2005 EAF Melt Shop Market Study

Market Survey Questionnaire with Sponsor Highlights

Project #344

Survey # 100

I. PLANT IDENTITY:

A. Name of Company: **Some Company**

B. Plant Location: **Somewhere, USA**

C. Designation:

D. General Phone #: **999-999-9999** Ext.

E. Comments: **Carbon steel sheet in hot rolled and pickled and cold rolled and galvanize coated coils are being produced. The plant operates 2 AC electric arc furnaces and 2 ladle furnaces feeding liquid steel to 2 single strand slab casters feeding a hot strip mill. It was indicated that the plant has continuous improvement objectives and has maintained the equipment and installed new technology. The plant has considerations and wish list items and suggests interested suppliers keep in contact and ensure they are on the approved bidders list.**

II. CONTACTS

1. Name: **Clark Kent** Date: **10/11/2005**
   Title: **Power Systems Engineer**
   Address: **123 End Road**
   City: **Small Town** State: **MA** Zip: **12345**
   Phone: **999.999.9999** Ext: Fax:
   eMail:

2. Name: **Slim Jim** Date: **10/11/2005**
   Title: **Electrical Engineer - Melt Shop**
   Address: **123 End Road**
   City: **Small Town** State: **MA** Zip: **12345**
   Phone: **999.999.9999** Ext: Fax:
   eMail:

3. Name: **John Doe** Date: **10/11/2005**
   Title: **Melt Shop Manager**
   Address: **123 End Road**
   City: **Small Town** State: **MA** Zip: **12345**
   Phone: **999.999.9999** Ext: Fax:
   eMail:

III. GENERAL EAF MELT SHOP INFORMATION

A. General Melt Shop Information

1. No. of EAF melting units: **2**

2. EAF & LF Data:

	Type (AC/DC)	*Heat Size (short tons)*	*Heats (per day)*	*Manufacturer*	*Year of Start-up*
EAF # **N**	**AC**	**130**	**30**	**Fuchs**	**1989**
EAF # **S**	**AC**	**130**	**30**	**Fuchs**	**1989**
EAF #					
LMF	XXXXX	**1&2 - 130**	**30**	**EMCI**	**1989**

a. Comment:

John pointed out they have 2 ladle furnaces.

3. Total Steel Production:2004 **2200** kton 2005 (projected) **2300** kton

4. What problem, issue or concern is presently having the most significant negative impact on the present steelmaking performance? (Distribute 10 point among the 3 or 4 selected priorities.)

Priority:

_____ Increase productivity
4 Reduce operating costs*
3 Improve quality
_____ Reduce scrap dependency
3 Reduce electricity consumption
_____ Other, specify _____

5. EAF Operating Parameters and Experience

a. Tap-to-Tap time, in minutes (a full cycle): Average: **41** Best: **37**

b. Power-on time, in minutes: Average: **33** Best: **29**

c. Is the EAF presently a bottleneck to steelmaking? **No**

d. If Yes, what improvement in Tap-to-Tap time is desired? **NA** % **NA** minutes

e. Comment:

John said the thin slab casters are the bottleneck operation. He also said it is better to say "maintain quality" since there are no major quality issues.

6. What is the composition of total energy input to your EAF?

Chemical: **35** % Electrical: **65** %

7. Comment:

John said this melt shop equipment performs very well enabling them to meet all of their objectives.

B. EAF Auxiliary Technologies

1. Oxy-fuel Burners - Characterize Oxy-fuel Burners & Their Maintenance

a. Describe oxy-fuel burners currently installed on EAF's in the melt shop:

EAF	# of Burners	Suppliers	Location	Rated Power
N	**3**	**Praxair**	**Sidewall**	**1600 SCFM**
S	**3**	**Praxair**	**Sidewall**	**1600 SCFM**

(1) Comment:

John indicated these co-jet burners are valuable in melting and refining the heats. He said they are used for injecting oxygen, natural gas and carbon.

b. Describe normal oxy-fuel burner maintenance practice:
(Indicate whether repair or replaced, frequency, who handles repair or service, and how often are burners repaired or replaced?)

John said all repair and lance replacements are done by plant personnel

c. Carbon Injection

Indicate whether the carbon injection equipment is: ☑ owned, ☐ leased,
☐ provided by carbon supplier as a part of the contract for carbon, or
☐ other, specify:

d. Indicate the relative importance (current or potential) to your melt shop of the

(1) Functions of the burner/lance/injector systems for your electric furnace operation:
(By distributing 10 points among the 3 most important functions.)

Scrap melt-in **3** Decarburization **4** Slag foaming **3**
Inject carbon-bearing solids ____ Injecting flux materials ____
Other ____, specify:

(2) Attributes of the burner/lance/injector systems of your electric furnace:
(By distributing 10 points among the 3 most important functions.)

Ease of use **3** Reliability/lack of downtime **4**

Ease of maintenance ____

Getting spare parts and other services from burner/injector supplier **3**
Use optimization consulting by supplier of burner/injector ____
Accuracy of control of inputs ____

Amount of fuel and/or oxygen required ____

Others ____, specify:

e. Comment:

John said the foamy slag practice is extremely important for chemistry and furnace operation.

C. Electrode Arms

1. Characterize Existing Electrode Arms

a What type do you have? ☑ Current-carrying type or ☐ Conventional standard type
If current-carrying conducting arms…
(1) What type? ☑ Copper ☐ Aluminum
(2) What manufacturer? **Fluhe**

b. Are there plans to replace your electrode arms? **No**

(1) If YES,

(a) When: **NA**
(b) Is a supplier selected ☐ or one or more being considered ☐?
(c) Identify supplier(s) selected:_____
considered:_____
(d) Is a type selected ☐ or considered ☐ ?
(e) What type? ☐ Water cooled bus ☐ Copper Clad ☐ Aluminum

(2) If NO, would current carrying electrode arms be on your wish list? **NA**

c. Comments:

John said their electrode arms were installed in 2003 and work very well.

D. Ladle Refining

1. Are bauxite fines currently used in ladle metallurgy desulfurization? **Yes**

If Yes…

a What type of bauxites are used? ☑ Calcined ☐ Raw

b What is the granulometry? **Sized for a feed system**

c What is the chemical composition?
Fe: **DK** % Al_2O_3: **DK** % SiO_2: **DK** % LOI (loss on ignition): ___ %

d Is it possible to use a bauxite fines with an LOI content of ~ 15

(1) What amount (by weight) of would be added to a heat in the ladle ____ Lbs.
(2) What typical sizing Maximum: **DK** Minimum: **DK**
(3) What minimum Al_2O_3 content is required of such bauxite fines? _____ %

2. Comments:

John said he did not know all the specifics without research. He said they want the lime-to-alumina ratio between 1.5 to 1.8. Dan said this product is used at the ladle met station.

E. Ladle Degassing

1 Do you have Ladle Degassing? **Yes**

If Yes…

a. Are you satisfied with its performance? **Yes**

(1) If not, why not?

NA

b. What share of heats are currently degassed? **10** %

(1) Do you expect this to increase over the next few years? **Yes**

c. Comment:

2 Do you plan to enhance your product line quality and/or steel grades to service value added markets by the addition of vacuum degassing technology? **NA**

If Yes,

a. When? **NA**

b. Have you selected a vendor? **NA**

(1) If Yes, who? **NA**

c. Is money approved? **N/A**

3 Is the performance of your steam ejector compromised by contamination by particulate in the off-gases? **NA**

a. Are you aware that a filter would eliminate the problem? **NA**

b. Comment: **John said they operate an AOD.**

4. Comment:

John said they use the degasser for electric steels for motor laminations and they expect that type of steel production to increase.

F. Operating Costs

1. Assuming that melt shop operating costs (in general) are measured on a cost per ton of liquid steel, indicate the basis of how these costs are measured: (indicate by "x" below)

a. _X_ Separate applications (ladle, EAF, ladle refining, etc
b. ____ One Total Plant Cost
c. _X_ By Item (refractories, electrodes, energy, scrap, alloys, lime, etc
d. ____ All of the above
e. ____ Incentive / Benefit sharing with vendor
f. ____ Other, specify:
g. Comment:

Liquid steel cost per ton is the only way to effectively measure the input costs from each process involved.

IV. SCRAP CHARGING, SCRAP & OTHER ALLOY CHARGE MATERIALS CHARGED

A. Are used tires currently used as EAF feed material? **No**

if YES. 1. What share of heats (per month) include truck/automobile tires? **NA** %

2. What amount (by weight) of automobile tires is included in a heat?
   Minimum: _____ Maximum: _____ Tons
3. Typical sizing: Minimum: _____ Maximum: _____
4. What are any are some of concern about the use of tires?

They are concerned with problems with the baghouse and environmental issues. He added this product would also increase the sulfur load.

B. What percent is required to meet your product requirements for your three leading grades. Do you use low residual scrap (LRS) or alternative iron (AI) units (pig iron, DRI or HBI) :

Grade	*LRS or AI % of Charge*	*Grades % of Production*
1.	**Pig iron - 15%, HBI 5-10%**	**100**
2.		
3.		

C. Comment:

John said that basically the choice of alternative iron is based on heat chemistry and the cost of these units.

D. (Ask only of Flat Roll EAF) Would you consider the addition of a continuous scrap charger to your EAF to reduce power-off times due to bucket charging, eliminate heat losses due to opening the roof for charging, and eliminate the emissions from bucket charging? **No**

E. Characterize the Cast Aluminum Deox Used

Do you use Aluminum Deox? **Yes**

1. Type of Al Deox -	2. Size or Weight *Add Comments below	3.% Al - -	4. Amount Consumed (Lbs. per Ton)	5. Applied to X Tons of Steel	6. Amount Consumed (Lbs per Mo.)	7. Packaging (Bs-Bundles, S–Supersacks, Bk-Bulk), other, specify
Notchbar	5 lb					
	50 lb bundles					
	Other, specify:					
Cones	2oz					
	4oz	**98**	**4.0**	**192,000**	**768,000**	**S**
	6oz					
	Other, specify:					
Shot	3/8 inch					
	Other, specify:					
Substitutes	Briquettes					
	Other, specify: **Wire**	**95-98**	**(1)**	**(1)**	**(1)**	**Reels**

1. Comment:

   John said the aluminum deox is used at the ladle treatment station.
   (1) He said they use wire to trim the heats and it is included in the approximate 4.0 pounds per ton.

F. Steel Turnings

1. Does your facility consume steel or iron shavings or turnings?
   a. If Yes, this facility is limited from using more turnings because:
      - ☐ Contaminants on turnings(i.e. oil, water)
      - ☐ Recovery or yield issues
      - ☐ Not practical because:
   b. Comment on the issues behind the limitation:

2. Would your facility consume greater quantities of steel turnings, if the above issues were addressed in an economical manner?
3. Comment:

V. REFRACTORY WEAR MEASUREMENT

A. Do you currently use, or have you investigated products that measure refractory wear or thickness? **Yes**

1. If yes, specify type: ☐ Infrared/Thermographic ☑ Laser ☐ Thermocouples ☐ Optical scanning ☐ Other, specify:

B. Do you know of technology that monitors refractory wear continuously? **Yes**

1. Comment:

John said they had discussions with Minteq about their system, MinScan. He said he likes the idea and feels it will have a good return but right now it is not a spending priority.

C. In what EAF melt shop molten metal application is refractory erosion or failure causing the most significant problem?

☑ EAF (1. Specify: ☐ roof ☑ walls ☐ bottom)
☑ AOD (2. Specify: ☐ lid ☑ walls ☐ bottom)
☐ Degasser (3. Specify where: _____)
☑ Ladle (4. Specify: ☑ slag line ☑ walls ☐ bottom)
☐ Other, specify:

1. Comment:

John said erosion and failure indicates you have bad practices. He said to be safe, the tendency is to take the refractories out too soon, which increases refractory costs.

D. Could a system that continuously monitors refractory wear help improve that problem/ situation? **Yes**

1. If YES, how?

☐ By reducing or eliminating breakouts
☑ By Improving gunning practices
☑ Improve RH degasser refractory performance (specify what part: **Walls**)
☑ Improving Ladle refractory life (a. specify at ☑ slag line ☑ walls ☐ bottom)
☐ Other, specify:

2. Comment:

John said he would expect that a monitor would be effective in using the refractory and going into a reline on a just-in-time basis.

E. Specifically regarding the EAF bottom refractory, assuming that you could continuously monitor the refractory thickness, this would allow you to…

☐ Reduce chain profiling of the bottom
☑ More effectively gun the furnace bottom
☑ Increase the campaign life
☑ Increase production
☐ Other, specify:

F. Comment:

John said based on the information gained on the performance of a monitor previously discussed, he feels there is merit to at least trying one. He said now this is not a spending priority.

VI. MAJOR ELECTRICAL EQUIPMENT & POWER SYSTEM

A. EAF Transformer

EAF Designation	Manufacturer	Year of Startup	Power (MVA)	Active Power (MW)	Voltage (Kv)	Current (Amps)	Type of Delta**	Type of Buss***	Other, Specify:
N	**ABB**	**1994**	**90**	**90**	**34.5**	**62-65,000**	**2**	**1**	
S	**ABB**	**1994**	**90**	**90**	**34.5**	**62-65,000**	**2**	**1**	

** ABB/N.I., Tamini, Siemens ** E- external, I- internal *** CT - Copper plate, CP - Copper pipe*

Comment?

1. Do you plan to increase your power system or transformer? **No**
2. Comment?

   Slim said the original transformers were supplied by Ferranti Packard in 1989 and were rated at 60 MVA. The transformers were rewound by ABB to the present 90 MVA. He said they now have more furnace than the caster can handle.

B. Reactor

1. Are you aware that fixed tap dry-type air-core series reactors have been used successfully with EAFs for over 13 years? **Yes**
2. Are you presently using a series reactor? **Yes**
   a. If Yes…
      (1) Indicate rating: **490,000** Kvar
      (2) Rank the following benefits provided by installing a series connected dry-type air-core reactor: (Distribute 10 points among the 3 most important benefits)

      _____ Reduced tap to tap times
      2 Reduced energy consumption
      _____ Reduced electrode consumption
      4 Reduced flicker
      _____ Reduced transient over voltages on upstream electrical equipment
      4 Other, specify: **Arc stabilization**

      (3) If you see a benefit, would you be interested in learning more about applying this solution? **Yes**

   b. If no, why not?

      NA

   c. Comment:

3. Are you aware that modeling techniques are available that can help select the most cost effective solution with regard to the application of series impedance? **No**
4. If you decide to employ a tapped EAF series reactor, what payback timeframe is required?
   - ☐ 1 year
   - ☐ 2 years
   - ☐ Other, specify:

5. What benefit (or added benefit if already have series reactor) could be realized by having automatic on-line tapped switchable series reactors to provide optimized impedance during the melt cycle?

6. Comment:

Slim said they now minimize the use of the tap changer and there would be no benefit from an automatic type.

C. Substation/Power Distribution

1. Hardware Manufacturer: **Transformers - Ferranti Packard / Switches - ABB**
2. Engineering by: **Premier Power and in-plant engineering**
3. Installation by (If applicable): **Premier Power and in-plant engineering**
4. Year of Start-up: **2000**
5. Substation transformer rating: _____**50**_____ MVA
6. Comment:

Slim said the substation basically was completely upgraded about 5 years ago. He said there are 4 step down transformers in this substation.

D. Power Compensation

Do you have static var compensation? **Yes**

1. If YES,
   a. Rating: __**310**__ Mvar
   b. Manufacturer: **Siemens**
   c. Installation by (If applicable): **11**
   d. Year of Installation: **2002**
   e. Characterize the benefits derived from your SVC: (Distribute 10 points among the following:)
      ___ Reduced tap to tap time (extra production)
      ___ Reduced energy consumption
      ___ Reduced electrode consumption
      ___ Reduced flicker
      ___ Stable voltage
      ___ Other, specify:
   f. Are you satisfied with SVC performance? **Yes**
   g. Would you consider a STATCOM instead of SVC for the same application in the future?
2. If No
   a. Why aren't you using an SVC?

      NA

   b. Are you presently using ONLY harmonic filters or capacitor banks? **No**

      If YES...

      (1) How many? _____

Designation	a. MVar Size	b. Kv Rating
(2) 2, 3, 4, 5,	50, 80, 75, 90	34.5
(3)		
(4)		

3. PCC (Point of Common Coupling):
   a. What is the MVAsc? **28,000** MVA
   b. kV level: **34.5**
4. Are there any power quality requirements (power factor, flicker, and harmonics) imposed by your electrical utility? **Yes** If yes, describe.
   a. Power Factor: **0.95** (i.e., 0.95 lag)
   b. Flicker: **<1.0** (i.e., Pst99=1.0)
   c. Harmonics: **(1)** (i.e., IEEE Std 519 Voltage and Current Limits)
5. Comment:

   (1) Clark said the harmonics requirement is as specified in the IEEE standard. He said he does not get involved with the contract language. Chris added that there has been no issues with the utility company.

E. Protective Relays

1. Estimate the total number of protective relays installed in the main substation and other switchgear to protect feeders, buses, and transformers: _____
   a. Or select range: ☑ 0-100 ☐ 100-200 ☐ 200-300 ☐ 300-400 ☐ 400-500 ☐ > 500
   b. What share (of total installed) of these protective devices involve the following technologies:

Technology	%
(1) Electromechanical:	
(2) Microprocessor*:	**100**

** or other electronic based*

   c. If electromechanical, any plans to replace electromechanical?
   d. Comment:

2. In addition to standard overcurrent devices (50/51 and or 50N/51N) indicate whether differential protection is applied to any of the following transformers?

Transformers:	Yes / No
a. Substation Step-Down Transformers	**Yes**
b. EAF Transformers (AC) in the melt shop	**No**
c. LMF Transformers (AC) in the melt shop	**No**

   d. If Yes to (a.) Substation transformers and No to (b. and c.) EAF and LMF units, explain why is differential protection not applied to the EAF and LMF units?

3. In addition to standard overcurrent devices (50/51 and or 50N/51N) indicate whether any other protection systems are applied to the EAF and/or LMF vaults:

Other Protection Systems:	Yes / No
a. Impedance based relay systems	**No**
b. Fire suppression systems	**Yes**
c. Flash sensor systems (☐ visible or ☐ UV)	**No**
d. Manually activated tripping (ie, panic button)	**No**
e. Other, specify type:	

4. (Only if EAF is DC type) In addition to standard overcurrent devices (50/51 and or 50N/51N) on the AC side of the EAF transformer, indicate any other type of protection systems that are applied to the rectifier on a DC EAF System?

Other Protection Systems:	Yes / No
a. Fire suppression systems	
b. Flash sensor systems (☐ visible or ☐ UV)	
c. Manually activated tripping (ie, panic button)	
d. Other, specify type:	

5. Have you experienced primary or secondary fault events in the EAF transformer vault that required replacement of buswork, arresters, EAF transformers, or other vault equipment?.. **No**

If YES...

a. What was the approx. length of the outage in lost production? _____ hours

b. What was the approx cost of the outage in replacement parts? $_____

c. Comment:

Clark said they are working with Cooper to add differential protection to the EAF transformer and eventually the LMF transformer. He said there is differential protection on the step down transformers.

VII. AUTOMATION

A. Electrode Regulation Control System

1. Who is supplier: **AMI / G.E.**
2. When was the current system installed? **2001**
3. Are you satisfied with the performance? **Yes**

a. If not, why?

NA

B. Level II Control System

1. Who is supplier: **Siemens**
2. When was the current system installed? **1991**
3. Are you satisfied with the performance? **Yes**

a. If not, why?

NA

C. Comment:

Clark said the AMI / G.E. electrode regulation control is backed up by a neural system.

VIII. PLANS TO UPGRADE, REPLACE, OR ADD ANY MAJOR PROCESS EQUIPMENT

A. Last Major Melt Shop Upgrade

1. Scope:
2. Vendor: **Flohe**
3. Year completed: **2003**

B. Do you have plans to upgrade, replace, or add any major process equipment to the EAF Melt Shop? **No**

1. Specify the equipment:
   - ☐ New melt shop
   - ☐ Mechanical furnace upgrade (hydraulics, electrode arms, …)
   - ☐ Electrical furnace upgrade (e.g. furnace transformer, automation, electrode control
   - ☐ Arc furnace switchgear
   - ☐ Substation/other switchgear
   - ☐ Reactive power compensation
   - ☐ Other, specify

If YES, describe plans in table below:

a. Scope	b. N or U*	c. P or C**	d. Approx Value	e. Is Money approved?	f. Year of Order

** N – New U – Upgrade ** P - Planned C - Considered*

C. Indicate the equipment/design changes that would have the greatest impact on quality in terms of either reducing melt shop-related rejections or facilitating the production of higher quality (i.e., higher priced) end product markets

1. _____
2. _____
3. _____
4. Comment: **The respondents mutually agreed they do not need equipment design changes that will improve quality since they have no such issues.**

D. Who are the key decision makers that will be involved in the specification and selection

1. Name: **Improvement team** Title: **Members (management & workers)**
2. Name: _____ Title: _____

E. Comment:

John said the Nucor practice is to get input from the front line personnel and pass their recommendations up through the plant and then corporate management.