT LIME/DOLOMITE

SUMMARY:

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

ASSUMPTIONS:

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 (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
LIME ROCK MINING:				
	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	
	MINE ELECTRICAL POWER REQ'D - (MM kWhr/yr)	9.3234		
LIME ROCK PREP 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		
LIME CALCINATION:				
	NET PREPPED LIME ROCK TO CALC.	1.7607	0.0528	1.8135
	DIESEL FUEL - LIME ROCK TRANS.		0.0002	
	BURNT LIME/DOLOMITE	1.0001	0.0000	1.0001
	N.G. FUEL (DRYING, CALCINATION, ETC.)		0.2184	
	CALC, ELECTRICAL POWER REQ'D	46.5875		
	NET LIME/MgO SHIPPED	1.0001	0.0000	1.0001
	LIME TRANSPORT FUEL		0.0063	

ALIME

13-June-2000

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**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
91.1852	TOTAL ELECTRICAL POWER - (MM kWhr/yr)	\$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
\$1.657	OPERATING HOURS/mt - MINE HAUL TRUCKS (4)	\$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
\$3.000	EQUIPMENT MAINTENANCE & PARTS - \$/mt	\$3,000,000	\$3.00
\$12.500	RAW MATERIAL VALUE ADDED - \$/mt	\$12,500,000	\$12.50
	TOTAL:	\$77,826,004	\$77.83

AORE
13-June-2000
Rev. 2
BASIS:

SUMMARY CONSUMABLES LUMP IRON ORE DELIVERED

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:

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)
0.00449 FUEL REQUIREMENT - SHIPPING (kg/mt/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
\$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 (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
LUMP ORE MINING:				
	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		0.0026	
	MINE ELECTRICAL POWER REQ'D - (MM kWhr/yr)	20.6657		
ORE PREPARATION:				
	CRUSHED LUMP ORE TO SHIPPING	1.0003	0.0300	1.0303
	FINE ORE TO DISPOSAL	0.2501	0.0075	0.2576
	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:	\$37,836,259	\$37.84	

AFINEORE
 13-June-2000
 Rev. 2
 BASIS:

SUMMARY CONSUMABLES FINE IRON ORE DELIVERED

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

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
LUMP ORE MINING:				
	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		0.0026	
	MINE ELECTRICAL POWER REQ'D - (MM kWhr/yr)	20.6657		
ORE PREPARATION:				
	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

Rev. 2

BASIS:

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

**SUMMARY CONSUMABLES
 IRON ORE CONCENTRATOR**

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

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (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 CONCENTRATION:				
	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)

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
ORE MINING:				
	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		
ORE CONCENTRATION:				
	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		
PELLETIZING:				
	NET OXIDE FEED TO PELLETIZING	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		
	NET PELLETS, ETC. TO SHIPMENT	1.0000		
	N.G. FUEL (DRYING, INDURATION, ETC.)		0.0288	
	PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr)	71.8837		
COSTS - THROUGH PELLETT DELIVERY:		\$/YEAR	\$/T	
197.4046	TOTAL ELECTRIC POWER REQ'D - (MM kWhr/yr)	\$6,514,353	\$6.51	
0.0183	TOTAL FUEL OIL THROUGH PELLETT - MM mt/yr	\$7,591,173	\$7.59	
0.0288	TOTAL N.G. FUEL THROUGH PELLETT - MM mt/yr	\$3,589,842	\$3.59	
\$1.201	CONC. PLANT LABOR COSTS - \$/mt PRODUCT	\$1,201,000	\$1.20	
\$1.377	ORE MINING LABOR COSTS - (\$/mt ORE)	\$4,324,123	\$4.32	
\$1.100	PELLET PLANT LABOR COSTS - (\$/mt PELLETT)	\$1,100,000	\$1.10	
\$3.660	PELLET PLANT CONSUM. COSTS - (\$/mt PELLETT)	\$3,660,000	\$3.66	
\$3.850	FINE ORE PIPELINE TRANSPORT COSTS - \$/mt	\$3,850,000	\$3.85	
\$5.000	EQUIPMENT COST AMORTIZATION - \$/mt (PEL.)	\$5,000,000	\$5.00	
\$1.125	EQUIPMENT MAINTENANCE & PARTS - \$/mt (PEL.)	\$1,125,000	\$1.13	
\$10.000	RAW MATERIAL VALUE ADDED - \$/mt	\$10,000,000	\$10.00	
	TOTAL:	\$47,955,491	\$47.96	

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Rev. 2

BASIS:

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

SUMMARY CONSUMABLES COPRODUCT COKE PRODUCTION

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 OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (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)	<u>\$7,500,000</u>	<u>\$7.50</u>	
	TOTAL:	\$140,000,000	\$140.00	

ANRCOK

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 CONSUMABLES NON-RECOVERY COKE/CO-GENERATION

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.)
- 425.67 (kWhr/MT CHAR) ELECTRIC POWER GENERATED
- 515.50 (kWhr/MT COKE) ELECTRIC POWER GENERATED
- \$10.00 FINE COAL RECLAIMED - VALUE ADDED (\$/mt CONC.)
- \$38.50 LABOR COSTS - (\$/MN-HR INCLUDING BURDEN)

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
CHAR PRODUCT PRODUCTION:				
	FINE COAL SLURRY RECLAIMED	1.261	2.943	4.204
	ELECTRIC POWER IN COAL RECLAIM	6.937		
	FINE COAL TO CLEANING	1.236	2.935	4.171
	ELECTRICAL POWER IN CLEANING	9.272		
	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
	ELECTRICAL POWER IN CHARRING	10.355		
	TOTAL ELEC. THROUGH CHARRING	26.564		
	CO-GENERATED ELECTRIC POWER - CHAR	(351.444)		
	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-RECOVERY 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	

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**SUMMARY CONSUMABLES
NON-RECOVERY COKE/CO-GENERATION**

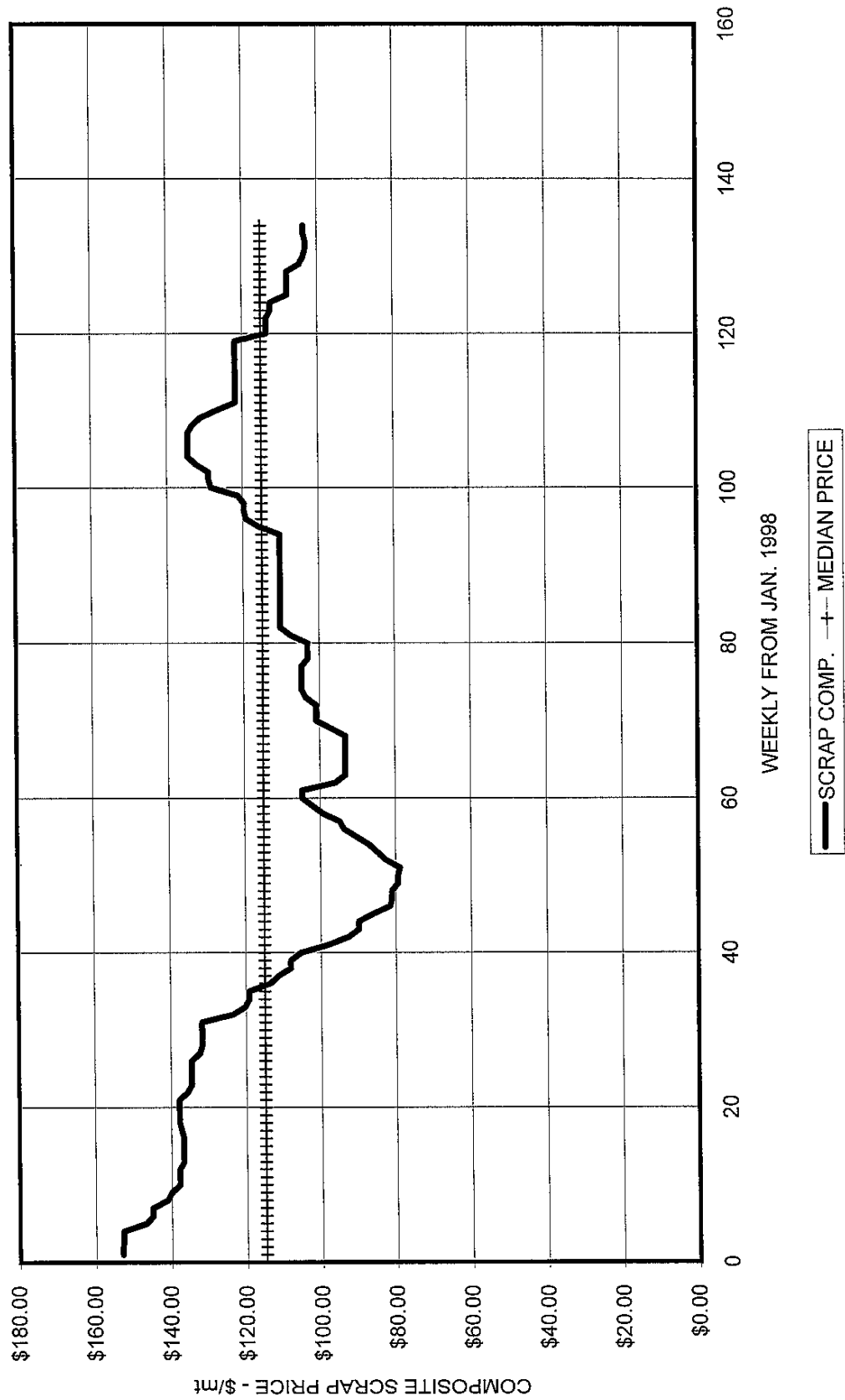
COSTS:		\$/YEAR	\$/T - PROD	\$/T - COKE
CHAR PRODUCT PRODUCTION:				
\$10.00	FINE COAL SLURRY RECLAIMED - (\$/mt DRY)	\$12,613,402	\$15.28	\$12.61
0.826	CHAR PRODUCT TO BRIQUETTING			
\$0.033	TOTAL ELEC. THROUGH CHARRING	\$876,619	\$1.06	\$0.88
\$0.033	CO-GENERATED ELECTRIC POWER - CHAR	(\$11,597,647)	(\$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 COKE)	(\$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

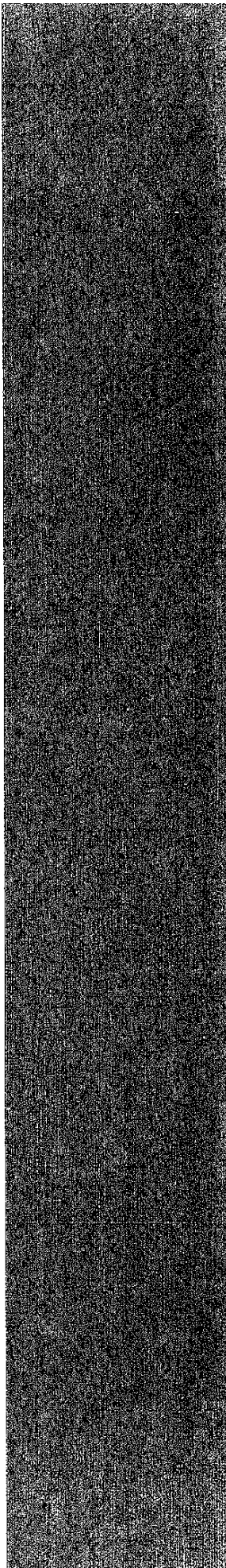
(From American Metal Market)

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
	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
MARCH	8	\$128.00	\$95.00	\$110.50	\$141.12	\$104.74	\$121.83
	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
APRIL	13	\$124.00	\$84.50	\$110.50	\$136.71	\$93.16	\$121.83
	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
MAY	17	\$124.50	\$88.00	\$103.00	\$137.26	\$97.02	\$113.56
	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
	21	\$125.00	\$94.00	\$98.00	\$137.81	\$103.64	\$108.05
JUNE	22	\$123.00	\$95.00	\$98.00	\$135.61	\$104.74	\$108.05
	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
	25	\$122.00	\$95.00	\$95.00	\$134.51	\$104.74	\$104.74
JULY	26	\$122.00	\$93.50	\$94.00	\$134.51	\$103.08	\$103.64
	27	\$120.00	\$93.50	\$93.50	\$132.30	\$103.08	\$103.08
	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
AUGUST	31	\$119.50	\$100.00		\$131.75	\$110.25	
	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	37	\$101.00	\$100.00		\$111.35	\$110.25	
	38	\$98.00	\$100.00		\$108.05	\$110.25	
	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	\$110.25	
	42	\$84.00	\$100.00		\$92.61	\$110.25	
	43	\$81.50	\$105.00		\$89.85	\$115.76	
	44	\$81.50	\$108.00		\$89.85	\$119.07	
NOVEMBER	45	\$78.00	\$108.50		\$86.00	\$119.62	
	46	\$74.00	\$108.50		\$81.59	\$119.62	
	47	\$73.50	\$110.00		\$81.03	\$121.28	
DECEMBER	48	\$73.50	\$116.50		\$81.03	\$128.44	
	49	\$72.00	\$117.00		\$79.38	\$128.99	
	50	\$72.00	\$117.00		\$79.38	\$128.99	
	51	\$71.50	\$120.00		\$78.83	\$132.30	
	52	\$75.00	\$122.00		\$82.69	\$134.51	
MEDIAN PRICE (1998-2000):						\$115.00	

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



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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

18-June-2000

Rev. 2

BASIS:

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

SUMMARY CONSUMABLES
BASE PROCESS SHAFT FURNACE DRI/EAF
100% DRI CHARGE - 1.0 wt.% CARBON

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
ORE MINING:				
	AS-MINED ROCK	6.2935	0.1946	6.4882
	WASTE ROCK	3.8060	0.1177	3.9237
	DIESEL FUEL (MINING ETC.)		0.0327	
	MINE ELECTRICAL POWER REQ'D (MM kWhr/yr)	31.4785		
ORE CONCENTRATION:				
	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		
	CONC. SLURRY PIPELINE POWER (MM kWhr/yr)	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		
SHAFT FURNACE 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		0.2555	
	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	141.5137		
EAF STEELMAKING:				
	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)	736.0266		
LADLE REFINING:				
	LIQ. EAF STEEL TO LRF	0.0000	1.0549	1.0549
	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)	34.8973		
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9768	0.0000	0.9768

ABASE

18-June-2000

Rev. 2

SUMMARY CONSUMABLES
BASE PROCESS SHAFT FURNACE DRI/EAF
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: 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	\$43.89
PELLETIZING:					
	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:					
	DRI TO EAF (1.0% C)	1.0450			
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	\$288,656	\$0.29	\$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	\$1,151,610	\$1.15	\$1.15
	SUB-TOTAL LRF:		\$6,815,685	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$205,382,946	\$205.38	

A10025

18-June-2000

Rev. 2

BASIS:

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

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

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
ORE MINING:				
	AS-MINED ROCK	6.3014	0.1949	6.4963
	WASTE ROCK	3.8107	0.1179	3.9286
	DIESEL FUEL (MINING ETC.)		0.0327	
	MINE ELECTRICAL POWER REQ'D (MM kWhr/yr)	31.5022		
ORE CONCENTRATION:				
	IRON ORE TO CONCENTRATOR	2.4907	0.0770	2.5677
	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		
PELLETIZING:				
	NET OXIDE FEED TO PELLETIZING	1.9714	0.1729	2.1443
	BINDER TO PELLETIZING	0.0118	0.0000	0.0118
	DOLOMITE TO PELLETIZING	0.0402	0.0000	0.0402
	TOTAL OTHER FEED TO PELLETIZING	0.5044		
	FUEL (DRYING, INDURATION, ETC.)		0.0514	
	PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr)	128.1416		
SHAFT FURNACE 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	
	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	143.8703		
EAF STEELMAKING:				
	TOTAL STEEL SCRAP (100% DRI)	0.0648	0.0000	0.0648
	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)		19.2500	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	736.4717		
LADLE REFINING:				
	LIQ. EAF STEEL TO LRF	0.0000	1.0549	1.0549
	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)	34.9184		
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9774	0.0000	0.9774

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SUMMARY CONSUMABLES
BASE PROCESS SHAFT FURNACE DRI/ EAF
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	\$2.37
\$124.45	PELLET N.G. FUEL - (\$/mt)	0.0514	\$6,399,407	\$6.40	\$3.59
	SUB-TOTAL PELLETIZING:		\$24,126,816	\$24.13	\$13.53
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	\$1.54
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	\$648,303	\$0.65	\$0.61
\$1,058.61	MISC. ADDITIVES - (AVG. \$/mt)	0.0072	\$7,580,000	\$7.58	\$7.19
\$58.15	STEEL C (CHARGE+SLAG INJ)	0.0099	\$576,293	\$0.58	\$0.55
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0045	\$4,605,810	\$4.61	\$4.37
\$77.10	LIME CHARGED	0.0126	\$968,452	\$0.97	\$0.92
\$0.042	O2 GAS TO EAF (MM Nm3/YR)	19.2500	\$808,500	\$0.81	\$0.77
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)	736.4717	\$24,303,567	\$24.30	\$23.04
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,831	\$0.29	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$61,094,755	\$61.09	\$57.91
LADLE REFINING:					
	LIQ. EAF STEEL TO CASTING	1.0000			
\$169.40	PULV. LIME TO LADLE REF. FCE. - (\$/mt)	0.0053	\$893,531	\$0.89	\$0.89
\$700.00	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,459	\$0.26	\$0.26
\$0.240	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,191	\$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)	34.9184	\$1,152,306	\$1.15	\$1.15
	SUB-TOTAL LRF:		\$6,817,087	\$6.82	\$6.82
TOTAL THROUGH LIQUID STEEL:			\$206,412,215	\$206.41	

ASC100

19-June-2000

Rev. 2

BASIS:

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

**SUMMARY CONSUMABLES
ELECTRIC ARC FURNACE WITH SCRAP CHARGE ONLY
100% STEEL SCRAP CHARGE TO EAF**

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

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
EAF STEELMAKING:				
	REVERT SCRAP CHARGE TO EAF	0.0496	0.0000	0.0496
	PURCHASED SCRAP CHARGE TO EAF	1.0280	0.0000	1.0280
	TOTAL STEEL SCRAP (100%)	1.0776	0.0000	1.0776
	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 REFINING 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

19-June-2000

Rev. 2

SUMMARY CONSUMABLES
ELECTRIC ARC FURNACE WITH SCRAP CHARGE ONLY
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					
EAF STEELMAKING:					
	REFINED STEEL TO LRF	1.0543			
\$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
	SUB-TOTAL EAF STEELMAKING:		\$211,622,171	\$211.13	\$200.26
LADLE REFINING:					
	LIQ. EAF STEEL TO CASTING	1.0521			
\$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
TOTAL THROUGH LIQUID STEEL:			\$218,437,800	\$217.94	

A3010

18-June-2000

Rev. 2

BASIS:

1.0000 MM MT/YEAR LIQUID STEEL PRODUCT

0.9767 MM MT/YEAR NET SLAB PRODUCT

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

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
ORE MINING:				
	AS-MINED ROCK	2.0874	0.0646	2.1520
	WASTE ROCK	1.2623	0.0390	1.3014
	DIESEL FUEL (MINING ETC.)		0.0099	
	MINE ELECTRICAL POWER REQ'D (MM kWhr/yr)	16.1883		
ORE CONCENTRATION:				
	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		
	CONC. SLURRY PIPELINE POWER (MM kWhr/yr)	40.4968		
PELLETIZING:				
	NET OXIDE FEED TO PELLETIZING	0.8419	0.0738	0.9157
	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		
	FUEL (DRYING, INDURATION, ETC.)		0.0220	
	PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr)	54.7208		
SHAFT FURNACE DIRECT REDUCTION:				
	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		0.0863	
	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	47.7673		
EAF STEELMAKING:				
	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	0.0125
	O2 GAS TO EAF (MM Nm3/YR)		11.8117	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	737.2919		
LADLE REFINING:				
	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	0.0004
	ARGON GAS TO LRF (MM Nm3/YR)		0.0632	
	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8913		
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9767	0.0000	0.9767

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Rev. 2

SUMMARY CONSUMABLES
BASE PROCESS SHAFT FURNACE DRI/EAF
30% 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: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
ORE:					
\$43.89	IRON ORE CONC. DELIVERED - (\$/mt DRY)	0.4860	\$21,328,869	\$21.33	\$43.89
PELLETIZING:					
	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	\$1.34	\$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	\$1.81	\$2.37
\$124.45	PELLET N.G. FUEL - (\$/mt)	0.0220	\$2,732,762	\$2.73	\$3.59
	SUB-TOTAL PELLETIZING:		\$10,302,960	\$10.30	\$13.53
DIRECT REDUCTION IN SHAFT FURNACE:					
	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:		\$16,872,863	\$16.87	\$47.83
EAF STEELMAKING:					
	REFINED STEEL TO LRF	1.0541			
\$140.00	TOTAL STEEL SCRAP (30% DRI, REVERT & BUNDLE)	0.7364	\$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
	SUB-TOTAL EAF STEELMAKING:		\$162,771,513	\$162.77	\$154.41
LADLE REFINING:					
	LIQ. EAF STEEL TO CASTING	1.0000			
\$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	\$1.15	\$1.15
	SUB-TOTAL LRF:		\$6,815,288	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$218,091,493	\$218.09	

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Rev. 2

BASIS:

1.0000 MM MT/YEAR LIQUID STEEL PRODUCT

0.9767 MM MT/YEAR NET SLAB PRODUCT

SUMMARY CONSUMABLES
BASE PROCESS SHAFT FURNACE DRI/ EAF
30% DRI CHARGE - 2.5% C

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
ORE MINING:				
	AS-MINED ROCK	2.0888	0.0646	2.1534
	WASTE ROCK	1.2632	0.0391	1.3023
	DIESEL FUEL (MINING ETC.)		0.0099	
	MINE ELECTRICAL POWER REQ'D (MM kWhr/yr)	16.1948		
ORE CONCENTRATION:				
	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		
	CONC. SLURRY PIPELINE POWER (MM kWhr/yr)	40.5237		
PELLETIZING:				
	NET OXIDE FEED TO PELLETIZING	0.8422	0.0739	0.9161
	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		
	FUEL (DRYING, INDURATION, ETC.)		0.0220	
	PELLET ELECTRICAL POWER REQ'D (MM kWhr/yr)	54.7449		
SHAFT FURNACE DIRECT REDUCTION:				
	NET PELLETS, ETC. TO SHAFT FCE.	0.7616	0.0000	0.7616
	DRI TO EAF (2.5% C)	0.3584	0.0000	0.3584
	FUEL TO DRI		0.0876	
	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	48.5357		
EAF STEELMAKING:				
	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)		25.0833	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	737.3320		
LADLE REFINING:				
	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)		0.0633	
	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8932		
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9767	0.0000	0.9767

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SUMMARY CONSUMABLES
BASE PROCESS SHAFT FURNACE DRI/ EAF
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:		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
PER UNIT					
ORE:					
\$43.89	IRON ORE CONC. DELIVERED - (\$/mt DRY)	0.4863	\$21,343,027	\$21.34	\$43.89
	PELLETIZING:				
	NET PELLETS, ETC. TO SHAFT FCE.	0.7616			
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	\$0.60
\$77.83	DOLOMITE TO PELLET. - (\$/mt LIME/DOL.)	0.0172	\$1,337,770	\$1.34	\$1.76
\$2.36	PELLET OTHER - (\$/mt PELLETS)	0.7616	\$1,797,318	\$1.80	\$2.36
\$0.033	PELLET ELECTRICAL - (MM kWhr/yr)	54.7449	\$1,806,582	\$1.81	\$2.37
\$124.45	PELLET N.G. FUEL - (\$/mt)	0.0220	<u>\$2,733,967</u>	<u>\$2.73</u>	<u>\$3.59</u>
	SUB-TOTAL PELLETIZING:		\$10,307,505	\$10.31	\$13.53
DIRECT REDUCTION IN SHAFT FURNACE:					
	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	\$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	<u>\$10,907,454</u>	<u>\$10.91</u>	<u>\$30.43</u>
	SUB-TOTAL DRI PRODUCTION:		\$17,144,288	\$17.14	\$47.83
EAF STEELMAKING:					
	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	\$7.19
\$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	<u>\$288,623</u>	<u>\$0.29</u>	<u>\$0.27</u>
	SUB-TOTAL EAF STEELMAKING:		\$163,834,945	\$163.83	\$155.42
LADLE REFINING:					
	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	<u>\$1,151,475</u>	<u>\$1.15</u>	<u>\$1.15</u>
	SUB-TOTAL LRF:		\$6,815,414	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$219,445,179	\$219.45	

AHYLV

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SUMMARY CONSUMABLES
HYLSA IVM PROCESS SHAFT FURNACE DRI/EAF
100% DRI CHARGE - 4.0 wt.% CARBON

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 OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (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 CONCENTRATION:				
	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 FURNACE DIRECT REDUCTION:				
	NET PELLETS, ETC. TO SHAFT FCE.	1.781	0.000	1.781
	DRI TO EAF (1.0% C, >450°C)	1.045	0.000	1.045
	FUEL TO DRI		0.2062	
	DRI ELECTRICAL POWER REQ'D - (kWhr/yr)	108.857		

AHYLIV

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SUMMARY CONSUMABLES
HYLSA IVM PROCESS SHAFT FURNACE DRI/ EAF
100% DRI CHARGE - 4.0 wt.% CARBON

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
EAF STEELMAKING:				
	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)		44.00	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (kWhr/yr)	639.221		
LADLE REFINING:				
	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)		0.0633	
	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

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SUMMARY CONSUMABLES
HYLSA IVM PROCESS SHAFT FURNACE DRI/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
 \$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	\$43.89
PELLETIZING:					
	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:					
	DRI TO EAF (1.0% C)	1.0450			
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)	108.8567	\$3,592,270	\$3.59	\$3.44
\$124.45	N.G. FUEL TO DRI - (\$/mt)	0.2062	\$25,656,170	\$25.66	\$24.55
	SUB-TOTAL DRI PRODUCTION:		\$42,762,983	\$42.76	\$40.92
EAF STEELMAKING:					
	REFINED STEEL TO LRF	1.0543			
\$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)	0.0084	\$489,310	\$0.49	\$0.46
\$1,031.03	EAF ELECTRODES - (\$/mt)	0.0038	\$3,939,447	\$3.94	\$3.74
\$77.10	LIME CHARGED	0.0124	\$952,588	\$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	\$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)	639.2210	\$21,094,291	\$21.09	\$20.01
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,656	\$0.29	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$58,155,205	\$58.16	\$55.16
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	\$1,151,610	\$1.15	\$1.15
	SUB-TOTAL LRF:		\$6,815,685	\$6.82	\$6.82
TOTAL THROUGH LIQUID STEEL:			\$196,141,518	\$196.14	

HOT METAL VARIATIONS

ABF

18-June-2000

Rev. 2

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.)

**SUMMARY CONSUMABLES
 BLAST FURNACE HOT METAL/EAF
 30% BF HOT METAL CHARGE - CO-PRODUCT COKE**

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
BLAST FURNACE:				
	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
	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 STEELMAKING:				
	TOTAL STEEL SCRAP (100% DRI)	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)		38.9907	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	542.1070		
LADLE REFINING:				
	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		
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

ABF

18-June-2000

Rev. 2

**SUMMARY CONSUMABLES
BLAST FURNACE HOT METAL/EAF
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
 \$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
BLAST FURNACE:					
BF HOT METAL FROM FURNACE TO EAF					
		0.3584			
\$37.84	LUMP IRON ORE FEED	0.1054	\$3,987,425	\$3.99	\$11.13
\$47.96	IRON PELLETT 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:					
	REFINED STEEL TO LRF	1.0000			
\$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:		\$6,816,080	\$6.82	\$6.82
TOTAL THROUGH LIQUID STEEL:			\$219,117,786	\$219.12	

ABFNRC

18-June-2000

Rev. 2

**SUMMARY CONSUMABLES
BLAST FURNACE HOT METAL/EAF
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 OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
BLAST FURNACE:				
	LUMP IRON ORE FEED	0.1076	0.0000	0.1076
	IRON PELLET FEED	0.2145	0.0000	0.2145
	IRON SINTER FEED	0.2145	0.0000	0.2145
	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
	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
			AS N.G.	
EAF STEELMAKING:				
	TOTAL STEEL SCRAP (100% DRI)	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)		38.9907	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D (MM kWhr/yr)	542.1070		
LADLE REFINING:				
	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	0.0004	0.0000	0.0004
	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

ABFNRC

18-June-2000

Rev. 2

**BLAST FURNACE HOT METAL/EAF
30% BF HOT METAL CHARGE
NON-RECOVERY PROCESS 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
 \$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
	BLAST FURNACE:				
	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 PELLETT 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:				
	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	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$157,109,974	\$157.11	\$148.99
	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:		\$6,816,080	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$207,696,321	\$207.70	

APIG

19-June-2000

Rev. 2

SUMMARY CONSUMABLES
BLAST FURNACE PRODUCING PIG IRON AS CHARGE TO EAF
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.)

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
BLAST FURNACE:				
	LUMP IRON ORE FEED	0.1054	0.000	0.105
	IRON PELLETT FEED	0.2097	0.000	0.210
	IRON SINTER FEED	0.2097	0.000	0.210
	IRON SCRAP FEED	0.0337	0.000	0.034
	LIMESTONE FEED	0.0026	0.000	0.003
	GRAVEL FEED	0.0026	0.000	0.003
	COKE FEED	0.1753	0.000	0.175
	AIR TO FURNACE (AS GAS)	0.0000	0.587	0.587
	MOISTURE TO FURNACE (AS GAS)	0.0000	0.006	0.006
	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:				
	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)			
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:				
	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

APIG

19-June-2000

Rev. 2

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

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
	BLAST FURNACE:				
	BF HOT METAL TO PIGGING	0.3584			
\$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
	PIGGING OPERATION:				
	BF PIG IRON TO EAF	0.3584			
\$2.25	PIGGING OPERATION (ALL-IN)	0.3584	\$806,437	\$0.81	\$2.25
	SUB-TOTAL BF PIG IRON:		\$806,437	\$0.81	\$2.25
	EAF STEELMAKING:				
	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	\$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	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$164,702,084	\$164.70	\$156.19
	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:		\$6,816,080	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$226,709,895	\$226.71	

ATECN

19-June-2000

Rev. 2

SUMMARY CONSUMABLES**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 OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (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
	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 FURNACE 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	
	ELEC. POWER - CONSUMED FCE - (MM kWhr/yr)	25.0740	GENERATED	378.1112
	HOT METAL PRODUCED	0.0000	0.3582	
EAF FURNACE:				
	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)		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 REFINING:				
	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		
	REFINED STEEL TO CASTING	0.0000	1.0523	1.0523
	NET STEEL SLAB PRODUCED	0.9770	0.0000	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

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

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt 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			
	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:		\$21,284,581	\$21.28	\$33.38
TECNORED FURNACE:					
	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 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	\$22.14
\$0.033	NET ELECTRICAL POWER REQ'D (MM kWhr/yr)	(378.1)	(\$12,477,670)	(\$12.48)	(\$34.81)
0.1860	LABOR IN TECNO - (\$/mt)	0.3584	\$66,651	\$0.07	\$0.19
\$10.00	OTHER IN TECNO - (\$/mt)	0.3584	\$3,584,166	\$3.58	\$10.00
	SUB-TOTAL BF HOT METAL:		\$23,864,860	\$23.86	\$66.58
EAF STEELMAKING:					
	REFINED STEEL TO LRF	1.0523			
\$140.00	TOTAL STEEL SCRAP (REVERT & PURCHASED)	0.7366	\$103,127,846	\$103.13	\$98.00
\$1,070.09	MISC. ADDITIVES - (AVG. \$/mt)	0.0071	\$7,580,000	\$7.58	\$7.20
\$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	\$3.77
\$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	\$288,705	\$0.29	\$0.27
	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	\$1,151,806	\$1.15	\$1.15
	SUB-TOTAL LRF:		\$6,816,080	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$185,862,764	\$207.15	

ATECN2

19-June-2000

Rev. 2

SUMMARY CONSUMABLES**TECNORED PROCESS THROUGH EAF PROD. OF LIQ. STEEL
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 OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (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
	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 FURNACE 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	
	ELEC. POWER - CONSUMED FCE - (MM kWhr/yr)	25.0740		
	HOT METAL PRODUCED	0.0000	0.3582	
EAF FURNACE:				
	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)		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 REFINING:				
	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		
	REFINED STEEL TO CASTING	0.0000	1.0523	1.0523
	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

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.

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
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			
	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	<u>\$2,391,385</u>	<u>\$2.39</u>	<u>\$3.75</u>
	SUB-TOTAL GREEN-BALL PELLETIZING:		\$21,284,581	\$21.28	\$33.38
TECNORED FURNACE:					
	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 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	\$22.14
\$0.033	NET ELECTRICAL POWER REQ'D (MM kWhr/yr)	25.1	\$827,443	\$0.83	\$2.31
0.1860	LABOR IN TECNO - (\$/mt)	0.3584	\$66,651	\$0.07	\$0.19
\$10.00	OTHER IN TECNO - (\$/mt)	0.3584	<u>\$3,584,166</u>	<u>\$3.58</u>	<u>\$10.00</u>
	SUB-TOTAL BF HOT METAL:		\$37,169,973	\$37.17	\$103.71
EAF STEELMAKING:					
	REFINED STEEL TO LRF	1.0523			
\$140.00	TOTAL STEEL SCRAP (REVERT & PURCHASED)	0.7366	\$103,127,846	\$103.13	\$98.00
\$1,070.09	MISC. ADDITIVES - (AVG. \$/mt)	0.0071	\$7,580,000	\$7.58	\$7.20
\$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	\$3.77
\$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	\$288,705	\$0.29	\$0.27
	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>\$1.15</u>
	SUB-TOTAL LRF:		\$6,816,080	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$199,167,877	\$220.45	

ACOREX
 04-Aug-2000
 Rev. 3
 BASIS:

**SUMMARY CONSUMABLES
 COREX HOT METAL/EAF
 60% COREX HOT METAL CHARGE - 40% MIDREX DRI**

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 OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
COREX FURNACE:				
	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 SHAFT 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
 04-Aug-2000
 Rev. 2

SUMMARY CONSUMABLES
COREX HOT METAL/EAF
60% COREX HOT METAL CHARGE - 40% MIDREX DRI

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
EAF STEELMAKING:				
	MIDREX DRI (40.13% DRI)	0.4180	0.0000	0.4180
	HOT METAL FROM COREX FURNACE	0.6237	0.0000	0.6237
	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)		38.99	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (kWhr/yr)	406.2297		
LADLE REFINING FURNACE:				
	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
Rev. 3

**SUMMARY CONSUMABLES
COREX HOT METAL/EAF
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
\$0.033 ELECTRICAL POWER RATE - (\$/kWhr)

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
COREX:					
\$37.84	IRON ORE LUMP. DELIVERED - (\$/mt DRY)	0.4313	\$16,322,186	\$16.32	\$26.17
\$47.96	IRON ORE PELLETS DELIVERED - (\$/mt)	0.4313	\$20,687,421	\$20.69	\$33.17
\$40.00	IRON SINTER FEED	0.1181	\$4,722,696	\$4.72	\$7.57
\$10.00	IRON SCRAP FEED	0.0000	\$0	\$0.00	\$0.00
\$65.00	LIMESTONE FEED	0.1382	\$8,985,262	\$8.99	\$14.41
\$50.00	GRAVEL FEED	0.1382	\$6,911,740	\$6.91	\$11.08
\$58.16	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)		\$6,236,559	\$6.24	\$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:					
\$47.96	MIDREX DRI (40.13% DRI)	0.4180			
\$0.04	NET PELLETS, ETC. TO SHAFT FCE.	0.7124	\$34,166,704	\$34.17	\$81.74
\$11.39	DRI LABOR - (MN-HR/mt DRI)	0.4180	\$644,674	\$0.64	\$1.54
\$0.033	DRI OTHER - (\$/mt DRI)	0.4180	\$4,761,020	\$4.76	\$11.39
\$124.45	DRI ELECTRICAL POWER REQ'D (MM kWhr/yr)	82.4296	\$2,720,177	\$2.72	\$6.51
	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:					
	REFINED STEEL TO LRF	1.0545			
	MIDREX DRI (40.13% DRI)	0.4180			
	HOT METAL FROM COREX FURNACE	0.6237			
\$0.00	TOTAL STEEL SCRAP (REVERT ONLY)	0.0000	\$0	\$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	\$0.92
\$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)	406.2297	\$13,405,579	\$13.41	\$12.71
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,705	\$0.29	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$49,507,306	\$49.51	\$46.95
LADLE REFINING:					
\$169.40	LIQ. EAF STEEL TO CASTING	1.0000			
\$700.00	PULV. LIME TO LADLE REF. FCE. - (\$/mt)	0.0053	\$893,142	\$0.89	\$0.89
\$0.240	SLAG/WIRE DESULFURIZER TO LRF	0.0004	\$258,347	\$0.26	\$0.26
\$4.498	ARGON GAS TO LRF (MM Nm3/YR)	0.0633	\$15,184	\$0.02	\$0.02
\$0.033	LRF OTHER - (\$/mt L.S.)	1.0000	\$4,497,600	\$4.50	\$4.50
	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.9032	\$1,151,806	\$1.15	\$1.15
	SUB-TOTAL LRF:		\$6,816,080	\$6.82	\$6.82
	TOTAL THROUGH LIQUID STEEL:		\$218,161,736	\$218.16	

AHISMT
21-June-2000
Rev. 2
BASIS:

SUMMARY CONSUMABLES
HISMELT PROCESS TO PRODUCE HOT METAL
32.7% HOT METAL CHARGE TO EAF

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 Nm ³ /YEAR AIR
61.452	MMM Nm ³ /YEAR OXYGEN
16.760	MMM Nm ³ /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 Nm ³ /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 - (Nm ³ /mt HM)
1,378.531	TOTAL AIR TO SRV - (Nm ³ /mt HM)
186.441	OXYGEN TO SRV - (Nm ³ /mt HM)
80.00%	PERCENT C IN COAL
174.81	SRV PLANT ELEC. POWER REQ'D, W/O O ₂ PLANT - (kWhr/mt HM)
0.3953	TOTAL ORE/TOTAL MINED ROCK RATIO - (MT/mt)

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SUMMARY CONSUMABLES
HISMELT PROCESS TO PRODUCE HOT METAL
32.7% HOT METAL CHARGE TO EAF

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
SRV REACTOR SYSTEM:				
	IRON ORE FINES FEED	0.5345	0.0000	0.5345
	COAL FINES TO FEED	0.2045	0.0000	0.2045
	OXYGEN GAS TO SRV - (MM Nm3/yr)	61.4524	0.0000	61.4524
	FLUX CHARGED TO SRV (LIME)	0.0615	0.0000	0.0615
	NATURAL GAS TO SRV - (MM Nm3/yr)	16.7598	0.0125	16.7598
	HOT METAL LEAVING SRV TO EAF	0.3585	0.0000	0.3585
	ELECT. POWER CONSUMMED IN SRV - (MM kWhr/yr)	62.6727		
EAF STEELMAKING:				
	HOT METAL LEAVING SRV TO EAF	0.3585	0.0000	0.3585
	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	0.0124
	O2 GAS TO EAF (MM Nm3/YR)		36.8404	
	LIQ. EAF STEEL TO LRF	0.0000	1.0545	1.0545
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	486.4149		
LADLE REFINING:				
	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	0.0025	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

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**SUMMARY CONSUMABLES
HISMELT PROCESS TO PRODUCE HOT METAL
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
 \$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)	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 Nm ³ /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	\$11.39
	SUB-TOTAL DRI PRODUCTION:		\$25,957,567	\$25.96	\$72.40
EAF STEELMAKING:					
	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	O ₂ GAS TO EAF (MM Nm ³ /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 Nm ³ /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:		\$8,307,733	\$8.31	\$8.31
	TOTAL THROUGH LIQUID STEEL:		\$212,904,134	\$212.90	

ROTARY HEARTH DRI FURNACES

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**SUMMARY CONSUMABLES
ROTARY HEARTH DIRECT REDUCTION/SAF/EAF PROCESS
(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)
3,344.545 TOTAL AIR TO RHF - (Nm3/mt HM)
13.500 OXYGEN TO RHF - (Nm3/mt HM)
18.6200 ELECTRIC POWER CONSUMED IN G-B PELLET. - (kWhr/mt GB)
0.9301 NET IRON RECOVERY IN SAF + LTF

PROCESS OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
GREEN BALL PELLETIZING:				
	IRON ORE FINES TO PELLETIZING	1.4535	0.0000	1.4535
	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
	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 HEARTH 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 ARC FURNACE MELTER:				
	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	0.0018		
	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		

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SUMMARY CONSUMABLES
ROTARY HEARTH DIRECT REDUCTION/SAF/ EAF PROCESS
(E.G. REDSMELT, IRON DYNAMICS, FASTMELT, ETC.)

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
EAF STEELMAKING:				
	PURCHASED SCRAP TO EAF	0.1181		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	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D	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

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**SUMMARY CONSUMABLES
ROTARY HEARTH DIRECT REDUCTION/SAF/EAF PROCESS
(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: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
ORE FINES:					
\$21.19	IRON ORE FINES TO PELLETIZING	1.4535	\$30,800,714	\$30.80	\$15.30
GREEN BALL PELLETIZING:					
\$40.71	COAL FINES TO PELLETIZING	0.3496	\$14,233,112	\$14.23	\$7.07
\$90.02	BINDER TO PELLETIZING	0.0203	\$1,828,958	\$1.83	\$0.91
	RECYCLE DUST TO PELLETIZING	0.2046			
	RECYCLE PELLETS TO PELLETIZING	0.0516			
	GROSS GREEN-BALL PELLETS	2.0653			
\$0.033	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	\$4,750,203	\$4.75	\$2.36
	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			
\$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			
\$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/yr)	318.9235	\$10,524,475	\$10.52	\$11.55
0.1019	SAF LABOR - (MN-HR/mt)	0.9112	\$3,574,026	\$3.57	\$3.92
10.46	SAF OTHER - (\$/mt)	0.9112	\$9,531,256	\$9.53	\$10.46
	SUB-TOTAL HM PRODUCTION IN SAF:		\$38,675,376	\$38.68	\$42.44

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**SUMMARY CONSUMABLES
 ROTARY HEARTH DIRECT REDUCTION/SAF/EAF PROCESS
 (E.G. REDSMELT, IRON DYNAMICS, FASTMELT, ETC.)**

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
EAF STEELMAKING:					
	REFINED STEEL TO LRF	1.0032			
	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:					
	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

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Rev. 2

BASIS:

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

SUMMARY CONSUMABLES

MAUMEE ROTARY HEARTH FURNACE DRI WITH BRIQUETTES/EAF

100% DRI CHARGE - 4.0 wt.% CARBON

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)

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
BRIQUETTING OF IRON UNITS:				
	ORE FINES DELIVERED TO PLANT SITE	0.7868		0.7868
	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		1.1217
	AUXILIARY FUEL TO DRI		0.0567	
	RHF DRI ELEC. POWER REQ'D - (MM kWhr/yr)	165.0916		
EAF STEELMAKING:				
	HBI FEED TO EAF	1.1217		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		0.0023	
	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
	NET STEEL SLAB PRODUCED	0.9768	0.0000	0.9768

AMAUMEE

22-June-2000

Rev. 2

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

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
ORE FINES:					
	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:					
\$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			
	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	\$12.07
	SUB-TOTAL GREEN-BALL PELLETIZING:		\$41,930,014	\$41.93	\$22.09
ROTARY HEARTH FURNACE:					
	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	\$5.45	\$4.86
0.1098	LABOR IN RHF - (\$/mt)	1.1217	\$4,742,672	\$4.74	\$4.23
\$13.69	OTHER IN RHF - (\$/mt)	1.1217	\$15,355,662	\$15.36	\$13.69
	SUB-TOTAL SAF HOT METAL:		\$32,604,415	\$32.60	\$29.07
EAF STEELMAKING:					
	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	\$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	\$18.70
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,652	\$0.29	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$60,969,232	\$60.97	\$57.83
LADLE REFINING:					
	LIQ. EAF STEEL TO CASTING	1.0000			
\$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	\$4.50
\$0.033	LRF ELECTRICAL POWER REQ'D (MM kWhr/yr)	34.8703	\$1,150,721	\$1.15	\$1.15
	SUB-TOTAL LRF:		\$9,124,443	\$9.12	\$9.12
	TOTAL THROUGH LIQUID STEEL:		\$177,034,955	\$177.03	

AITMK3

22-June-2000

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

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 OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
PELLETIZING/DRYING:				
	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 REDUCTION:				
	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 kWhr/yr)	133.3960		

AITMK3

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Rev. 3

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

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
EAF STEELMAKING:				
	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	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (MM kWhr/mt)	467.0000		
	LIQ. EAF STEEL TO LRF	0.0000	1.0032	1.0032
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	0.0025		0.0004
	ARGON GAS TO LRF (MM Nm3/YR)		0.063	
	LRF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	34.8703		
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

AITMK3

22-June-2000

Rev. 3

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

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
ORE FINES:					
\$21.19	IRON ORE FINES TO PELLETIZING	1.4535	\$30,800,714	\$30.80	\$21.19
GREEN BALL PELLETIZING:					
\$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			
	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	<u>\$6,489,190</u>	<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			
	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>
	SUB-TOTAL RHF HOT SHOT IRON:		\$30,900,985	\$30.90	\$33.46
EAF STEELMAKING:					
	REFINED STEEL TO LRF	1.0032			
	NET HOT SHOT 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)	0.0038	\$3,917,931	\$3.92	\$3.91
\$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
\$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	<u>\$288,705</u>	<u>\$0.29</u>	<u>\$0.29</u>
	SUB-TOTAL EAF STEELMAKING:		\$75,003,422	\$75.00	\$74.77
LADLE REFINING:					
	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	0.0025	\$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>	<u>\$1.15</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

19-June-2000

Rev. 2

BASIS:

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

SUMMARY CONSUMABLES

CIRCORED/HBI/EAF

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

SUMMARY:

- 1.791 MM MT/YEAR FINE ORE FEED (BY-PRODUCT OF LUMP)
- 1.544 MM MT/YEAR NET INDURATED MICRO PELLETS
- 1.089 MM MT/YEAR NET DRI 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)
- 27.6 MICRO PELLET PLANT ELEC. POWER REQ'D (kWhr/mt FEED)
- 1.00% DRI/HBI PERCENT CARBON - (WT.% C)
- 15.05 FUEL TO DRI - (GJ/mt DRI)
- 301.95 FUEL TO DRI - (kg/mt DRI)
- 147.18 HBI ELEC. POWER REQ'D - (kWhr/mt HBI)
- 2.20 AUX. FUEL TO EAF/LRF - kg/mt LIQ. ST.
- 566.7 EAF ELEC. POWER (TOTAL) - (kWhr/mt LIQ. STEEL)
- 33.075 LRF ELEC. POWER - (kWhr/mt LIQ. STEEL)

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
FINE ORE MICROPELLETIZING:				
	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.)		0.0467	
	MICRO-PELLET ELEC. POWER REQ'D - (MM kWhr/yr)	49.3584		
DIRECT REDUCTION - CFB/BB:				
	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 STEELMAKING:				
	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 REFINING:				
	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

Rev. 2

SUMMARY CONSUMABLES
CIRCORED/HBI/EAF
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: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt 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>	<u>\$3.77</u>
	SUB-TOTAL PELLETIZING:		<u>\$7,576,666</u>	<u>\$7.58</u>	<u>\$4.91</u>
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	<u>\$40,922,190</u>	<u>\$40.92</u>	<u>\$37.58</u>
	SUB-TOTAL DRI PRODUCTION:		<u>\$78,219,475</u>	<u>\$78.22</u>	<u>\$71.83</u>
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	\$0.90
\$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	\$15.96
\$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	<u>\$288,652</u>	<u>\$0.29</u>	<u>\$0.27</u>
	SUB-TOTAL EAF STEELMAKING:		<u>\$55,601,711</u>	<u>\$55.60</u>	<u>\$52.74</u>
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:		<u>\$5,921,802</u>	<u>\$5.92</u>	<u>\$5.92</u>
TOTAL THROUGH LIQUID STEEL:			\$185,266,268	\$185.27	

ACIRFR

19-June-2000

Rev. 2

Page 1

BASIS:

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:

1.737 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 MICROPELLETIZING:				
	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 REDUCTION 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		
	SLAG/WIRE DESULFURIZER TO LTF	0.0046		
	ELECTRIC POWER CONSUMP. SAF/LTF - (MM kWhr/yr)	318.9235		

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**SUMMARY CONSUMABLES
CIRCOFER PROCESS TO PRODUCE HOT METAL
MAXIMUM HOT METAL CHARGED - CFB/SAF/EAFF**

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
EAFF 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	
EAFF 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

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SUMMARY CONSUMABLES
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: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
ORE:					
\$21.19	IRON ORE FINES DELIVERED - (\$/mt DRY)	1.7367	\$36,799,736	\$36.80	\$21.19
FINE ORE MICROPELLETIZING:					
\$5.00	ORE FINES DELIVERED TO PLANT SITE	1.7367			
\$26.67	RECYCLE DUST TO MICROPELLETIZING	0.0868	\$434,164	\$0.43	\$0.25
	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	\$1,628,826	\$1.63	\$1.06
	SUB-TOTAL PELLETIZING:		\$15,081,672	\$15.08	\$8.81
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 PELLETS) - (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	\$3,800,677	\$3.80	\$3.70
	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	\$9,531,256	\$9.53	\$9.29
	SUB-TOTAL HM PRODUCTION IN SAF:		\$38,675,376	\$38.68	\$40.83

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

COSTS: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
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	\$288,705	\$0.29	\$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	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
	SUB-TOTAL LRF:		\$6,657,409	\$6.66	\$6.66
TOTAL THROUGH LIQUID STEEL:			\$188,541,164	\$188.54	

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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)

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
FINE ORE MICROPELLETIZING:				
	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
	FUEL (DRYING, INDURATION, ETC.)		0.0457	
	MICRO-PELLET ELEC. POWER REQ'D - (kWhr/yr)	28.9590		
DIRECT REDUCTION - 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		0.2830	
	DRI/HBI ELECTRICAL POWER REQ'D - (kWhr/mt)	187.5973		
EAF STEELMAKING:				
	HBI FEED TO EAF	1.0890		1.0890
	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)	0.0120	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 - (kWhr/mt)	597.4453		
LADLE REFINING:				
	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 - (kWhr/mt)	34.8703		
	REFINED STEEL TO CASTING	0.0000	1.0521	1.0521
	NET STEEL SLAB PRODUCED	0.9768	0.0000	0.9768

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SUMMARY CONSUMABLES
FINMET FLUIDED BED DIRECT REDUCTION HBI/EAF
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: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
ORE:					
\$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)				
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	\$5,684,295	\$5.68	\$3.77
	SUB-TOTAL PELLETIZING:		\$6,774,720	\$6.77	\$4.49
DIRECT REDUCTION IN CFB/BB FLUID BED REACTORS:					
	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:					
	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	\$0.90
\$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	\$4,485,250	\$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)	597.4453	\$19,715,695	\$19.72	\$18.70
\$124.45	N.G. AUX. FUEL TO EAF	0.0023	\$288,652	\$0.29	\$0.27
	SUB-TOTAL EAF STEELMAKING:		\$55,601,961	\$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	\$0.26
\$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	\$1,150,721	\$1.15	\$1.15
	SUB-TOTAL LRF:		\$5,921,802	\$5.92	\$5.92
	TOTAL THROUGH LIQUID STEEL:		\$185,121,343	\$185.12	

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BASIS:

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

**SUMMARY CONSUMABLES
 GENERIC IRON CARBIDE/EAF**

100% IC CHARGE - 6.5 wt.% CARBON

SUMMARY:

1.701 MM MT/YEAR FINE ORE FEED (BY-PRODUCT OF LUMP) 13.40
 1.229 MM MT/YEAR NET IC TO EAF 268.86
 33.075

ASSUMPTIONS:

0.0154 TOTAL FUEL FOR ORE SHIPPING (MT/mt FINE ORE) 0.0364
 6.50% EFFECTIVE IC PERCENT CARBON - (WT.% C)
 67.20% ORE FINES PERCENT IRON - (WT.% Fe DRY) 9,000.00
 1.0763

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
ORE HANDLING/DELIVERY:				
	ORE FINES DELIVERED TO PLANT SITE	1.7011		1.7011
FLUID-BED REDUCTION PROCESS:				
	NET IRON CARBIDE TO EAF (1.0% C)	1.2289		1.2289
	FUEL TO IRON CARBIDE REACTOR		0.3304	
	IRON CARBIDE ELEC. POWER REQ'D - (MM kWhr/yr)	253.4460		
EAF STEELMAKING:				
	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)		71.5000	
	AUX. FUEL TO EAF		0.0023	
	EAF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	509.2178		
LADLE REFINING:				
	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	1.0521	1.0521
	NET STEEL SLAB PRODUCED	0.9768	0.0000	0.9768

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**SUMMARY CONSUMABLES
GENERIC IRON CARBIDE/EAF
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: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt 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:					
	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	\$41,118,476	\$41.12	\$33.46
	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	\$288,652	\$0.29	\$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	\$1,150,721	\$1.15	\$1.15
	SUB-TOTAL LRF:		\$5,921,802	\$5.92	\$5.92
	TOTAL THROUGH LIQUID STEEL:		\$177,845,224	\$177.85	

AIC2

20-June-2000

Rev. 1

**SUMMARY CONSUMABLES
IRON CARBIDE/SAF MELTER/EAF
40% IRON CARBIDE CHARGE - 6.5 wt.% CARBON**

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

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
ORE HANDLING/DELIVERY:				
	ORE FINES DELIVERED TO PLANT SITE	0.6804		0.6804
FLUID-BED REDUCTION PROCESS:				
	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 ARC MELTING FURNACE FOR IC:				
	NET IC CHARGE TO SAF	0.4916	0.0000	0.4916
	LIME FLUX TO SAF	0.0298		
	SILICA FLUX TO SAF	0.0157		
	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 STEELMAKING:				
	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
	O2 GAS TO EAF (MM Nm3/YR)		44.48	
	AUX. FUEL TO EAF		0.0023	0.0053
	EAF ELECTRICAL POWER REQ'D - (MM kWhr/yr)	268.3688	0.063	
LADLE REFINING:				
	LIQ. EAF STEEL TO LRF	0.0000	1.0317	1.0317
	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)	0.0000	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

20-June-2000

Rev. 1

**SUMMARY CONSUMABLES
IRON CARBIDE/SAF MELTER/EAF
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: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
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 REACTORS:					
	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	\$16.45	\$33.46
	SUB-TOTAL DRI PRODUCTION:		\$32,537,414	\$32.54	\$66.19
IRONMAKING IN SAF FURNACE:					
	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/yr)	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:					
	REFINED STEEL TO LRF	1.0317			
	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
	SUB-TOTAL EAF STEELMAKING:		\$134,773,608	\$134.77	\$130.64
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	\$993,135	\$0.99	\$0.99
	SUB-TOTAL LRF:		\$6,657,409	\$6.66	\$6.66
TOTAL THROUGH LIQUID STEEL:			\$205,395,012	\$205.40	

OTHER PROCESSES

ASLRN

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

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 OPERATION	STREAM LABLE	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
GREEN-BALL PELLETIZING:				
	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
	RECYCLE PELLETS TO PELLETIZING	0.0516	0.0070	0.0587
	GROSS PELLETS	2.0653	0.2816	2.3469
	ELEC. POWER IN G-B PELLETIZING - (MM kWhr/yr)	38.4560		
ROTARY KILN 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		

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

PROCESS OPERATION	STREAM LABEL	DRY SOLIDS (MM T/YR)	LIQUID (MM T/YR)	TOTAL (MM T/YR)
EAFF STEELMAKING:				
	NET DRI CHARGE	0.9365	0.0000	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
	LIME CHARGED	0.0243		0.0243
	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	
	LRF ELECTRICAL POWER REQ'D - (MM kWhr/mt)	30.0950		
	REFINED STEEL TO CASTING	0.0000	1.0000	1.0000
	NET STEEL SLAB PRODUCED	0.9770	0.0000	0.9770

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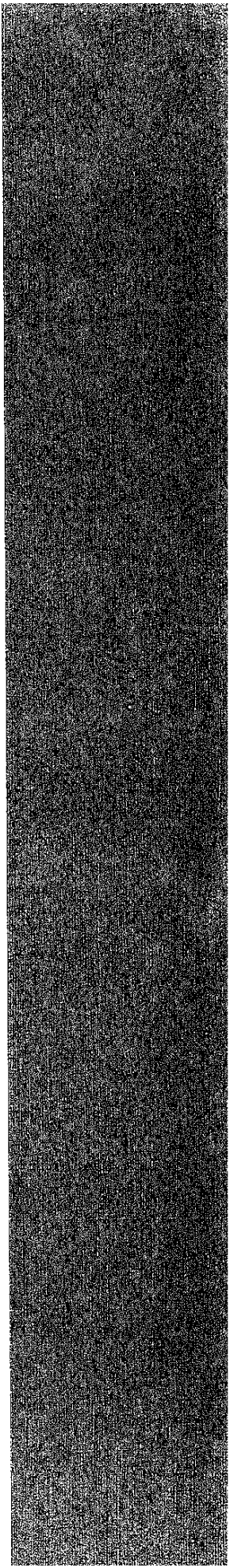
SUMMARY CONSUMABLES
SL/RN PROCESS TO PRODUCE DRI
MAXIMUM DRI CHARGED - 85.8 WT.%

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: PER UNIT		(MM mt/YR)	\$/YEAR	\$/mt L.S.	\$/mt UNIT
ORE:					
\$21.19	IRON ORE CONC. DELIVERED - (\$/mt DRY)	1.3560	\$28,733,640	\$28.73	\$21.19
PELLETIZING:					
NET GREENBALL PELLETS:					
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	\$1,269,048	\$1.27	\$0.63
SUB-TOTAL PELLETIZING:			\$49,072,305	\$49.07	\$24.37
DIRECT REDUCTION IN ROTARY KILN:					
0.0676	DRI TO EAF (4.0% C)	0.9365			
	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	\$5,470,822	\$5.47	\$5.84
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
SUB-TOTAL EAF STEELMAKING:			\$78,263,927	\$78.26	\$78.02
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	0.0038	\$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
SUB-TOTAL LRF:			\$9,059,062	\$9.06	\$9.06
TOTAL THROUGH LIQUID STEEL:			\$185,443,658	\$185.44	

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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	PROCESS ELEC. POWER REQ'D. (kWhr/mt LS)	COMPONENT ELEC. POWER REQ'D. (kWhr/mt LS)	TOTAL ELEC. POWER REQ'D. (kWhr/mt LS)	PROCESS CO2 PRODUCED (mt/mt LS)	EQUIV. E.P. CO2 PRODUCED (mt/mt LS)	TOTAL CO2 EQUIVALENT (mt/mt LS)
SHAFT FURNACE DRI - VARIATION IN CARBON AND SCRAP CHARGE							
C-1	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON	1,263.96	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
C-3	100% STEEL SCRAP CHARGE TO EAF	761.83	60.62	822.45	0.0874	0.8035	0.8909
C-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
C-5	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
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF	1,134.50	132.87	1,267.37	0.9086	1.1560	2.0646
HOT METAL VARIATIONS							
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
C-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
C-9	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 (378.11)	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	563.99	263.37	847.37	0.8689	0.7729	1.6418

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

APPENDIX	IRONMAKING PROCESS	PROCESS ELEC. POWER REQ'D. (kW/hr/mt LS)	COMPONENT ELEC. POWER REQ'D. (kW/hr/mt LS)	TOTAL ELEC. POWER REQ'D. (kW/hr/mt LS)	PROCESS CO2 PRODUCED (mt/mt LS)	EQUIV. E.P. CO2 PRODUCED (mt/mt LS)	TOTAL CO2 EQUIVALENT (mt/mt LS)
ROTARY HEARTH FURNACES							
C-14	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	513.46	176.82	690.28	1.3624	0.6296	1.9921
C-15	MAUMEE BRIQUETTE DR/ EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	837.27	128.82	966.09	1.1498	0.8812	2.0310
C-16	ITMK3 TO EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	670.17	155.23	825.40	1.5213	0.7529	2.2742
FLUID-BED DR/ HBI							
C-17	CIRCORED/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	841.96	58.89	900.84	1.1999	0.8217	2.0217
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
C-19	FINMET/HBI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	848.87	58.89	907.76	1.0742	0.8280	1.9022
C-20a	GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF	797.53	175.42	972.95	1.2864	0.8874	2.1738
OTHER PROCESSES							
C-21	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 all-in 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 not 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 significant variable 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

SEQ. NO.	PROCESS	COST PER NET MT LIQUID STEEL							TOTAL LIQ. STEEL	
		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MKG.		LADLE REFINING
SHAFT FURNACE DRI PROCESSES:										
C-1	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
C-3	100% STEEL SCRAP CHARGE TO EAF						\$102.80	\$67.21	\$6.82	\$176.83
C-4	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT. % DRI CARBON		\$21.33	\$10.30	\$16.87		\$73.64	\$59.68	\$6.82	\$188.64
C-5	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT. % DRI CARBON		\$21.34	\$10.31	\$17.14		\$73.64	\$60.73	\$6.82	\$189.99
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF		\$64.31	\$24.10	\$42.76			\$58.16	\$6.82	\$196.15
HOT METAL VARIATIONS										
C-7	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	\$3.99	\$18.45			\$32.75	\$73.66	\$53.98	\$6.82	\$189.65
C-8	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	\$4.07	\$10.29			\$29.41	\$73.66	\$53.98	\$6.82	\$178.23
C-9	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	\$3.99	\$18.45			AS PIG \$33.56	\$73.66	\$61.57	\$6.82	\$198.05
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION			\$21.28		\$23.86	\$73.66	\$52.05	\$6.82	\$177.67
C-11	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION			\$21.28		\$37.17	\$73.66	\$52.05	\$6.82	\$190.98
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	\$81.03	\$52.06	\$8.31	\$190.82

**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.	PROCESS	COST PER NET MT LIQUID STEEL									
		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MKG.	LADLE REFINING	TOTAL LIQ. STEEL	
ROTARY HEARTH FURNACES											
C-14	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$30.80		\$31.78	\$22.33	\$38.68	\$11.81	\$46.24	\$6.67	\$188.31	
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		\$11.81	\$58.47	\$8.32	\$178.76	
FLUID-BED DRI/HBI											
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	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	\$63.75	\$46.52	\$6.66	\$179.90	
OTHER PROCESSES											
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$28.73		\$49.07	\$20.31		\$11.81	\$61.73	\$9.09	\$180.74	

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES

SENSITIVITY: \$120.00/mt STEEL SCRAP PRICE

SEQ. NO.	PROCESS	COST PER NET MT LIQUID STEEL									
		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MKG.	LADLE REFINING	TOTAL LIQ. STEEL	
SHAFT FURNACE DRI PROCESSES:											
C-1	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	
C-3	100% STEEL SCRAP CHARGE TO EAF						\$123.36	\$67.21	\$6.82	\$197.39	
C-4	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	
C-5	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	
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF		\$64.31	\$24.10	\$42.76			\$58.16	\$6.82	\$196.15	
HOT METAL VARIATIONS											
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	
C-8	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	
C-9	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	\$3.99	\$18.45			AS PIG \$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-11	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	

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

SEQ. NO.	PROCESS	COST PER NET MT LIQUID STEEL									
		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MKG.	LADLE REFINING	TOTAL LIQ. STEEL	
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	MAJUMEE BRIQUETTE DR/ 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-BED DR/ HBI											
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	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	
OTHER PROCESSES											
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	

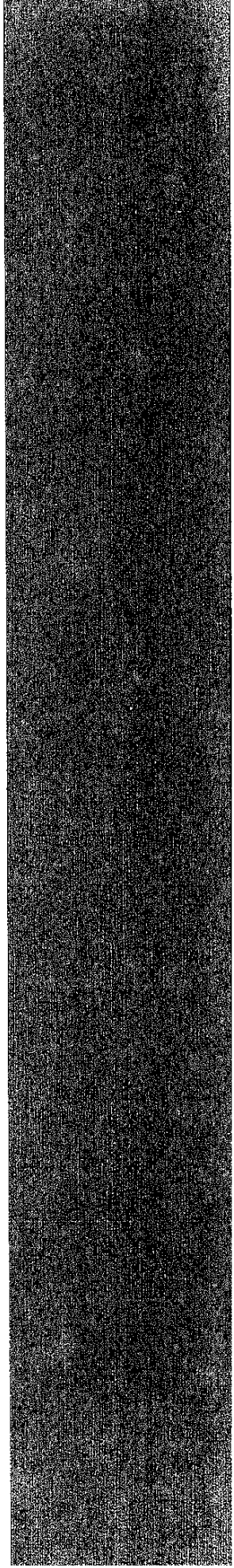
SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES

SENSITIVITY: \$140.00/mt STEEL SCRAP PRICE		COST PER NET MT LIQUID STEEL									
SEQ. NO.	PROCESS	ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MT KG.	LADLE REFINING	TOTAL LIQ. STEEL	
SHAFT FURNACE DRI PROCESSES:											
C-1	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	
C-3	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	
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF		\$64.31	\$24.10	\$42.76			\$58.16	\$6.82	\$196.15	
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	
C-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	
C-9	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	\$23.46	\$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	

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

SENSITIVITY: \$140.00/mt STEEL SCRAP PRICE		COST PER NET MT LIQUID STEEL									
SEQ. NO.	PROCESS	ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MTKG.	LADLE REFINING	TOTAL LIQ. STEEL	
ROTARY HEARTH FURNACES											
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-BED DRI/HBI											
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	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	\$89.25	\$45.52	\$6.66	\$205.40	
OTHER PROCESSES											
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$28.73		\$49.07	\$20.31		\$16.63	\$61.73	\$9.09	\$185.46	

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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.

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION					TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	
SHAFT FURNACE DRI PROCESSES:							
C-1	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON						
	IRON UNIT INPUT:	Concentrate delivered to pelletizing plant.	1.4652				
	INDURATED PELLET PRODUCTION:	Composite of four Vendor quotations for similar scope.	3.3000 3.5000 4.2000 5.0000	\$135.0 \$155.0 \$175.0 \$300.0 AVERAGE: \$46.72	\$40.91 \$44.29 \$41.67 \$60.00 \$46.72		\$83.19
	KOBE/MIDREX SHAFT FURNACE:	Composite of three Vendor quotations for similar scope.	4.5000 4.0000 4.5000	\$670.0 \$565.0 \$655.0 AVERAGE:	\$148.89 \$141.25 \$145.56 \$145.23		\$151.77
	ELECTRIC ARC STEELMAKING/LRF:	Composite of three Vendor quotations for similar scope.	4.9200 4.9200 4.9200	\$410.0 \$385.0 \$400.0 AVERAGE:	\$83.33 \$78.25 \$81.30 \$80.96		\$85.41
	OUTSIDE BOUNDARY LIMITS:	Includes: ore/concentrate storage, water services, waste disposal, off-gas treatment, offices, labs, etc. (L-S.)	4.0000	\$180.0	\$45.00		\$45.00
C-2	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON						
	IRON UNIT INPUT:	Same as C-1.	1.4670				
	INDURATED PELLET PRODUCTION:	Same as C-1.			\$46.72		\$83.27
	KOBE/MIDREX SHAFT FURNACE:	Same as C-1.			\$145.23		\$151.77
	ELECTRIC ARC STEELMAKING/LRF:	Same as C-1.			\$80.96		\$85.41
	OUTSIDE BOUNDARY LIMITS:	Same as C-1.			\$45.00		\$45.00
							\$365.36
							\$365.45

NOTES: (1) 2000 BASIS

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION						TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	UNIT CST./ mt LIQ. ST.	
C-3	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 1.0280	\$153.12 \$20.56	\$173.68
C-4	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON IRON UNIT INPUT: INDURATED PELLET PRODUCTION: KOBEMIDREX 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. Same as C-3.	0.4860		\$46.72 \$145.23 \$80.96 \$45.00 \$20.00	0.7612 0.3527 1.0541 1.0000 0.7364	\$35.56 \$51.22 \$85.34 \$45.00 \$14.73	\$231.85
C-5	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON IRON UNIT INPUT: INDURATED PELLET PRODUCTION: KOBEMIDREX 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. Same as C-3.	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
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF IRON UNIT INPUT: INDURATED PELLET PRODUCTION: HYLIVM SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-1. Same as C-1. Composite of two Vendor quotations for similar scope. Same as C-1. Same as C-1.	1.4650 4.2000 2.8000	\$612.0 \$390.8 AVERAGE:	\$46.72 \$145.71 \$139.56 \$142.64 \$80.96 \$45.00	1.7807 1.0450 1.0543 1.0000	\$83.19 \$149.05 \$85.36 \$45.00	\$362.60

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION					TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	
HOT METAL VARIATIONS							
C-7	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE IRON UNIT INPUT: INTEGRATED BLAST FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Lump ore, Pellets, Sinter, Scrap, etc. delivered to stockpiles with reclaim and handling systems included in OSBL. Based on Vendor quotation. Same as C-1. Same as C-1. Same as C-3.	0.1054 0.2097 0.2097 0.0337 2.3100	\$6335.00	\$275.00 \$80.96 \$45.00 \$20.00	0.3584 1.0542 1.0000 0.7366	\$98.56 \$85.35 \$45.00 \$14.73 \$243.64
C-7a	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. Same as C-3.	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
C-8	30% BLAST FURNACE HOT METAL/70% 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. Same as C-3.			\$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
C-9	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. Same as C-3.	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

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT. LIQUID STEEL PRODUCTION						TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM m/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	UNIT GST./ mt LIQ. ST.	
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION IRON UNIT INPUT (AS FINE ORE):	Iron ore fines received into stockpiles with reclaim systems to green-ball pelletizing. Internal LGE cost estimate for confidential client.	0.5080	\$14.1	\$46.62	0.6377	\$29.73	
	GREEN-BALL PELLET PRODUCTION:		0.3020	\$29.5	\$97.59	0.3584	\$34.98	
	TECHNORED FURNACE & ANCILLARIES:	Internal LGE cost estimate for confidential client.	0.3020	\$7.4	\$24.57	0.3584	\$8.81	
	CO-GENERATION:	Internal LGE cost estimate for confidential client.	1.2500	\$75.0	\$60.00	1.0540	\$63.24	
	ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Based on internal LGE estimate. Same as C-1. Same as C-3.			\$20.00	0.7366	\$14.73	\$196.48
C-11	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION IRON UNIT INPUT (AS FINE ORE):	Same as C-10.	0.5080	\$14.1	\$46.62	0.6377	\$29.73	
	GREEN-BALL PELLET PRODUCTION:	Same as C-10.	0.3020	\$29.5	\$97.68	0.3584	\$35.01	
	TECHNORED FURNACE & ANCILLARIES:	Same as C-10.	1.2500	\$75.0	\$60.00	1.0540	\$63.24	
	ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Based on internal LGE estimate. Same as C-1. Same as C-3.			\$45.00	1.0000	\$45.00	
	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX):	Iron ore as lump and as pellets are on a purchased basis.	0.4313	\$104.1	\$344.83	0.6237	\$215.07	
C-12	MIDREX SHAFT FURNACE:	Iron ore pellets are purchased. Based on Vendor quotation.	0.4313	\$17.8	\$120.00	0.4180	\$50.16	
	COREX FURNACE & ANCILLARIES:		0.7124		\$60.00	1.0545	\$63.27	
	MIDREX SHAFT FURNACE:	Same as C-1.	0.3020		\$60.00	1.0000	\$45.00	
	ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-1. Same as C-1.	0.1480		\$45.00	1.0000	\$45.00	\$373.50

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION					TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	
C-13	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:	Same as C-10. Based on Vendor quotation. Same as C-1. Same as C-1. Same as C-3.	0.5345 0.3650	\$116.6	\$319.45 \$80.96 \$45.00 \$20.00	0.3585 1.0545 1.0000 0.7366	\$114.52 \$85.37 \$45.00 \$14.73 \$259.63
ROTARY HEARTH FURNACES							
C-14	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION: ROTARY HEARTH REDUCTION FCE.:	Same as C-10. Same as C-10 with adjustments. Based on three Vendor quotations.	1.4545 0.3020 3.4000 1.2500	\$42.2 \$465.0 \$166.2 AVERAGE: \$136.47	\$23.32 \$139.67 \$136.76 \$132.98 \$136.47	2.0653	\$48.16
	SUBMERGED ARC MELTING FURNACE:	Based on three Vendor quotations.	0.3020 3.4000 1.2500	\$14.0 \$160.0 \$53.1 AVERAGE:	\$46.36 \$47.06 \$42.50 \$45.31	0.9112	\$41.28
	ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Based on internal LGE estimate. Same as C-1. Same as C-3.	1.2500	\$75.0	\$60.00 \$45.00 \$20.00	1.0032 1.0000 0.1544	\$60.19 \$45.00 \$3.09 \$334.67
C-15	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): GREEN BRIQUETTE PRODUCTION: ROTARY HEARTH REDUCTION FCE.:	Same as C-10. Based on Vendor quotation. Based on Vendor quotation. Same as C-1. Same as C-3.	1.5735 0.1200 0.1200	\$4.3 \$14.5	\$35.83 \$120.83 \$80.96 \$45.00	1.9932 1.1217 1.0543 1.0000	\$71.42 \$135.54 \$85.36 \$45.00 \$292.32

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION					TOTAL SCOPE	
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.		UNIT CST./ mt LIQ. ST.
C-16	ITMIK3 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.	1.4535 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
FLUID-BED DRI/HBI								
C-17	CIRCORED/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-1. 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 1.0890 1.0543 1.0000	\$15.34 \$114.35 \$32.67 \$85.36 \$45.00	\$232.37
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. Same as C-1.	1.7387 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	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. Same as C-1.	1.7511 4.0000 4.0000 4.0000	\$40.0 \$649.0 \$180.0	\$10.00 \$162.25 \$45.00 \$35.83 \$30.00	1.5091 1.0890 1.0890 1.0543 1.0000	\$15.09 \$176.69 \$49.01 \$37.78 \$30.00	\$263.47

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION					TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	
C-20a	GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF (2) IRON UNIT INPUT (FINE ORE, ETC.): FLUIDIZED-BED FINES REDUCTION: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-10.	1.7011	\$700.0	\$176.77	1.2289	\$217.23
		Based on Vendor quotation.	3.9600		\$80.96	1.0543	\$85.36
		Same as C-14.			\$45.00	1.0000	\$45.00
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: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-10.	0.6804	\$700.0	\$176.77	0.4916	\$86.90
		Based on Vendor quotation.	3.9600		\$45.31	1.0890	\$49.34
		Same as C-14.			\$60.00	1.0543	\$63.26
		Same as C-1.			\$45.00	1.0000	\$45.00
		Same as C-3.			\$20.00	0.6375	\$12.75
OTHER PROCESSES							
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): GREEN-BALL PELLET PRODUCTION: FLUIDIZED-BED FINES REDUCTION: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-10.	1.3560		\$46.62	2.0137	\$93.88
		Same as C-10.	2.8000	\$350.0	\$125.00	0.9365	\$117.06
		Based on Vendor quotation.			\$80.96	1.0543	\$85.36
		Same as C-14.			\$45.00	1.0000	\$45.00
		Same as C-3.			\$20.00	0.1544	\$3.09
							\$347.59
							\$257.24
							\$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 utilized 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

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
SHAFT FURNACE DRI PROCESSES:					
C-1	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON	\$365.36	\$132.44	\$205.39	10.57%
C-2	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%
C-4	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON	\$231.85	\$137.51	\$203.36	19.55%
C-5	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 METAL 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-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.
(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.

\$250.00

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - RESEQUENCED

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
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
4	HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
6	30% MINI-BF H.M.*	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1,002.39	0.9027	1.8170
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	1.1545	1.7799
11	COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
13	REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
16	CIRCORED/HB/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
17	CIRCOFER/HB/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
18	FINMET/HB/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	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	\$192.65	21.87%	1,185.22	1.3320	2.0648
21	SLURN 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 LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
LOWEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	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	1.1959	2.0217
17	CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
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 DR/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
HIGHEST THIRD								
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
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	H/LSA 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	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

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kW/hr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
LOWEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
19	GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
14	MAUMEE BRIQUETTE DR/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
16	CIRCORED/HB/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1959	2.0217
18	FINMET/HB/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
MIDDLE THIRD								
17	CIRCOFER/HB/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
20	GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
13	REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
4	H/LSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
1	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
HIGHEST THIRD								
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
6	30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
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
11	COREX/MIDREX WITH 60% H.M.	\$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%	685.69	1.1545	1.7799

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

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST THIRD								
14	MAUMEE BRIQUETTE DR/EAFF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
19	GENERIC IRON CARBIDE (100%)/EAFF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
15	ITMK3 DR SHOT TO EAFF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
18	FINMET/HBI/EAFF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
16	CIRCORED/HBI/EAFF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
17	CIRCOFER/HBI/SAF/EAFF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
MIDDLE THIRD								
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
20	GENERIC I.C. (40%)/SAF/EAFF	\$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	H.Y.L.S.A IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
2	100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
HIGHEST THIRD								
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
6	30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
1	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
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	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 LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
HIGHEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
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
17	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
18	FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	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 THIRD								
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
20	GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
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
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
LOWEST THIRD								
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
13	REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
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	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

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST THIRD								
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	1.1545	1.7799
13	REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
17	CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
6	30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
MIDDLE THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
16	CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
18	FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
11	COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839
14	MAUMEE BRIQUETTE DR/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
HIGHEST THIRD								
19	GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
20	GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1,185.22	1.3320	2.0648
4	H/LSA 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

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON PROCESS CO2

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST THIRD								
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
12	HISMELT 32.7% 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	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
6	30% MINI-BF 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	H/LSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
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
1	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
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%	966.09	1.1498	2.0310
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	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
16	CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
HIGHEST THIRD								
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	\$192.65	21.87%	1185.22	1.3320	2.0648
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	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
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 - TOTAL CUMULATIVE CO2

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
LOWEST THIRD								
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
9	30% TECNORED H.M. W COGEN	\$195.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
12	HISMELT 32.7% 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	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
6	30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
MIDDLE THIRD								
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
18	FINMET/HB/EAFF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
13	REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
16	CIRCORED/HB/EAFF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
14	MAUMEE BRIQUETTE DRI/EAFF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
4	HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
HIGHEST THIRD								
20	GENERIC I.C. (40%)/SAF/EAFF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
19	GENERIC IRON CARBIDE (100%)/EAFF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
1	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
17	CIRCOFER/HB/SAF/EAFF	\$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
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 - RESEQUENCED

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
1	100% DRI, 1.0% C, MIDREX	\$355.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
2	100% STEEL 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
4	HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	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
7	30% BF H.M./70% SCRAP NR COKE	\$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
11	COREX/MIDREX WITH 60% H.M.	\$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	REDSMELT	\$334.67	\$101.83	\$188.31	17.73%	690.28	1.3624	1.9921
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
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
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%	907.76	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
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

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

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	TOTAL ELEC. (KWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$176.83	42.09%	822.45	0.0874	0.8909
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$177.67	36.74%	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
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$178.23	29.28%	660.35	0.9594	1.5615
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$178.76	23.72%	825.40	1.5213	2.2742
20	GENERIC I.C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$179.90	27.02%	1185.22	1.3320	2.0648
MIDDLE THIRD								
21	SU/RN ROTARY KILN	\$344.39	\$74.08	\$180.74	19.55%	999.74	2.2869	3.1988
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
13	REDSMELT	\$334.67	\$101.83	\$188.31	17.73%	690.28	1.3624	1.9921
17	CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$188.64	26.21%	1,030.37	0.4283	1.3681
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$189.65	24.46%	795.44	0.8974	1.6746
HIGHEST THIRD								
6	30% MINI-BF H.M.*	\$198.05	\$142.86	\$189.65	30.32%	795.44	0.8974	1.6746
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$190.82	22.39%	847.37	0.8689	1.6418
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$190.98	31.30%	685.69	1.1545	1.7799
4	HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$198.05	20.43%	1002.39	0.9027	1.8170
1	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
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 - SORTED ON I.R.R.

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
HIGHEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$176.83	42.09%	822.45	0.0874	0.8909
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
6	30% MINI-BF H.M.*	\$198.05	\$142.86	\$189.65	30.32%	795.44	0.8974	1.6746
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$178.23	29.28%	660.35	0.9594	1.5615
16	CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
20	GENERIC I.C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$179.90	27.02%	1185.22	1.3320	2.0848
MIDDLE THIRD								
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$188.64	26.21%	1,030.37	0.4283	1.3681
17	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
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$189.65	24.46%	795.44	0.8974	1.6746
18	FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$178.76	23.72%	825.40	1.5213	2.2742
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$190.82	22.39%	847.37	0.8689	1.6418
LOWEST THIRD								
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$198.05	20.43%	1002.39	0.9027	1.8170
19	GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
21	SLRN ROTARY KILN	\$344.39	\$74.08	\$180.74	19.55%	999.74	2.2869	3.1988
13	REDSMELT	\$334.67	\$101.83	\$188.31	17.73%	690.28	1.3624	1.9921
4	H/LSA 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	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

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$140/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt Ls)	PROCESS CO2 (mt/mt Ls)	TOTAL CO2 (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	\$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
4	H/LSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$219.12	11.14%	795.44	0.8974	1.6746
6	30% MINI-BF H.M.*	\$198.05	\$142.86	\$219.12	14.56%	795.44	0.8974	1.6746
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$207.70	16.55%	660.35	0.9594	1.5615
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$227.52	6.48%	1002.39	0.9027	1.8170
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$207.14	21.36%	307.58	1.1545	1.4350
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$220.45	14.74%	685.69	1.1545	1.7799
11	COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.63	\$218.17	5.72%	942.91	2.9239	3.7839
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$212.92	13.05%	847.37	0.8689	1.6418
13	REDSMELT	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.9921
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$183.48	22.05%	825.40	1.5213	2.2742
16	CIRCORED/HB/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
17	CIRCOFER/HB/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
18	FINMET/HB/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	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	\$205.40	16.52%	1185.22	1.3320	2.0648
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$185.46	18.06%	999.74	2.2869	3.1988

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)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST 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
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
21	SLRN 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
MIDDLE THIRD								
13	REDSMELT	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.9921
4	HLYSA 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	2.0948
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$207.14	21.36%	307.58	1.1545	1.4350
7	30% BF 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
HIGHEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$217.95	17.76%	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
11	COREX/MIDREX 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%	685.69	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)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
HIGHEST THIRD								
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
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
18	FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$183.48	22.05%	825.40	1.5213	2.2742
9	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
MIDDLE THIRD								
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$185.46	18.06%	999.74	2.2869	3.1988
2	100% STEEL SCRAP	\$173.68	\$0.00	\$217.95	17.75%	822.45	0.0874	0.8909
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$207.70	16.55%	660.35	0.9594	1.5615
20	GENERIC I.C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$205.40	16.52%	1185.22	1.3320	2.0648
13	REDSMELT	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.9921
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$220.45	14.74%	685.69	1.1545	1.7799
6	30% MINI-BF H.M.*	\$198.05	\$142.86	\$219.12	14.56%	795.44	0.8974	1.6746
LOWEST THIRD								
4	HYL-SA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
12	HISMELT 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
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$219.12	11.14%	795.44	0.8974	1.6746
1	100% DRI, 1.0% C, MIDREX	\$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
11	COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.17	5.72%	942.91	2.9239	3.7839

IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE CAPITAL COSTS*

LOWEST THIRD

100% STEEL SCRAP
TECHNORED W/O COGEN
TECHNORED WITH COGEN
MINI BLAST FURNACE
30% DRI/70% STEEL SCRAP
CIRCORED
CIRCOFER

MIDDLE THIRD

BLAST FURNACE - N.R. COKE
BLAST FURNACE - C.P. COKE
30% COLD PIG IRON/70% SCRAP
40% GEN. IRON CARBIDE/60% SCRAP
HISMELT
FINMET
MAUMEE BRIQUETTE RHF

HIGHEST THIRD

ITMK3
REDSMELT RHF
SL/RN/ROTARY KILN
GENERIC IRON CARBIDE (100%)
HYLSA IVM SHAFT FCE. DRI (100%)
MIDREX SHAFT FURNACE DRI (100%)
COREX/MIDREX

*NOTE: THROUGH LIQUID
STEEL PRODUCTION

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

LOWEST THIRD

GENERIC IRON CARBIDE (100%)
 MAUMEE BRIQUETTE RHF
 ITMK3
 SL/RN ROTARY KILN
 CIRCORED
 FINMET

MIDDLE THIRD

CIRCOFER
 40% GEN. IRON CARBIDE/60% SCRAP
 REDSMELT
 BLAST FURNACE H.M. - NR COKE
 HYLSA IVM (100%)
 TECNORED H.M. WITH COGEN
 MIDREX SHAFT FCE. DRI (100%)

HIGHEST THIRD

30% MIDREX SHAFT FCE. DRI
 HISMELT
 MINI BLAST FURNACE
 BLAST FURNACE H.M. - C.P. COKE
 30% PIG IRON/70% SCRAP
 COREX/MIDREX
 TECNORED H.M. W/O COGEN

*NOTE: THROUGH PRODUCTION
OF IRON UNIT FEED TO EAF

IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL *

\$100/mt STEEL SCRAP COST

LOWEST THIRD

100% STEEL SCRAP
MAUMEE BRIQUETTE RHF
TEGNORED H.M. WITH COGEN
GENERIC IRON CARBIDE (100%)
BLAST FURNACE H.M. - N.R. COKE
ITMK3
GENERIC IRON CARBIDE (40%)

MIDDLE THIRD

SL/RN ROTARY KILN
FINMET
CIRCORED
REDSMELT
CIRCOFER
MIDREX SHAFT FCE. DRI (30%)
BLAST FURNACE H.M. - C.P. COKE

HIGHEST THIRD

MINI BLAST FURNACE
HISMELT
TEGNORED H.M. W/O COGEN
HYLSA I/M
30% COLD PIG IRON/70% SCRAP
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL *

\$120/mt STEEL SCRAP COST

LOWEST THIRD

MAUMEE BRIQUETTE RHF
GENERIC IRON CARBIDE (100%)
HTMK3
SL/RN ROTARY KIEN
FINMET
CIRCORED
CIRCOFER

MIDDLE THIRD

REDSMELT
TECNORED H.M. WITH COGEN
40% GEN. IRON CARBIDE/60% SCRAP
BLAST FURNACE H.M. - NR COKE
HYLSA IVM (100%)
100% STEEL SCRAP
HISMELT

HIGHEST THIRD

30% MIDREX SHAFT FCE. DRI
MINI BLAST FURNACE
BLAST FURNACE H.M. - C.P. COKE
MIDREX SHAFT FCE. DRI (100%)
TECNORED H.M. W/O COGEN
30% PIG IRON/70% SCRAP
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL *

\$140/mt STEEL SCRAP COST

LOWEST THIRD

MAUMEE BRIQUETTE RHF
GENERIC IRON CARBIDE (100%)
ITMK3
FINMET
CIRCORED
SL/RN ROTARY KILN
CIRCOFER

MIDDLE THIRD

REDSMELT
HYLSA IVM
MIDREX SHAFT FCE. DRI (100%)
GENERIC IRON CARBIDE (40%)
TECNORED H.M. WITH COGEN
BLAST FURNACE H.M. - N.R. COKE
HISMELT

HIGHEST THIRD

100% STEEL SCRAP
MIDREX SHAFT FURNACE (60%)
COREX/MIDREX
MINI BLAST FURNACE
BLAST FURNACE H.M. - C.P. COKE
TECNORED H.M. W/O COGEN
30% COLD PIG IRON/70% SCRAP

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY SIMPLE INTERNAL RATE OF RETURN*

\$100/mt STEEL SCRAP COST

HIGHEST THIRD

100% STEEL SCRAP
TECNORED HM WITH COGEN
TECNORED HM W/O COGEN
30% MINI BLAST FURNACE H.M.
BLAST FCE. H.M. - N.R. COKE
CIRCORED
GENERIC IRON CARBIDE (40%)

MIDDLE THIRD

30% MIDREX SHAFT FCE. DRI/70% SCRAP
CIRCOFER
MAUMEE BRIQUETTE RHF
BLAST FURNACE H.M. - C.P. COKE
FINMET
ITMK3
HISMELT

LOWEST THIRD

30% COLD PIG IRON/70% SCRAP
GENERIC IRON CARBIDE (100%)
SL/RN ROTARY KILN
REDSMELT
HYLSA IVM (100%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY SIMPLE INTERNAL RATE OF RETURN*

\$120/mt STEEL SCRAP COST

HIGHEST THIRD

100% STEEL SCRAP
TECNORED HM WITH COGEN
CIRCORED
CIRCOFER
MAUMEE BRIQUETTE RHF
FINMET
BLAST FCE. H.M. - N.R. COKE

MIDDLE THIRD

ITMK3
MINI BLAST FURNACE
40% GEN. IRON CARBIDE/60% SCRAP
TECNORED W/O COGEN
GENERIC IRON CARBIDE (100%)
30% MIDREX SHAFT FCE. DRI/70% SCRAP
HISMELT

LOWEST THIRD

SL/RN ROTARY KILEN
BLAST FURNACE HM. - CP COKE
REDSMELT
30% GOLD PIG IRON/70% SCRAP
HYLSA IVM (100%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY SIMPLE INTERNAL RATE OF RETURN*

\$140/mt STEEL SCRAP COST

HIGHEST THIRD

CIRCORED
CIRCOFER

MAUMEE BRIQUETTE RHF
FINMET

ITMK3

TEGNORED H.M. WITH COGEN
GENERIC IRON CARBIDE (100%)

MIDDLE THIRD

SL/RN ROTARY KILN
100% STEEL SCRAP

BLAST FURNACE H.M. - N.R. COKE
GENERIC IRON CARBIDE (40%)

REDSMELT

TECNORED H.M. W/O COGEN
MINI BLAST FURNACE H.M.

LOWEST THIRD

HYLSA IVM
HISMELT

MIDREX SHAFT FURNACE DRI (30%)

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

MIDREX SHAFT FURNACE DRI (100%)

30% COLD PIG IRON/70% SCRAP

COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED TOTAL ELECTRIC POWER CONSUMPTION*

LOWEST THIRD

TECNORED H.M. WITH COGEN
 BLAST FURNACE H.M. - N.I.R. COKE
 TECNORED H.M. W/O COGEN
 REDSMELT
 CIRCOFER
 BLAST FURNACE H.M. - C.P. COKE
 MINI BLAST FURNACE

MIDDLE THIRD

100% STEEL SCRAP
 ITMK3
 HISMELT
 CIRCORED
 FINMET
 COREX/MIDREX
 MAUMEE BRIQUETTE RHF

HIGHEST THIRD

GENERIC IRON CARBIDE (100%)
 SL/RN ROTARY KILN
 30% PIG IRON/70% SCRAP
 30% MIDREX SHAFT FCE, DRI
 40% GENERIC IRON CARBIDE
 HYLSA IVM (100%)
 MIDREX SHAFT FCE, DRI (100%)

*NOTE: THROUGH PRODUCTION
 OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED PROCESS ONLY CO2 EVOLUTION*

LOWEST THIRD

100% STEEL SCRAP
30% MIDREX SHAFT FCE. DRI
HISMELT
BLAST FURNACE H.M. - C.P. COKE
MINI BLAST FURNACE
30% COLD PIG IRON/SCRAP
HYLSA IVM

MIDDLE THIRD

BLAST FURNACE H.M. - N.R. COKE
MIDREX SHAFT FCE. DRI (100%)
FINMET
MAUMEE BRIQUETTE RHF
TECNORED H.M. W/O COGEN
TECNORED H.M. WITH COGEN
CIRCORED

HIGHEST THIRD

GENERIC IRON CARBIDE (100%)
40% GENERIC IRON CARBIDE/SCRAP
REDSMELT
ITMK3
CIRCOFER
SL/RN ROTARY KILN
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED TOTAL CUMULATIVE CO2 EVOLUTION*

LOWEST THIRD

100% STEEL SCRAP
30% MIDREX SHAFT FCE DRI
TECNORED H.M. WITH COGEN
BLAST FURNACE H.M. - N.R. COKE
HISMELT
BLAST FURNACE - C.P. COKE
MINI BLAST FURNACE

MIDDLE THIRD

TECNORED H.M. W/O COGEN
30% COLD PIG IRON/70% SCRAP
FINMET
REDSMELT
CIRCORED
MAUMEE BRIQUETTE RHF
HYLSA IVM

HIGHEST THIRD

40% GENERIC IRON CARBIDE/SCRAP
GENERIC IRON CARBIDE (100%)
MIDREX SHAFT FURNACE DRI (100%)
ITMK3
CIRCOFER
SL/RN ROTARY KIEN
COREX/MIDREX

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

IRONMAKING PROCESSES SORTED BY RANKING SUM - ENERGY & ENVIRONMENTAL VARIABLES 5-7

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP
 BLAST FURNACE H.M. - N.R. COKE
 BLAST FURNACE H.M. - C.P. COKE
 TECNORED H.M. WITH COGEN
 HISMELT
 MINI BLAST FURNACE
 MIDREX SHAFT FCE. DRI (30%)

MIDDLE THIRD

TECNORED H.M. - W/O COGEN
 COLD PIG IRON (30%)/SCRAP (70%)
 FINMET
 REDSMELT
 CIRCORED
 MAUMEE BRIQUETTE RHF
 HYLSA IVM (100%)

HIGHEST THIRD

CIRCOFER
 ITMK3
 GENERIC IRON CARBIDE (100%)
 MIDREX SHAFT FCE. DRI (100%)
 GENERIC IRON CARBIDE (40%)
 COREX/MIDREX
 SL/RN ROTARY KILN

*NOTE: THROUGH PRODUCTION
 OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY RANKING SUM

- COST-RELATED VARIABLES 1-4

\$100/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP
TECNORED H.M. WITH COGEN
CIRGORED
BLAST FURNACE H.M. - N.R. COKE
MAUMEE BRIQUETTERHF
GENERIC IRON CARBIDE (40%)
CIRCOFER

MIDDLE THIRD

ITMK3
GENERIC IRON CARBIDE (100%)
MINI BLAST FURNACE H.M. (30%)
MIDREX SHAFT FCE. DRI (30%)
FINMET
TECNORED H.M. - W/O COGEN
SL/RN ROTARY KILN

HIGHEST THIRD

BLAST FURNACE H.M. - C.I.P. COKE
REDSMELT
HISMELT
COLD PIG IRON (30%/SCRAP (70%))
HILYSA IVM (100%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

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

\$120/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP

CIRCORED

MAUMEE BRIQUETTE RHF

CIRCOFER

TECHNORED H.M. WITH COGEN

ITMK3

FINMET

MIDDLE THIRD

GENERIC IRON CARBIDE (100%)

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

GENERIC IRON CARBIDE (40%)

SL/RN ROTARY KILN

MINI BLAST FURNACE H.M. (30%)

MIDREX SHAFT FCE. DRI (30%)

REDSMELT

HIGHEST THIRD

TECHNORED H.M. - W/O COGEN

HISMELT

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

HYLSA IVM (100%)

COLD PIG IRON (30%)/ SCRAP (70%)

MIDREX SHAFT FCE. DRI (100%)

COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

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

\$140/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

CIRCORED
MAUMEE BRIQUETTE RHF
CIRCOFER
100% STEEL SCRAP
ITMK3
FINMET
GENERIC IRON CARBIDE (100%)

MIDDLE THIRD

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%)

HIGHEST THIRD

TECNORED H.M. - W/O COGEN
HISMELT
HYLSA IVM (100%)
BLAST FURNACE 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

IRONMAKING PROCESSES SORTED BY RANKING SUM

- ALL VARIABLES SUMMED 1-7

\$100/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP
TECNORED H.M. WITH COGEN
BLAST FURNACE H.M. - N.R. COKE
MINI BLAST FURNACE
MIDREX SHAFT FCE. DRI (30%)
CIRCORED
TECNORED H.M. W/O COGEN

MIDDLE THIRD

MAUMEE BRIQUETTE RHF
BLAST FURNACE H.M. - C.P. COKE
FINMET
HISMELT
CIRCOFER
ITMK3
GENERIC IRON CARBIDE (40%)

HIGHEST THIRD

GENERIC IRON CARBIDE (100%)
REDSMELT
GOLD PIG IRON (30%)/SCRAP (70%)
SL/RN ROTARY KILN
HYLSA IVM (100%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY RANKING SUM

- ALL VARIABLES SUMMED 1-7

\$120/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP
TECNORED H.M. WITH COGEN
BLAST FURNACE H.M. - N.R. COKE
CIRCORER
MAUMEE BRIQUETTE RHF
FINMET
MINI BLAST FURNACE H.M. (30%)

MIDDLE THIRD

CIRCOFER
MIDREX SHAFT FCE. DRI (30%)
HISMELT
BLAST FURNACE H.M. - C.P. COKE
ITMK3
TECNORED H.M. - W/O COGEN
GENERIC IRON CARBIDE (100%)

HIGHEST THIRD

REDSMELT
GENERIC IRON CARBIDE (100%)
SL/RN ROTARY KILN
COLD PIG IRON (30%)/SCRAP (70%)
HYLSA IVM (100%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY RANKING SUM

- ALL VARIABLES SUMMED 1-7

\$140/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP
TEGNORED H.M. WITH COGEN
CIRCORED
BLAST FURNACE H.M. - N.R. COKE
MAUMIEE BRIQUETTE RHF
FINMET
CIRCOFER

MIDDLE THIRD

ITMK3
MINI BLAST FURNACE H.M. (30%)
MIDREX SHAFT FCE. DRI (30%)
GENERIC IRON CARBIDE (100%)
BLAST FURNACE H.M. - C.P. COKE
HISMELT
REDSMELT

HIGHEST THIRD

TEGNORED H.M. - W/O COGEN
SL/RN/ROTARY KILN
GENERIC IRON CARBIDE (100%)
HYLSA VM (100%)
GOLD PIG IRON (30%)/ SCRAP (70%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

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 all-in 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 not 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 significant variable 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

SEQ. NO.	PROCESS	COST PER NET MT LIQUID STEEL							TOTAL LIQ. STEEL	
		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MKG.		LADLE REFINING
SHAFT FURNACE DRI PROCESSES:										
C-1	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
C-3	100% STEEL SCRAP CHARGE TO EAF						\$102.80	\$67.21	\$6.82	\$176.83
C-4	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT. % DRI CARBON		\$21.33	\$10.30	\$16.87		\$73.64	\$59.68	\$6.82	\$188.64
C-5	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT. % DRI CARBON		\$21.34	\$10.31	\$17.14		\$73.64	\$60.73	\$6.82	\$189.99
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF		\$64.31	\$24.10	\$42.76			\$58.16	\$6.82	\$196.15
HOT METAL VARIATIONS										
C-7	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE	\$3.99	\$18.45			\$32.75	\$73.66	\$53.98	\$6.82	\$189.65
C-8	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, N.R. COKE	\$4.07	\$10.29			\$29.41	\$73.66	\$53.98	\$6.82	\$178.23
C-9	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	\$3.99	\$18.45			AS PIG \$33.56	\$73.66	\$61.57	\$6.82	\$198.05
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION			\$21.28		\$23.86	\$73.66	\$52.05	\$6.82	\$177.67
C-11	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION			\$21.28		\$37.17	\$73.66	\$52.05	\$6.82	\$190.98
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	\$81.03	\$52.06	\$8.31	\$190.82

**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.	PROCESS	COST PER NET MT LIQUID STEEL									
		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MKG.	LADLE REFINING	TOTAL LIQ. STEEL	
ROTARY HEARTH FURNACES											
C-14	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$30.80		\$31.78	\$22.33	\$38.68	\$11.81	\$46.24	\$6.67	\$188.31	
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		\$11.81	\$58.47	\$8.32	\$178.76	
FLUID-BED DRI/HBI											
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	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	\$63.75	\$46.52	\$6.66	\$179.90	
OTHER PROCESSES											
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$28.73		\$49.07	\$20.31		\$11.81	\$61.73	\$9.09	\$180.74	

SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES

SENSITIVITY: \$120.00/mt STEEL SCRAP PRICE

SEQ. NO.	PROCESS	COST PER NET MT LIQUID STEEL									
		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MKG.	LADLE REFINING	TOTAL LIQ. STEEL	
SHAFT FURNACE DRI PROCESSES:											
C-1	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	
C-3	100% STEEL SCRAP CHARGE TO EAF						\$123.36	\$67.21	\$6.82	\$197.39	
C-4	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	
C-5	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	
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF		\$64.31	\$24.10	\$42.76			\$58.16	\$6.82	\$196.15	
HOT METAL VARIATIONS											
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	
C-8	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	
C-9	30% COLD PIG IRON/70% SCRAP TO EAF, 4.5% CARBON PIG	\$3.99	\$18.45			AS PIG \$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-11	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	

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

SEQ. NO.	PROCESS	COST PER NET MT LIQUID STEEL									
		ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MKG.	LADLE REFINING	TOTAL LIQ. STEEL	
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	MAJUMEE BRIQUETTE DR/EAFF 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-BED DR/EBI											
C-17	CIRCORED/HBI/EAFF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$37.95		\$7.58	\$78.22			\$55.60	\$5.92	\$185.27	
C-18	CIRCOFER/HBI/SAF/EAFF 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/EAFF WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$37.11		\$6.77	\$79.72			\$55.60	\$5.92	\$185.12	
C-20a	GENERIC IRON CARBIDE/EAFF RECYCLE SCRAP CHARGE TO EAF	\$36.05			\$81.34			\$54.53	\$5.92	\$177.84	
C-20b	GENERIC IRON CARBIDE/SAF/EAFF 60% SCRAP CHARGE TO EAF	\$14.42			\$32.54	\$17.01	\$76.50	\$45.52	\$6.66	\$192.65	
OTHER PROCESSES											
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	

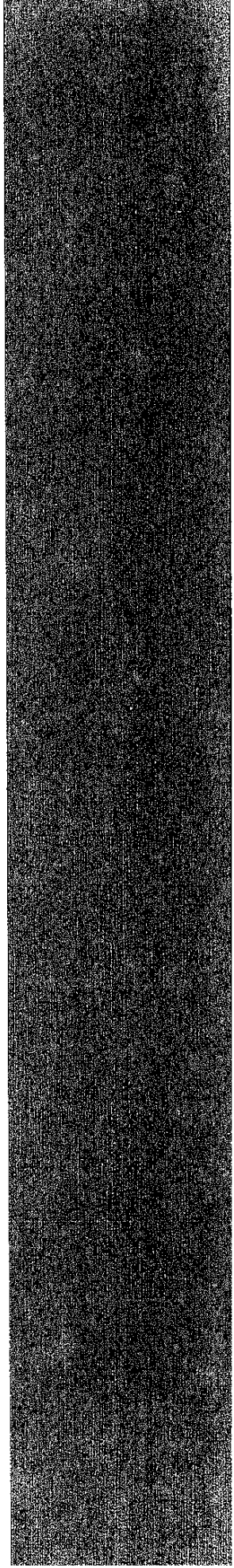
SUMMARY OF RELATIVE OPERATING COSTS - IRONMAKING PROCESSES

SENSITIVITY: \$140.00/mt STEEL SCRAP PRICE		COST PER NET MT LIQUID STEEL									
SEQ. NO.	PROCESS	ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MT KG.	LADLE REFINING	TOTAL LIQ. STEEL	
SHAFT FURNACE DRI PROCESSES:											
C-1	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	
C-3	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	
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF		\$64.31	\$24.10	\$42.76			\$58.16	\$6.82	\$196.15	
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	
C-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	
C-9	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	\$23.46	\$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	

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

SENSITIVITY: \$140.00/mt STEEL SCRAP PRICE		COST PER NET MT LIQUID STEEL									
SEQ. NO.	PROCESS	ORE, OTHER IRON UNITS	CONC. DELIVERED	PELLETIZING/ BRIQUETTING	REDUCTION	HOT METAL PROD.	PURCHASED EAF SCRAP	EAF STEEL/MT KG.	LADLE REFINING	TOTAL LIQ. STEEL	
ROTARY HEARTH FURNACES											
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-BED DRI/HBI											
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	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	\$89.25	\$45.52	\$6.66	\$205.40	
OTHER PROCESSES											
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF	\$28.73		\$49.07	\$20.31		\$16.63	\$61.73	\$9.09	\$185.46	

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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.

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION					TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	
SHAFT FURNACE DRI PROCESSES:							
C-1	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON						
	IRON UNIT INPUT:	Concentrate delivered to pelletizing plant.	1.4652				
	INDURATED PELLET PRODUCTION:	Composite of four Vendor quotations for similar scope.	3.3000 3.5000 4.2000 5.0000	\$135.0 \$155.0 \$175.0 \$300.0 AVERAGE: \$46.72	\$40.91 \$44.29 \$41.67 \$60.00 \$46.72	1.7807	\$83.19
	KOBE/MIDREX SHAFT FURNACE:	Composite of three Vendor quotations for similar scope.	4.5000 4.0000 4.5000	\$670.0 \$565.0 \$655.0 AVERAGE:	\$148.89 \$141.25 \$145.56 \$145.23	1.0450	\$151.77
	ELECTRIC ARC STEELMAKING/LRF:	Composite of three Vendor quotations for similar scope.	4.9200 4.9200 4.9200	\$410.0 \$385.0 \$400.0 AVERAGE:	\$83.33 \$78.25 \$81.30 \$80.96	1.0549	\$85.41
	OUTSIDE BOUNDARY LIMITS:	Includes: ore/concentrate storage, water services, waste disposal, off-gas treatment, offices, labs, etc. (L-S.)	4.0000	\$180.0	\$45.00	1.0000	\$45.00
C-2	100% SHAFT FURNACE DRI CHARGE TO EAF, 2.5 WT.% CARBON						
	IRON UNIT INPUT:	Same as C-1.	1.4670				
	INDURATED PELLET PRODUCTION:	Same as C-1.			\$46.72	1.7826	\$83.27
	KOBE/MIDREX SHAFT FURNACE:	Same as C-1.			\$145.23	1.0450	\$151.77
	ELECTRIC ARC STEELMAKING/LRF:	Same as C-1.			\$80.96	1.0549	\$85.41
	OUTSIDE BOUNDARY LIMITS:	Same as C-1.			\$45.00	1.0000	\$45.00
							\$365.36
							\$365.45

NOTES: (1) 2000 BASIS

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION						TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	UNIT CST./ mt LIQ. ST.	
C-3	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 1.0280	\$153.12 \$20.56	\$173.68
C-4	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON IRON UNIT INPUT: INDURATED PELLET PRODUCTION: KOBEMIDREX 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. Same as C-3.	0.4860		\$46.72 \$145.23 \$80.96 \$45.00 \$20.00	0.7612 0.3527 1.0541 1.0000 0.7364	\$35.56 \$51.22 \$85.34 \$45.00 \$14.73	\$231.85
C-5	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 2.5 WT.% DRI CARBON IRON UNIT INPUT: INDURATED PELLET PRODUCTION: KOBEMIDREX 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. Same as C-3.	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
C-6	HYLSA SHAFT FURNACE WITHOUT REFORMER, HOT DRI CHARGE TO EAF IRON UNIT INPUT: INDURATED PELLET PRODUCTION: HYLIVM SHAFT FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-1. Same as C-1. Composite of two Vendor quotations for similar scope. Same as C-1. Same as C-1.	1.4650 4.2000 2.8000	\$612.0 \$390.8 AVERAGE:	\$46.72 \$145.71 \$139.56 \$142.64 \$80.96 \$45.00	1.7807 1.0450 1.0543 1.0000	\$83.19 \$149.05 \$85.36 \$45.00	\$362.60

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION					TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	
HOT METAL VARIATIONS							
C-7	30% BLAST FURNACE HOT METAL/70% SCRAP TO EAF, CO-PRODUCT COKE IRON UNIT INPUT: INTEGRATED BLAST FURNACE: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Lump ore, Pellets, Sinter, Scrap, etc. delivered to stockpiles with reclaim and handling systems included in OSBL. Based on Vendor quotation. Same as C-1. Same as C-1. Same as C-3.	0.1054 0.2097 0.2097 0.0337 2.3100	\$6335.00	\$275.00 \$80.96 \$45.00 \$20.00	0.3584 1.0542 1.0000 0.7366	\$98.56 \$85.35 \$45.00 \$14.73 \$243.64
C-7a	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. Same as C-3.	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
C-8	30% BLAST FURNACE HOT METAL/70% 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. Same as C-3.			\$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
C-9	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. Same as C-3.	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

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT. LIQUID STEEL PRODUCTION						TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM m/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	UNIT GST./ mt LIQ. ST.	
C-10	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITH CO-GENERATION IRON UNIT INPUT (AS FINE ORE):	Iron ore fines received into stockpiles with reclaim systems to green-ball pelletizing. Internal LGE cost estimate for confidential client.	0.5080	\$14.1	\$46.62	0.6377	\$29.73	
	GREEN-BALL PELLET PRODUCTION:		0.3020	\$29.5	\$97.59	0.3584	\$34.98	
	TECHNORED FURNACE & ANCILLARIES:	Internal LGE cost estimate for confidential client.	0.3020	\$7.4	\$24.57	0.3584	\$8.81	
	CO-GENERATION:	Internal LGE cost estimate for confidential client.	1.2500	\$75.0	\$60.00	1.0540	\$63.24	
	ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Based on internal LGE estimate. Same as C-1. Same as C-3.			\$20.00	0.7366	\$14.73	\$196.48
C-11	30% TECNORED HOT METAL/70% SCRAP TO EAF, WITHOUT CO-GENERATION IRON UNIT INPUT (AS FINE ORE):	Same as C-10.	0.5080	\$14.1	\$46.62	0.6377	\$29.73	
	GREEN-BALL PELLET PRODUCTION:	Same as C-10.	0.3020	\$29.5	\$97.68	0.3584	\$35.01	
	TECHNORED FURNACE & ANCILLARIES:	Same as C-10.	1.2500	\$75.0	\$60.00	1.0540	\$63.24	
	ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Based on internal LGE estimate. Same as C-1. Same as C-3.			\$45.00	1.0000	\$45.00	
	COREX/MIDREX WITH 60% HOT METAL 40% DRI CHARGE TO EAF IRON UNIT INPUT (COREX):	Iron ore as lump and as pellets are on a purchased basis.	0.4313	\$104.1	\$344.83	0.6237	\$215.07	
C-12	MIDREX SHAFT FURNACE:	Iron ore pellets are purchased. Based on Vendor quotation.	0.4313	\$17.8	\$120.00	0.4180	\$50.16	
	COREX FURNACE & ANCILLARIES:		0.7124		\$60.00	1.0545	\$63.27	
	MIDREX SHAFT FURNACE:	Same as C-1.	0.3020		\$60.00	1.0000	\$45.00	
	ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-1. Same as C-1.	0.1480		\$45.00	1.0000	\$45.00	\$373.50

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION					TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	
C-13	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:	Same as C-10. Based on Vendor quotation. Same as C-1. Same as C-1. Same as C-3.	0.5345 0.3650	\$116.6	\$319.45 \$80.96 \$45.00 \$20.00	0.3585 1.0545 1.0000 0.7366	\$114.52 \$85.37 \$45.00 \$14.73 \$259.63
ROTARY HEARTH FURNACES							
C-14	REDSMELT HOT METAL WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (AS FINE ORE): GREEN-BALL PELLET PRODUCTION: ROTARY HEARTH REDUCTION FCE.:	Same as C-10. Same as C-10 with adjustments. Based on three Vendor quotations.	1.4545 0.3020 3.4000 1.2500	\$42.2 \$465.0 \$166.2 AVERAGE: \$136.47	\$23.32 \$139.67 \$136.76 \$132.98 \$136.47	2.0653 1.0261	\$48.16 \$140.03
	SUBMERGED ARC MELTING FURNACE:	Based on three Vendor quotations.	0.3020 3.4000 1.2500	\$14.0 \$160.0 \$53.1 AVERAGE:	\$46.36 \$47.06 \$42.50 \$45.31	0.9112	\$41.28
	ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Based on internal LGE estimate. Same as C-1. Same as C-3.	1.2500	\$75.0	\$60.00 \$45.00 \$20.00	1.0032 1.0000 0.1544	\$60.19 \$45.00 \$3.09 \$334.67
C-15	MAUMEE BRIQUETTE DRI/EAF WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): GREEN BRIQUETTE PRODUCTION: ROTARY HEARTH REDUCTION FCE.:	Same as C-10. Based on Vendor quotation. Based on Vendor quotation. Same as C-1. Same as C-3.	1.5735 0.1200 0.1200	\$4.3 \$14.5	\$35.83 \$120.83 \$80.96 \$45.00	1.9932 1.1217 1.0543 1.0000	\$71.42 \$135.54 \$85.36 \$45.00 \$292.32

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION					TOTAL SCOPE	
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.		UNIT CST./ mt LIQ. ST.
C-16	ITMIK3 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.	1.4535 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
	FLUID-BED DRI/HBI							
C-17	CIRCORED/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-1. 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 1.0890 1.0543 1.0000	\$15.34 \$114.35 \$32.67 \$85.36 \$45.00	\$232.37
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. Same as C-1.	1.7387 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	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. Same as C-1.	1.7511 4.0000 4.0000 4.0000	\$40.0 \$649.0 \$180.0	\$10.00 \$162.25 \$45.00 \$35.83 \$30.00	1.5091 1.0890 1.0890 1.0543 1.0000	\$15.09 \$176.69 \$49.01 \$37.78 \$30.00	\$263.47

CAPITAL COST ESTIMATE BASIS - IRONMAKING PROCESSES

SEQ. NO.	PROCESS	COST PER ANNUAL MT LIQUID STEEL PRODUCTION					TOTAL SCOPE
		BASIS FOR COST	CAPACITY (MM mt/yr)	INSTALLED COST(1)	COST PER ANNUAL mt	mt UNIT/ mt LIQ. ST.	
C-20a	GENERIC IRON CARBIDE/EAF RECYCLE SCRAP CHARGE TO EAF (2) IRON UNIT INPUT (FINE ORE, ETC.): FLUIDIZED-BED FINES REDUCTION: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS:	Same as C-10. Based on Vendor quotation.	1.7011	\$700.0	\$176.77	1.2289	\$217.23
		Same as C-14. Same as C-1.	3.9600		\$80.96 \$45.00	1.0543 1.0000	\$85.36 \$45.00
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: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-10. Based on Vendor quotation.	0.6804	\$700.0	\$176.77	0.4916	\$86.90
		Same as C-14. Same as C-1. Same as C-3.	3.9600		\$45.31 \$60.00 \$45.00 \$20.00	1.0890 1.0543 1.0000 0.6375	\$49.34 \$63.26 \$45.00 \$12.75
OTHER PROCESSES							
C-21	SL/RN ROTARY KILN WITH ONLY RECYCLE SCRAP CHARGE TO EAF IRON UNIT INPUT (FINE ORE, ETC.): GREEN-BALL PELLET PRODUCTION: FLUIDIZED-BED FINES REDUCTION: ELECTRIC ARC STEELMAKING/LRF: OUTSIDE BOUNDARY LIMITS: SCRAP RECEIVING/HANDLING:	Same as C-10. Same as C-10. Based on Vendor quotation.	1.3560		\$46.62	2.0137	\$93.88
		Same as C-14. Same as C-1. Same as C-3.	2.8000	\$350.0	\$125.00 \$80.96 \$45.00 \$20.00	0.9365 1.0543 1.0000 0.1544	\$117.06 \$85.36 \$45.00 \$3.09

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 utilized 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

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
SHAFT FURNACE DRI PROCESSES:					
C-1	100% SHAFT FURNACE DRI CHARGE TO EAF, 1.0 WT.% CARBON	\$365.36	\$132.44	\$205.39	10.57%
C-2	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%
C-4	30% SHAFT FURNACE DRI/70% SCRAP TO EAF, 1.0 WT.% DRI CARBON	\$231.85	\$137.51	\$203.36	19.55%
C-5	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 METAL 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-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.
(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.

\$250.00

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - RESEQUENCED

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
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
4	HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
6	30% MINI-BF H.M.*	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1,002.39	0.9027	1.8170
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	1.1545	1.7799
11	COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
13	REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
16	CIRCORED/HB/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
17	CIRCOFER/HB/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
18	FINMET/HB/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	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	\$192.65	21.87%	1,185.22	1.3320	2.0648
21	SLURN 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 LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	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	1.1959	2.0217
17	CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
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 DR/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
HIGHEST THIRD								
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
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	H/LSA 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	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

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kW/hr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
19	GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
14	MAUMEE BRIQUETTE DR/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
16	CIRCORED/HB/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1959	2.0217
18	FINMET/HB/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
MIDDLE THIRD								
17	CIRCOFER/HB/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
20	GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
13	REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
4	H/LSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
1	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
HIGHEST THIRD								
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
6	30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
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
11	COREX/MIDREX WITH 60% H.M.	\$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%	685.69	1.1545	1.7799

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

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST THIRD								
14	MAUMEE BRIQUETTE DR/EAFF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
19	GENERIC IRON CARBIDE (100%)/EAFF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
15	ITMK3 DR SHOT TO EAFF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
18	FINMET/HBI/EAFF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
16	CIRCORED/HBI/EAFF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
17	CIRCOFER/HBI/SAF/EAFF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
MIDDLE THIRD								
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
20	GENERIC I.C. (40%)/SAF/EAFF	\$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	H.Y.L.S.A IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
2	100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
HIGHEST THIRD								
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
6	30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
1	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
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	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 LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
HIGHEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
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
17	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
18	FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	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 THIRD								
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
20	GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
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
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
LOWEST THIRD								
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
13	REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
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	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

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST THIRD								
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	1.1545	1.7799
13	REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
17	CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
6	30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
MIDDLE THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$197.39	30.14%	822.45	0.0874	0.8909
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$198.19	19.38%	847.37	0.8689	1.6418
16	CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
18	FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
11	COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.16	5.72%	942.91	2.9239	3.7839
14	MAUMEE BRIQUETTE DR/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
HIGHEST THIRD								
19	GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$183.10	18.81%	999.74	2.2869	3.1988
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$212.79	13.89%	1002.39	0.9027	1.8170
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$203.36	19.55%	1,030.37	0.4283	1.3681
20	GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1,185.22	1.3320	2.0648
4	H/LSA 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

VARIABLES FOR RANKING OF IRONMAKING PROCESSES - SORT ON PROCESS CO2

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST THIRD								
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
12	HISMELT 32.7% 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	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
6	30% MINI-BF 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	H/LSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
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
1	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
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%	966.09	1.1498	2.0310
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$205.72	20.25%	685.69	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
16	CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
HIGHEST THIRD								
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	\$192.65	21.87%	1185.22	1.3320	2.0648
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	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
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 - TOTAL CUMULATIVE CO2

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$120/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
LOWEST THIRD								
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
9	30% TECNORED H.M. W COGEN	\$195.48	\$125.95	\$192.41	29.14%	307.58	1.1545	1.4350
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$192.97	23.04%	660.35	0.9594	1.5615
12	HISMELT 32.7% 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	\$243.64	\$142.86	\$204.39	18.04%	795.44	0.8974	1.6746
6	30% MINI-BF H.M.	\$198.05	\$142.86	\$204.39	22.64%	795.44	0.8974	1.6746
MIDDLE THIRD								
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
18	FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
13	REDSMELT	\$334.67	\$101.83	\$190.67	16.96%	690.28	1.3624	1.9921
16	CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
4	HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
HIGHEST THIRD								
20	GENERIC I.C. (40%)/SAF/EAF	\$257.24	\$100.79	\$192.65	21.87%	1185.22	1.3320	2.0648
19	GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
1	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$181.12	22.89%	825.40	1.5213	2.2742
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
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 - RESEQUENCED

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
1	100% DRI, 1.0% C, MIDREX	\$355.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
2	100% STEEL 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
4	H/LSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	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
7	30% BF H.M./70% SCRAP NR COKE	\$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
11	COREX/MIDREX WITH 60% H.M.	\$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	REDSMELT	\$334.67	\$101.83	\$188.31	17.73%	690.28	1.3624	1.9921
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
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
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%	907.76	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
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

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

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	TOTAL ELEC. (KWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$176.83	42.09%	822.45	0.0874	0.8909
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$177.67	36.74%	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
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$178.23	29.28%	660.35	0.9594	1.5615
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$178.76	23.72%	825.40	1.5213	2.2742
20	GENERIC I.C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$179.90	27.02%	1185.22	1.3320	2.0648
MIDDLE THIRD								
21	SU/RN ROTARY KILN	\$344.39	\$74.08	\$180.74	19.55%	999.74	2.2869	3.1988
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
13	REDSMELT	\$334.67	\$101.83	\$188.31	17.73%	690.28	1.3624	1.9921
17	CIRCOFER/HBI/SAF/EAF	\$239.63	\$96.20	\$188.55	25.37%	780.99	1.6404	2.3528
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$188.64	26.21%	1,030.37	0.4283	1.3681
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$189.65	24.46%	795.44	0.8974	1.6746
HIGHEST THIRD								
6	30% MINI-BF H.M.*	\$198.05	\$142.86	\$189.65	30.32%	795.44	0.8974	1.6746
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$190.82	22.39%	847.37	0.8689	1.6418
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$190.98	31.30%	685.69	1.1545	1.7799
4	HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$198.05	20.43%	1002.39	0.9027	1.8170
1	100% DRI, 1.0% C, MIDREX	\$365.36	\$132.44	\$205.39	10.57%	1,326.73	1.0514	2.2617
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 - SORTED ON I.R.R.

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$100/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
HIGHEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$176.83	42.09%	822.45	0.0874	0.8909
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
6	30% MINI-BF H.M.*	\$198.05	\$142.86	\$189.65	30.32%	795.44	0.8974	1.6746
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$178.23	29.28%	660.35	0.9594	1.5615
16	CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
20	GENERIC I.C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$179.90	27.02%	1185.22	1.3320	2.0848
MIDDLE THIRD								
3	30% DRI, 1.0% C/70% SCRAP	\$231.85	\$137.51	\$188.64	26.21%	1,030.37	0.4283	1.3681
17	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
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$189.65	24.46%	795.44	0.8974	1.6746
18	FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$178.76	23.72%	825.40	1.5213	2.2742
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$190.82	22.39%	847.37	0.8689	1.6418
LOWEST THIRD								
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$198.05	20.43%	1002.39	0.9027	1.8170
19	GENERIC IRON CARBIDE (100%)/EAF	\$347.59	\$66.19	\$177.84	20.24%	972.95	1.2864	2.1738
21	SLRN ROTARY KILN	\$344.39	\$74.08	\$180.74	19.55%	999.74	2.2869	3.1988
13	REDSMELT	\$334.67	\$101.83	\$188.31	17.73%	690.28	1.3624	1.9921
4	H/LSA 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	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

(BASIS: 1.00 MM mt LIQUID STEEL PER YEAR, \$140/mt STEEL SCRAP COST)

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	TOTAL ELEC. (kWhr/mt Ls)	PROCESS CO2 (mt/mt Ls)	TOTAL CO2 (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	\$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
4	H/LSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$219.12	11.14%	795.44	0.8974	1.6746
6	30% MINI-BF H.M.*	\$198.05	\$142.86	\$219.12	14.56%	795.44	0.8974	1.6746
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$207.70	16.55%	660.35	0.9594	1.5615
8	30% COLD PIG IRON/70% SCRAP	\$248.06	\$145.12	\$227.52	6.48%	1002.39	0.9027	1.8170
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$207.14	21.36%	307.58	1.1545	1.4350
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$220.45	14.74%	685.69	1.1545	1.7799
11	COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.63	\$218.17	5.72%	942.91	2.9239	3.7839
12	HISMELT 32.7% H.M.	\$259.63	\$137.85	\$212.92	13.05%	847.37	0.8689	1.6418
13	REDSMELT	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.9921
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$183.48	22.05%	825.40	1.5213	2.2742
16	CIRCORED/HBI/EAF	\$232.37	\$78.79	\$185.27	27.64%	900.84	1.1999	2.0217
17	CIRCOFER/HBISAF/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%	907.76	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	\$205.40	16.52%	1185.22	1.3320	2.0648
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$185.46	18.06%	999.74	2.2869	3.1988

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)

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	TOTAL ELEC. (kWhr/mt LS)	PROCESS CO2 (mt/mt LS)	TOTAL CO2 (mt/mt LS)
LOWEST 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
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
21	SLRN 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
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	2.0948
9	30% TECNORED H.M. W COGEN	\$196.48	\$125.95	\$207.14	21.36%	307.58	1.1545	1.4350
7	30% BF 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
HIGHEST THIRD								
2	100% STEEL SCRAP	\$173.68	\$0.00	\$217.95	17.76%	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
11	COREX/MIDREX 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%	685.69	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)

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	TOTAL ELEC. (kWhr/mt L.S.)	PROCESS CO2 (mt/mt L.S.)	TOTAL CO2 (mt/mt L.S.)
HIGHEST THIRD								
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
14	MAUMEE BRIQUETTE DRI/EAF	\$292.32	\$66.44	\$177.03	24.66%	966.09	1.1498	2.0310
18	FINMET/HBI/EAF	\$263.47	\$79.42	\$185.12	24.31%	907.76	1.0742	1.9022
15	ITMK3 DR SHOT TO EAF	\$296.10	\$67.60	\$183.48	22.05%	825.40	1.5213	2.2742
9	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
MIDDLE THIRD								
21	SL/RN ROTARY KILN	\$344.39	\$74.08	\$185.46	18.06%	999.74	2.2869	3.1988
2	100% STEEL SCRAP	\$173.68	\$0.00	\$217.95	17.75%	822.45	0.0874	0.8909
7	30% BF H.M./70% SCRAP NR COKE	\$243.63	\$110.77	\$207.70	16.55%	660.35	0.9594	1.5615
20	GENERIC I.C. (40%)/SAF/EAF*	\$257.24	\$100.79	\$205.40	16.52%	1185.22	1.3320	2.0648
13	REDSMELT	\$334.67	\$101.83	\$193.03	16.17%	690.28	1.3624	1.9921
10	30% TECNORED H.M. W/O COGEN	\$187.71	\$163.09	\$220.45	14.74%	685.69	1.1545	1.7799
6	30% MINI-BF H.M.*	\$198.05	\$142.86	\$219.12	14.56%	795.44	0.8974	1.6746
LOWEST THIRD								
4	HYLSA IVM	\$362.60	\$125.52	\$196.15	13.72%	1,267.37	0.9086	2.0646
12	HISMELT 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
5	30% BF H.M./70% SCRAP CP COKE	\$243.64	\$142.86	\$219.12	11.14%	795.44	0.8974	1.6746
1	100% DRI, 1.0% C, MIDREX	\$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
11	COREX/MIDREX WITH 60% H.M.	\$373.50	\$161.83	\$218.17	5.72%	942.91	2.9239	3.7839

IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE CAPITAL COSTS*

LOWEST THIRD

100% STEEL SCRAP
TECHNORED W/O COGEN
TECHNORED WITH COGEN
MINI BLAST FURNACE
30% DRI/70% STEEL SCRAP
CIRCORED
CIRCOFER

MIDDLE THIRD

BLAST FURNACE - N.R. COKE
BLAST FURNACE - C.P. COKE
30% COLD PIG IRON/70% SCRAP
40% GEN. IRON CARBIDE/60% SCRAP
HISMELT
FINMET
MAUMEE BRIQUETTE RHF

HIGHEST THIRD

ITMK3
REDSMELT RHF
SL/RN/ROTARY KILN
GENERIC IRON CARBIDE (100%)
HYLSA IVM SHAFT FCE. DRI (100%)
MIDREX SHAFT FURNACE DRI (100%)
COREX/MIDREX

*NOTE: THROUGH LIQUID
STEEL PRODUCTION

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

LOWEST THIRD

GENERIC IRON CARBIDE (100%)
 MAUMEE BRIQUETTE RHF
 ITMK3
 SL/RN ROTARY KILN
 CIRCORED
 FINMET

MIDDLE THIRD

CIRCOFER
 40% GEN. IRON CARBIDE/60% SCRAP
 REDSMELT
 BLAST FURNACE H.M. - NR COKE
 HYLSA IVM (100%)
 TECNORED H.M. WITH COGEN
 MIDREX SHAFT FCE. DRI (100%)

HIGHEST THIRD

30% MIDREX SHAFT FCE. DRI
 HISMELT
 MINI BLAST FURNACE
 BLAST FURNACE H.M. - C.P. COKE
 30% PIG IRON/70% SCRAP
 COREX/MIDREX
 TECNORED H.M. W/O COGEN

*NOTE: THROUGH PRODUCTION
OF IRON UNIT FEED TO EAF

IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL *

\$100/mt STEEL SCRAP COST

LOWEST THIRD

100% STEEL SCRAP
MAUMEE BRIQUETTE RHF
TEGNORED H.M. WITH COGEN
GENERIC IRON CARBIDE (100%)
BLAST FURNACE H.M. - N.R. COKE
ITMK3
GENERIC IRON CARBIDE (40%)

MIDDLE THIRD

SL/RN ROTARY KILN
FINMET
CIRCORED
REDSMELT
CIRCOFER
MIDREX SHAFT FCE. DRI (30%)
BLAST FURNACE H.M. - C.P. COKE

HIGHEST THIRD

MINI BLAST FURNACE
HISMELT
TEGNORED H.M. W/O COGEN
HYLSA I/M
30% COLD PIG IRON/70% SCRAP
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL *

\$120/mt STEEL SCRAP COST

LOWEST THIRD

MAUMEE BRIQUETTE RHF
GENERIC IRON CARBIDE (100%)
HTMK3
SL/RN ROTARY KIEN
FINMET
CIRCORED
CIRCOFER

MIDDLE THIRD

REDSMELT
TECNORED H.M. WITH COGEN
40% GEN. IRON CARBIDE/60% SCRAP
BLAST FURNACE H.M. - NR COKE
HYLSA IVM (100%)
100% STEEL SCRAP
HISMELT

HIGHEST THIRD

30% MIDREX SHAFT FCE. DRI
MINI BLAST FURNACE
BLAST FURNACE H.M. - C.P. COKE
MIDREX SHAFT FCE. DRI (100%)
TECNORED H.M. W/O COGEN
30% PIG IRON/70% SCRAP
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED RELATIVE OPERATING COSTS FOR LIQUID STEEL *

\$140/mt STEEL SCRAP COST

LOWEST THIRD

MAUMEE BRIQUETTE RHF
GENERIC IRON CARBIDE (100%)
ITMK3
FINMET
CIRCORED
SL/RN ROTARY KILN
CIRCOFER

MIDDLE THIRD

REDSMELT
HYLSA IVM
MIDREX SHAFT FCE. DRI (100%)
GENERIC IRON CARBIDE (40%)
TECNORED H.M. WITH COGEN
BLAST FURNACE H.M. - N.R. COKE
HISMELT

HIGHEST THIRD

100% STEEL SCRAP
MIDREX SHAFT FURNACE (60%)
COREX/MIDREX
MINI BLAST FURNACE
BLAST FURNACE H.M. - C.P. COKE
TECNORED H.M. W/O COGEN
30% COLD PIG IRON/70% SCRAP

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY SIMPLE INTERNAL RATE OF RETURN*

\$100/mt STEEL SCRAP COST

HIGHEST THIRD

100% STEEL SCRAP
TECNORED HM WITH COGEN
TECNORED HM W/O COGEN
30% MINI BLAST FURNACE H.M.
BLAST FCE. H.M. - N.R. COKE
CIRCORED
GENERIC IRON CARBIDE (40%)

MIDDLE THIRD

30% MIDREX SHAFT FCE. DRI/70% SCRAP
CIRCOFER
MAUMEE BRIQUETTE RHF
BLAST FURNACE H.M. - C.P. COKE
FINMET
ITMK3
HISMELT

LOWEST THIRD

30% COLD PIG IRON/70% SCRAP
GENERIC IRON CARBIDE (100%)
SL/RN ROTARY KILN
REDSMELT
HYLSA IVM (100%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY SIMPLE INTERNAL RATE OF RETURN*

\$120/mt STEEL SCRAP COST

HIGHEST THIRD

100% STEEL SCRAP
TECNORED HM WITH COGEN
CIRCORED
CIRCOFER
MAUMEE BRIQUETTE RHF
FINMET
BLAST FCE. H.M. - N.R. COKE

MIDDLE THIRD

ITMK3
MINI BLAST FURNACE
40% GEN. IRON CARBIDE/60% SCRAP
TECNORED W/O COGEN
GENERIC IRON CARBIDE (100%)
30% MIDREX SHAFT FCE. DRI/70% SCRAP
HISMELT

LOWEST THIRD

SL/RN ROTARY KILEN
BLAST FURNACE HM. - CP COKE
REDSMELT
30% GOLD PIG IRON/70% SCRAP
HYLSA IVM (100%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY SIMPLE INTERNAL RATE OF RETURN*

\$140/mt STEEL SCRAP COST

HIGHEST THIRD

CIRCORED
CIRCOFER
MAUMEE BRIQUETTE RHF
FINMET
ITMK3
TEGNORED H.M. WITH COGEN
GENERIC IRON CARBIDE (100%)

MIDDLE THIRD

SL/RN ROTARY KILN
100% STEEL SCRAP
BLAST FURNACE H.M. - N.R. COKE
GENERIC IRON CARBIDE (40%)
REDSMELT
TECNORED H.M. W/O COGEN
MINI BLAST FURNACE H.M.

LOWEST THIRD

HYLSA IVM
HISMELT
MIDREX SHAFT FURNACE DRI (30%)
BLAST FURNACE H.M. - C.P. COKE
MIDREX SHAFT FURNACE DRI (100%)
30% COLD PIG IRON/70% SCRAP
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED TOTAL ELECTRIC POWER CONSUMPTION*

LOWEST THIRD

TECNORED H.M. WITH COGEN
 BLAST FURNACE H.M. - N.I.R. COKE
 TECNORED H.M. W/O COGEN
 REDSMELT
 CIRCOFER
 BLAST FURNACE H.M. - C.P. COKE
 MINI BLAST FURNACE

MIDDLE THIRD

100% STEEL SCRAP
 ITMK3
 HISMELT
 CIRCORED
 FINMET
 COREX/MIDREX
 MAUMEE BRIQUETTE RHF

HIGHEST THIRD

GENERIC IRON CARBIDE (100%)
 SL/RN ROTARY KILN
 30% PIG IRON/70% SCRAP
 30% MIDREX SHAFT FCE, DRI
 40% GENERIC IRON CARBIDE
 HYLSA IVM (100%)
 MIDREX SHAFT FCE, DRI (100%)

*NOTE: THROUGH PRODUCTION
 OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED PROCESS ONLY CO2 EVOLUTION*

LOWEST THIRD

100% STEEL SCRAP
30% MIDREX SHAFT FCE. DRI
HISMELT
BLAST FURNACE H.M. - C.P. COKE
MINI BLAST FURNACE
30% COLD PIG IRON/SCRAP
HYLSA IVM

MIDDLE THIRD

BLAST FURNACE H.M. - N.R. COKE
MIDREX SHAFT FCE. DRI (100%)
FINMET
MAUMEE BRIQUETTE RHF
TECNORED H.M. W/O COGEN
TECNORED H.M. WITH COGEN
CIRCORED

HIGHEST THIRD

GENERIC IRON CARBIDE (100%)
40% GENERIC IRON CARBIDE/SCRAP
REDSMELT
ITMK3
CIRCOFER
SL/RN ROTARY KILN
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY ESTIMATED TOTAL CUMULATIVE CO2 EVOLUTION*

LOWEST THIRD

100% STEEL SCRAP
30% MIDREX SHAFT FCE DRI
TECNORED H.M. WITH COGEN
BLAST FURNACE H.M. - N.R. COKE
HISMELT
BLAST FURNACE - C.P. COKE
MINI BLAST FURNACE

MIDDLE THIRD

TECNORED H.M. W/O COGEN
30% COLD PIG IRON/70% SCRAP
FINMET
REDSMELT
CIRCORED
MAUMEE BRIQUETTE RHF
HYLSA IVM

HIGHEST THIRD

40% GENERIC IRON CARBIDE/SCRAP
GENERIC IRON CARBIDE (100%)
MIDREX SHAFT FURNACE DRI (100%)
ITMK3
CIRCOFER
SL/RN ROTARY KIEN
COREX/MIDREX

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

IRONMAKING PROCESSES SORTED BY RANKING SUM - ENERGY & ENVIRONMENTAL VARIABLES 5-7

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP
 BLAST FURNACE H.M. - N.R. COKE
 BLAST FURNACE H.M. - C.P. COKE
 TECNORED H.M. WITH COGEN
 HISMELT
 MINI BLAST FURNACE
 MIDREX SHAFT FCE. DRI (30%)

MIDDLE THIRD

TECNORED H.M. - W/O COGEN
 COLD PIG IRON (30%)/SCRAP (70%)
 FINMET
 REDSMELT
 CIRCORED
 MAUMEE BRIQUETTE RHF
 HYLSA IVM (100%)

HIGHEST THIRD

CIRCOFER
 ITMK3
 GENERIC IRON CARBIDE (100%)
 MIDREX SHAFT FCE. DRI (100%)
 GENERIC IRON CARBIDE (40%)
 COREX/MIDREX
 SL/RN ROTARY KILN

*NOTE: THROUGH PRODUCTION
 OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY RANKING SUM

- COST-RELATED VARIABLES 1-4

\$100/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP
TECNORED H.M. WITH COGEN
CIRGORED
BLAST FURNACE H.M. - N.R. COKE
MAUMEE BRIQUETTERHF
GENERIC IRON CARBIDE (40%)
CIRCOFER

MIDDLE THIRD

ITMK3
GENERIC IRON CARBIDE (100%)
MINI BLAST FURNACE H.M. (30%)
MIDREX SHAFT FCE. DRI (30%)
FINMET
TECNORED H.M. - W/O COGEN
SL/RN ROTARY KILN

HIGHEST THIRD

BLAST FURNACE H.M. - C.I.P. COKE
REDSMELT
HISMELT
COLD PIG IRON (30%/SCRAP (70%))
HILYSA IVM (100%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

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

\$120/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP

CIRCORED

MAUMEE BRIQUETTE RHf

CIRCOFER

TECHNORED H.M. WITH COGEN

ITMK3

FINMET

MIDDLE THIRD

GENERIC IRON CARBIDE (100%)

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

GENERIC IRON CARBIDE (40%)

SL/RN ROTARY KILN

MINI BLAST FURNACE H.M. (30%)

MIDREX SHAFT FCE. DRI (30%)

REDSMELT

HIGHEST THIRD

TECHNORED H.M. - W/O COGEN

HISMELT

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

HYLSA IVM (100%)

COLD PIG IRON (30%)/ SCRAP (70%)

MIDREX SHAFT FCE. DRI (100%)

COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

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

\$140/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

CIRCORED
MAUMEE BRIQUETTE RHF
CIRCOFER
100% STEEL SCRAP
ITMK3
FINMET
GENERIC IRON CARBIDE (100%)

MIDDLE THIRD

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%)

HIGHEST THIRD

TECNORED H.M. - W/O COGEN
HISMELT
HYLSA IVM (100%)
BLAST FURNACE 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

IRONMAKING PROCESSES SORTED BY RANKING SUM

- ALL VARIABLES SUMMED 1-7

\$100/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP
TECNORED H.M. WITH COGEN
BLAST FURNACE H.M. - N.R. COKE
MINI BLAST FURNACE
MIDREX SHAFT FCE. DRI (30%)
CIRCORED
TECNORED H.M. W/O COGEN

MIDDLE THIRD

MAUMEE BRIQUETTE RHF
BLAST FURNACE H.M. - C.P. COKE
FINMET
HISMELT
CIRCOFER
ITMK3
GENERIC IRON CARBIDE (40%)

HIGHEST THIRD

GENERIC IRON CARBIDE (100%)
REDSMELT
GOLD PIG IRON (30%)/SCRAP (70%)
SL/RN ROTARY KILN
HYLSA IVM (100%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY RANKING SUM

- ALL VARIABLES SUMMED 1-7

\$120/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP
TECNORED H.M. WITH COGEN
BLAST FURNACE H.M. - N.R. COKE
CIRCORED
MAUMEE BRIQUETTE RHF
FINMET
MINI BLAST FURNACE H.M. (30%)

MIDDLE THIRD

CIRCOFER
MIDREX SHAFT FCE. DRI (30%)
HISMELT
BLAST FURNACE H.M. - C.P. COKE
ITMK3
TECNORED H.M. - W/O COGEN
GENERIC IRON CARBIDE (100%)

HIGHEST THIRD

REDSMELT
GENERIC IRON CARBIDE (100%)
SL/RN ROTARY KILN
COLD PIG IRON (30%)/SCRAP (70%)
HYLSA IVM (100%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL

IRONMAKING PROCESSES SORTED BY RANKING SUM

- ALL VARIABLES SUMMED 1-7

\$140/mt STEEL
SCRAP COST

RANKING VARIABLES

- 1 = INSTALLED CAPITAL COST
- 2 = OPERATING COST PER IRON UNIT
- 3 = OPERATING COST PER MT LIQUID STEEL
- 4 = SIMPLE INTERNAL RATE OF RETURN
- 5 = CUMULATIVE ELECTRICAL POWER
- 6 = CUMULATIVE PROCESS CO2 EMISSIONS
- 7 = TOTAL CUMULATIVE CO2 EMISSIONS

LOWEST THIRD

100% STEEL SCRAP
TEGNORED H.M. WITH COGEN
CIRCORED
BLAST FURNACE H.M. - N.R. COKE
MAUMIEE BRIQUETTE RHF
FINMET
CIRCOFER

MIDDLE THIRD

ITMK3
MINI BLAST FURNACE H.M. (30%)
MIDREX SHAFT FCE. DRI (30%)
GENERIC IRON CARBIDE (100%)
BLAST FURNACE H.M. - C.P. COKE
HISMELT
REDSMELT

HIGHEST THIRD

TEGNORED H.M. - W/O COGEN
SL/RN/ROTARY KILN
GENERIC IRON CARBIDE (100%)
HYLSA VM (100%)
GOLD PIG IRON (30%)/ SCRAP (70%)
MIDREX SHAFT FCE. DRI (100%)
COREX/MIDREX

*NOTE: THROUGH PRODUCTION
OF EAF/LRF LIQUID STEEL