I. PLANT IDENTITY

A. Name of Company: **ABC Corp.**
B. Plant Location: **Anytown, USA**
C. Mill Type: [ ] Integrated Mill, [x] Minigraduated Mill, [ ] Minimill, [ ] Specialty
D. Number of Casters: [ ] Billet, [ ] Bloom / Rounds, [ ] Slab, [ ] Thin Slab,
                           [ ] Other Caster
E. This Caster Designation Number:
F. Overall Comment:

   A wide variety of steel grades in carbon, low alloy, alloy and HSLA are produced here. The plant
is operating an EAF and a single strand thin slab caster. The thin slab machine produces slabs
that are reheated in a tunnel furnace prior to the hot strip mill. There are no firm plans for
upgrades or improvements and no tentative plans for the foreseeable future. Wish list items will
be discussed with individual suppliers if they initiate the contact.

II. CONTACTS

A. Name: **John Doe**  Date: 03/26/03
   Title: Manager Maint. Casting
   Address:
   City / State / Zip: **Anytown, USA**
   Phone:  
   Fax:  
   Email:  

B. Name: **Jim Doe**  Date: 03/28/03
   Title: Manager Caster
   Address: Same as above
   City / State / Zip:  
   Phone:  
   Fax:  
   Email:  

C. Name:  
   Title:  
   Address:  
   City / State / Zip:  
   Phone:  
   Fax:  
   Email:  

D. Name:  
   Title:  
   Address:  
   City / State / Zip:  
   Phone:  
   Fax:  
   Email:  

E. General Phone Number:  

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2003 NORTH AMERICAN CONTINUOUS CASTER MARKET STUDY
Prepared for: AIM Market Research
Prepared for: AIM Market Research
May 2003
III. CHARACTERIZE THE CASTING FACILITY

A. Characterizing the Caster

1. Type of Caster: ___ Slab, ___ Thin Slab, ___ Billet, ___ Bloom, ___ Rounds, ___ Other, Specify:

2. Number of Strands: ______ 1 ______

3. Caster Supplier / Builder: SMS

4. Start-Up Year: __ 1995 ___

5. Annual Production (This Caster): _______ 1450 _______ Ktons 2003 Projected

                      _______ 1400 _______ Ktons 2002 Actual

6. Ladle Capacity: _______ 185 _______ tons

7. Casting Time Per Heat: Min: _______ * ( minutes ) Avg: _______ 51 * Max: _______ * ( minutes )

8. If Sequence Casting, Number of Heats per Sequence: Min: _______ Avg: _______ 8 Max: _______

9. Production Rate of Caster: ______ 24 ______ Heats Per Day

   a. Is the Caster a Bottleneck to Steelmaking Production

10. Steel Grades Continuously Cast on this Machine

    90 % AK

    10 % SK

    ______% AK / SK

    ______% Stainless

    ______% Other, Specify:

11. Cross Sections Cast: (Min) ______ 2 ______ in. x ______ 40 ______ in.

        (Max) ______ 2 ______ in. x ______ 64 ______ in.

        Other:

12. Comments:

    * Jim Doe said average casting time per heat is 51 minutes. He offered: (inches/min)
      minimum 170; average 205; maximum 250.

B. What are the Fundamental Priorities of this Continuous Caster Operation?

   Distribute 10 points among the top 3 factors:

   ___ Improve Product Quality ___ Increase Production

   ___ Reduce Costs ___ Environmental Concerns

   ___ Improve Productivity ___ Other, Specify:

C. Are you satisfied with the current level of automation (Both Level I and II) of the Caster?  Yes

D. Comments:
IV. CHARACTERIZE EXISTING OSCILLATOR AND ITS PERFORMANCE
A. Oscillator Style:
B. How is Oscillator Performing? (Scale of 0 to 10, where 10 is the best) 10
C. Are there any problems, concerns, or issues regarding the performance, maintenance, and operation (Casting Speed, Oscillation Marks, etc.) of the existing oscillator? No
D. Comment:
   Jim said this basically is a new machine and all components are quite satisfactory.

V. CHARACTERIZE THE TUNDISH
A. Tundish Parameters
   1. Tundish Capacity: 30 tons
   2. Tundish Depth: 35 inches
   3. Number of Units on Hand: 9
   4. Dams and Weirs?: No
   5. Tundish Flux: Rice Hulls, x Other, Specify: Basic Flux
   6. Does the Tundish have a Permanent Mechanical Cover? Yes
   7. Do you use Continuous Temperature Monitoring? No
B. Tundish Refractory
   1. a. Safety Lining: Brick or x Castable
   2. a. Working Lining: Dry Vibe Spray Other, Specify: x
   3. Heats Per Tundish Working Lining: Average: 8, Maximum: 13
   4. Do you change the Tundish on the fly? No
   5. Tundish Preheating and Drying
      a. What Tundish preheating or drying equipment do you have?
      b. Supplier: North American
      c. Year Installed: 1995
      d. Are you satisfied with it's performance? Yes
      (1) Do you get a good heat transfer without impinging? Yes
e. Are you planning to add or replace this preheating or drying equipment? No
f. Are emissions from this type of equipment of any concern? No
6. Is Tundish Insulated? Yes
7. Comment:
V. CHARACTERIZE THE TUNDISH (Cont.)

6. If a new technology were available that could improve your caster flow control, would you
   ___ Be interested in participating as a beta site in the continued development and demonstration.
   ___ Adopt only after proven by others
   ___ Adopt after, ___1 year ___3 years ___5 years, other: ___

E. Comment:
   Jim said there would be some interest to develop a new technology providing it was beneficial.
   He said the present tundish flow control system is effective.

VI. CHARACTERIZE THE MOLD

A. Mold Shape: ___ Curved ___ Straight ___ Other, Specify:
   1. Is Caster Mold Adjustable? Yes

B. Mold Level Measurement System
   1. What technology do you now use for Mold Level Measurement
      ___ Eddy Current / Electromagnetic ___ Radioactive ___ Optical
      ___ Other, Specify:
      a. How many years have you used this technology ___7___
   2. Are you satisfied with your current Mold Level Measurement System Yes
      a. If NO, why not?
      N/A

3. What features or improvements would you like to see incorporated into your Mold Level
   Measurement System?
   Rate their importance on a scale of 0-10
   Feature or Improvement Rating
   a. N/A
   b. N/A
   c. N/A

4. Are you considering or would you consider replacing your current
   Mold Level Measurement System? No
   a. If YES, in what time frame? ___ N/A ____ ( Mo / Year )
   b. What features / improvements would you like to see in a new mold level measurement system
      that
      N/A
V. CHARACTERIZE THE TUNDISH (Cont.)

D. Tundish Flow Control

1. Device Used:  
   - Stopper Rod  
   - Slide Gate  
   - Open Pour  
   - Other, Specify:  
     a. If Slide Gate, is Stopper also used for stop/start?  **N/A**  
     b. If Stopper Rod Only, Are you using or considering porous plug, or **Neither**

2. Type of Pouring Tube:  
   - SEN (Submerged Entry Nozzle)  
   - SES (Submerged Entry Shroud)  
   - Metering Nozzle Only  
   - Other, Specify:  
     a. Indicate Primary and Other Suppliers and Percent  
        **Vesuvius - 100%**  
     b. Do you gas purge?  **Yes**  
     c. Describe Nozzle Port:  
        - Straight  
        - Bifurcated  
        - Other, Specify:  

3. Do you experience any undesirable effects on flow with the current method of flow control?  **No**  
   a. If YES, Describe the Problem:  
      **N/A**  
   b. What would be the benefit of reducing or eliminating this effect? 
      *Distribute 10 Points Among the 3 Most Important Benefit*  
      - Quality  
      - Ability to Continuously Cast Other Types of Steel  
      - Yield  
      - Reduce Turbulence  
      - Increase Production  
      - Increased Sequencing  
      - Reduce Downtime  
      - Other, Specify  
      **N/A**  

4. At what point during casting does diminished flow dictate aborting a Strand/Nozzle?  
   - 10%  
   - 25%  
   - 50%  
   - Other, Specify:  

5. What return of investment in terms of Increased Life, Dollars Savings, and/or Payback Time, would you need to seriously adopt a better flow control solution?  
   - Increased Life  
   - Dollar Savings  
   - Payback Months  
   a. Comment:  
      **Jim said he did not know how to respond to this question since he does not know anything about the new system.**
VI. CHARACTERIZE THE MOLD (Cont.)

5. How important are technical support, service, and availability of spare parts regarding Mold Level
   
   10 (Scale of 0-10)

6. Would you consider a supplemental Mold Level Measurement System as a back-up (redundant) system to your primary Mold Level Measurement System? **No**

C. Comment
   
   *Jim said the present mold level measurement system is very satisfactory.*

D. Measuring Casting Speed

1. If you had a better accuracy on Casting Speed (to within .1%), could you improve your Mold Level **No**
   
   a. If YES, what accuracy would be needed **N/A** %

VII. CASTER CUT

A. What is the number one problem / concern you have with the cutting process as it relates to gases?
   
   **N/A**

B. What would be the impact on production if they could cut faster, have narrower kerf width, and reduce or 

   **N/A**

C. Would you consider outsourcing total service of cutting torches, tips, and apparatus maintenance for **N/A**
   
   1. If YES, would you consider paying a monthly fee for this service **N/A**

D. Would you be interested in a real time cut optimization system that maximizes the profit potential of the strand, based on quality vents (e.g. mold level disturbances, speed fluctuations, spray water

E. Comment

   *Jim said a flying shear is used for slab cut-off.*
VIII. PROCESS IMPROVEMENT PRIORITIES AND PLANS FOR CASTER UPGRADES

A. What are the process improvement priorities for the caster operation
   None

B. Indicate the top three items (wish list) on the caster that need to be upgraded or replaced
   1. *
   2. 
   3. 

C. Are there any firm plans for capital expenditures to address the above priorities and/or to upgrade this
   No
   1. If YES,...
      a. Explain: N/A

b. What is the Timetable? N/A
c. What is the Scope? _____ Upgrade, _____ Replace, _____ New, _____ Undefined
d. Scope Includes: _____ Oscillator _____ Molds _____ Both
e. Have the funds been approved? N/A
f. Have your vendors been selected for these projects N/A
   If YES,
   (1) Specify Supplier: N/A

D. Comment
   * Jim Doe said there are no plans for upgrades and improvements for the caster. He also said nothing will be done in the foreseeable future. He said there are definite wish list items that will eventually become projects but he prefers to discuss these items with the appropriate supplier. He can be contacted and specifics will be addressed.
IX. CASTER MAINTENANCE

A. How would you characterize your current maintenance program
   
   __x__ Very Good, ___ Good, ___ Adequate, or ___ Inadequate

B. Which equipment or system in the caster requires the highest level of maintenance
   
   Segments

C. Are any maintenance services for this facility currently outsourced  Yes

   1. If YES, Indicate scope of outsourced maintenance services included

<table>
<thead>
<tr>
<th>Service</th>
<th>Supplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>x Roll Refurbishing Services</td>
<td>*</td>
</tr>
<tr>
<td>x Complete Mold Reconditioning</td>
<td>SMS Millcraft *</td>
</tr>
<tr>
<td>Caster Rolls Segment Repair</td>
<td></td>
</tr>
<tr>
<td>Fabrication and Repair of Components</td>
<td></td>
</tr>
<tr>
<td>Full Service Machining Capabilities</td>
<td></td>
</tr>
<tr>
<td>Technical Support</td>
<td></td>
</tr>
<tr>
<td>Total Assembly and Delivery of Completed Machinery and Equipment</td>
<td></td>
</tr>
<tr>
<td>Bearing Rework</td>
<td></td>
</tr>
<tr>
<td>Other, Specify:</td>
<td></td>
</tr>
</tbody>
</table>

   2. If NO, have you ever considered outsourcing these services   N/A

D. Do you have an existing strand conditioning monitoring system

   1. If YES, are you satisfied with its performance
      
      a. How could it be improved?

   2. If NO, do you need such a device

   3. Comment
X. SEGMENT REBUILDING AND BEARINGS

A. Segment rebuilding is now: **x** In-house  ____ Outsourced or  
   ____ In-house now, but plan to outsource in futur

1. If segment rebuilding is outsourced, who does it  **N/A**
   a. Are they on a cost per ton contract  **N/A**
   b. Do they decide on which **___**Bearings, **___**Rolls, or **___**both to use?  **N/A**
   c. Comment

   * John Doe said this caster only has three segments and they are rebuilt in-house. He said the larger rolls are refurbished by SMS Millcraft and the smaller rolls are done by a local shop. He said the molds are stripped by plant personnel and the coppers are recovered by SMS Millcraft.

2. What are your most critical segments?  **#1**
   a. What is your target life for those segments?  **____ 650K** Tons or  ______Heats
   b. What type of roll materials do you use in these segments  
      **Alloy Steel with Stainless Overlay**
   c. What lasts longer in these segments?  **____** Rolls or  **x** **Bearings**

      ( 1 ) Average life of that element:  ______Heats or  **650K** Tons

B. Bearings

1. Are you using bearing types or materials other than the standard spherical roller bearings on the segments?  **Yes**
   a. If YES,  ____ CARB Bearings,  ____ AP Bearings,  ____ Sealed Spherical,  ____ Split,
      ____ Bearings,  ____ Special Materials, or  **x** Other, Specify:  **P&N**

2. Are environmental ( waste treatment ) issues a...  **Yes**
   a. Factor in the selection of bearings?  **Yes**
   b. Or a trade-off for longer life?  **Yes**

C. Are caster bearings reworked?  **x** Yes,  ____ No,  ____ No, but plan to in the future

1. If YES, what are typical reclaim rates?  **20%**

2. Who does the caster bearing rework?  **____ In Plant Personnel  **x** Other, Specify:  **Timco**
   a. If OTHER, this is a:  ____ Bearing Manufacturer,  **x** Distributor,  ____ Segment Rebuilder, or
      ____ Other, Specify:

3. What factors are most important with regard to your bearing rework services

   *Distribute 10 points among the 3 most important factors*

   ____ Low Cost  ____ Yield  ____ Quality  ____ Reporting

   ____ Other, Specify:

4. Comment

   *John Doe said the bearing distributor selects bearings after they are removed and selects those to be sent back to the bearing manufacturer. John said it is not worth the time and effort to send them back to Germany and therefore not too many are reworked. He also pointed out that the Air Oil lubrication system has greatly improved bearing life.*
X. SEGMENT REBUILDING AND BEARINGS (Cont.)

D. What are the weak links in segment rebuilding? ___Bearings  ___Rolls
___Other(s), Specify:

1. If bearings or rolls are the weakest link, if presented with a better bearing or roll total solution that
would be more cost effective than your current set-up, what and how quick would that return on your
investment have to be for you to seriously consider or purchase the new total solution?

___ D.K.  Months or ___ D.K.  ROI

E. Comment

John said bearings are purchased from a company in Germany. He said they perform very well
in this thin slab caster. He said bearing life has increased significantly since the Air Oil
lubrication system was installed.

XI. CONTINUOUS CASTER BEARING LUBRICANT MAINTENANCE

A. Key Qualifier for High Temp Lubricants

1. Do the roll bearing in your continuous caster operation see temperatures greater than or equal to
225

___ D.K.

a. If YES, what are maximum lubricant application temperatures ______ degrees F

b. If NO, please indicate other high temperature (greater than 225 degrees F) lubrication applicatio

___ None (all applications are below 225 degrees F
___ Furnace outlet conveyor bearing
___ High temperature bushings, hinges, sheaves, and pin
___ Gearboxes (pouring ladle, etc.)
___ Oven bearings and chains
___ Trunnion bearings (pouring ladle, etc.)
___ Exhaust fan bearings
___ Melt furnace bearings
___ Heat treat furnace
___ Other, Specify:

All of the following questions relate only to lubricant applications over 225 degrees F in your operatio

B. Indicate the most critical issues regarding the use of these lubricants

Distribute 10 points among the most critical issues

___ Overall equipment downtime

___ Bearing or other component failure

___ Oxidation / carbonization of the oil / greas

___ Frequent re-lubrication or oil refill

___ Time and labor spent maintaining equipmen

___ Other, Specify:
XI. CONTINUOUS CASTER BEARING LUBRICANT MAINTENANCE (Cont.)

C. Consumption of lubricant(s) used in high temperature (greater than 225 degrees F)

- Under 100 lbs / yr.
- X 101-500 lbs / yr.
- ____ 501-5000 lbs / yr.
- ____ Over 5001 lbs / yr.

D. What factors are most important in a lubricant product for your continuous casting operation

(On a scale of 0-10 with 10 being must have or you won’t buy it, 5 being would like to have and 0 being don’t care.)

- ____ Resistance to oxidation / carbonization / coking
- 5 Allow for longer bearing / component life
- ____ Allow for less frequent re-lubrication
- ____ Maintenance interval
- ____ Non Flammability
- ____ Operable at high temperatures
- 5 Price
- ____ Others, Specify:

E. How would you rate your satisfaction with the bearing lubricant product(s) used

(On a scale of 0-10 with 10 being the most satisfied, 5 being okay with it, and 0 being very dissatisfied.)

- 9 Bearing / component life
- 9 Required re-lubrications / maintenanc
- 9 Role of lubricant in equipment failures / downtime

F. Considering the above, what if you overall level of satisfaction with the current lubricant used

(On a scale of 0-10 with 10 being the most satisfied, 5 being okay with it, and 0 being very dissatisfied.)

<table>
<thead>
<tr>
<th>Supplier</th>
<th>Lubricant</th>
<th>Rating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Various</td>
<td>Air Oil</td>
<td>9</td>
</tr>
</tbody>
</table>

G. How likely is it that you would consider a new supplier ____8____ (On a scale of 0-10, 10 being very likely)

H. If the ideal product were available tomorrow, the following factors (contract, etc.) could prevent you from

None
XI. CONTINUOUS CASTER BEARING LUBRICANT MAINTENANCE (Cont.)

I. Where do you purchase these lubricants?

<table>
<thead>
<tr>
<th></th>
<th>Almost Always</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Direct from lube producer</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Distributor</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>OEM</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, Specify:</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

J. The high temperature lubricants we use are specified by (check all that apply)

<table>
<thead>
<tr>
<th></th>
<th>Almost Always</th>
<th>Sometimes</th>
<th>Never</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Manufacturer</td>
<td>x</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Our maintenance personnel</td>
<td></td>
<td>x</td>
<td></td>
</tr>
<tr>
<td>Our technical / engineering personnel</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other, Specify:</td>
<td></td>
<td></td>
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</tbody>
</table>

K. Lubricant General Comments

John said they replaced the grease lubrication with an Air Oil system two years ago. He said this system works very well and also has resulted in much longer bearing life. John said he doubted that this machine saw temperatures of greater than or equal to 225 degrees F. He also said oil from various suppliers can be used in the Air Oil system.