NONRESIDENTIAL MARKET SHARE TRACKING STUDY

APPENDIX B
PHASE 2 INDUSTRIAL PURCHASES AND PRACTICES SURVEY

CONSULTANT REPORT

Prepared For:
California Energy Commission

Prepared By:
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With
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CEC 400-2005-013-AP2

YEAR 2002-2003
INDUSTRIAL ENERGY END-USER SURVEY

Business Name:
Address:

Survno:
SIC Code from Frame:
Utility Territory:

CONTACT LOG

	Date	Time	Caller	Respondent/phone #	Action/Comment
1					
2					
3					
4					

Site Visit Date:	Time Arrived	Time Left

Site Visit Contacts: _____ Phone #: _____

_____ _____

_____ _____

CONTENTS

Surveyor Name: _____ Phone #: _____

Signature: _____ Date: _____

Thank you for volunteering to help us with this important research project. The goal of this survey is to learn how California manufacturers run their facilities and make energy-related decisions. Your responses will be used to help plan for future power needs, as well as energy efficiency programs.

The following questions were designed to allow you to describe your use and maintenance practices for different types of energy-using equipment. First we will ask a few general questions that will help us group similar businesses together for our analysis. Rest assured, your business's privacy is of utmost concern to us. Therefore, individual responses from your business will never be reported in such a way as to risk revealing proprietary information; only aggregated responses will be reported.

For multiple-choice questions, please select the single best answer unless instructed to do otherwise with "Check all that apply" or similar language.

<For any quantitative questions, if the respondent has trouble answering, inform him/her that a rough, approximate answer is fine. In general, do not offer multiple choice answers unless the respondent needs assistance understanding the question.>

GENERAL

1. What do you make?

   _____
   _____
   _____

2. When was this facility built? *Month (if available)* _____ *Year* _____

3. What is the average annual revenue for this facility?

   $_____ ☐ Not sure, this is a rough estimate

   ☐ Don't know

4. About how many people work at your facility (full time equivalents)? *<Definition of full-time equivalents: Number of people working expressed as if everyone worked 40 hours per week. For example, five people working 48 hours per week each, would be 5 * (48/40) = 6.0 FTEs.>*

   _____ people ☐ Not sure, this is a rough estimate

   ☐ Don't know

5. How many shifts per week, hours/shift and days per week does the plant run, on average?

   Weekdays:

   _____ shifts / day _____hours / shift _____ days / wk

   ☐ Not sure, this is a rough estimate
   ☐ Don't know

   Saturday:

   _____ shifts / day _____hours / shift

   Sunday:

   _____ shifts / day _____hours / shift

6. What is the square footage for this facility? This is the building square footage.

   _____Sq. ft. (Preferred answer)

   ☐ Not sure, this is a rough estimate

   or if unknown:

   ☐ 1000 sq ft or less
   ☐ 1001 - 10,000 sq ft
   ☐ 10,001 – 25,000 sq ft
   ☐ 25,001 – 50,000 sq ft
   ☐ 50,001 – 100,000 sq ft
   ☐ 100,001 – 250,000 sq ft
   ☐ 250,001 – 500,000 sq ft
   ☐ Over 500,000 sq ft

   ☐ Don't know.

7. Which department most often specifies equipment such as motors and air compressors?

   ☐ Facilities
   ☐ Maintenance
   ☐ Engineering
   ☐ Manufacturing
   ☐ Other _____
   ☐ Not sure

8. Does that department pay the electric bills out of their accounts?

☐ Yes
☐ No
☐ Other _____
☐ Not sure

9. Has your overall production increased or decreased in the last three years?

☐ Yes – production increased about _____% in the last three years
☐ Yes – production decreased about _____% in the last three
☐ No change
☐ Refused to answer
☐ Not sure

10. Please estimate the percentage of lighted floor space by indoor lighting type:

_____ % T12 Fluorescent lamps
_____ % T8 Fluorescent lamps
_____ % other lighting types
100% TOTAL

☐ This is an estimate. *<Surveyor: Record any qualifiers used by respondent (especially if they quantify range of uncertainty, e.g. "about," "+/-10%," etc.)>*
☐ Don't know

11. Over the last 3 years have you chosen to not buy equipment you desired because of economic reasons?

☐ Yes
☐ No
☐ Don't know

12. Does your company allow supervisors or lower level managers to approve purchases up to a limited price ceiling?

☐ Yes: Can you tell me that ceiling? (*Allow uncertain numbers with qualifiers.)*
_____
☐ No
☐ Not applicable: there are no supervisors or lower level managers (below owner level)
☐ Don't know

13. Can you estimate your monthly or annual electric and other fuel (natural gas, propane, oil) bill for 2001 for this plant?

Electric	Gas	Oil/Other
☐ _____ kWh/yr	☐ _____ MCF/yr	☐ _____ gal/yr oil
☐ _____ kWh/mo	☐ _____ MCF/mo	☐ _____ gal/mo oil
☐ **$**_____ /mo	☐ **$**_____ /mo	☐ **$**_____ /mo oil
☐ **$**_____ /yr	☐ **$**_____ /yr	☐ **$**_____ /yr oil
☐ _____ kW	☐ Not sure	☐ $_____ /yr other
☐ Not sure	☐ Refused	☐ Not sure
☐ Refused		☐ Refused

14. In the last two years have plant personnel received training that included a section on energy management practices?

☐ Yes
☐ No
☐ Not sure

*<**ONLY** If Yes>*

15. What topics were included in the training? (Check all that apply.)

☐ Lighting
☐ Electrical fundamentals
☐ Electrical distribution equipment
☐ Motors
☐ Compressors
☐ Controls
☐ HVAC
☐ Heat recovery
☐ Power quality
☐ On-site generation / cogeneration
☐ Other: _____

Premium Efficiency
All new motors manufactured after October 1997 between 1 and 200 hp must meet minimum energy efficiency standards established by the Federal government. Subsequent to the 1997 federal standards, NEMA created a slightly higher voluntary standard (1-3% higher for large motors; 3-6% higher for others). Motors which meet or exceed the NEMA standards are called premium efficiency.

Motors meeting the 1997 federal requirements but NOT the NEMA standards have no officially recognized description but cannot be called "premium efficiency." The term "energy efficient" is sometimes used to describe such motors, but a motor called "energy efficient" is not necessarily premium efficiency.

EASA
Electrical Apparatus Service Association, Inc., the trade organization for many electrical repair shops that perform motor rewinding.

Variable Speed Drive (VSD)
A controller used to modulate motor shaft rotational speed. As an energy-efficiency tool, VSDs most often are adjustable frequency drives. They reduce speed on pumps, fans, and compressors instead of throttling or other less efficient means of flow reduction.

MOTORS

In this section we want to learn if you routinely buy premium efficiency motors, to learn about your motor rewinding practices, and to record any recent purchases of variable speed drives.

1. Some of my questions will be about "premium efficiency motors," a term that was used loosely by motor vendors, at least in the past. What does the term mean to you?

   ☐ Respondent defined "premium efficiency" as meeting or surpassing NEMA standards
   ☐ Respondent had a different definition:
   _____
   _____
   _____
   _____

2. If you see a motor billed as "energy efficient," what does that mean to you? *<Select all that respondent indicates.>*

   ☐ Means nothing
   ☐ Meets or exceeds federal standards
   ☐ Equals NEMA premium efficiency standards
   ☐ Exceeds NEMA premium efficiency standards

   <If respondent did not define "premium efficiency" as meeting or exceeding NEMA standards OR selected the 3rd or 4th option for question 2, read the following:

   "Well, all new motors manufactured after October 1997 between 1 hp and 200 hp must meet minimum energy efficiency standards established by the Federal government. Subsequent to the 1997 federal standards, NEMA created a slightly higher voluntary standard (1-3% higher for large motors; 3-6% higher for others). Motors which meet or exceed the NEMA standards are called premium efficiency.

   Motors meeting the 1997 federal requirements but NOT the NEMA standards have no officially recognized description but cannot be called "premium efficiency." The term "energy efficient" is sometimes used to describe such motors, but a motor called "energy efficient" is not necessarily premium efficiency.">

   For EVERYONE, read:

   "In this study, we consider all motors coming into your facility as being members of one of 3 groups: packaged equipment motors, inventory replacement motors, or special-order replacement motors. Packaged equipment motors are those shipped as part of equipment upon purchase. Inventory replacement motors are those stored in stockrooms for replacement throughout the plant as needed. Special-order replacement motors are usually large, ordered for a particular application."

3. Does your purchasing department have a standard clause or routinely follow a procedure to specify that "premium efficiency" motors must be used when ***packaged equipment*** is purchased?

   ☐ Yes
   ☐ No
   ☐ Under certain conditions
   ☐ Not sure

4. When buying ***inventory replacement motors such as those stocked in an on-site store room***, do you have a policy about the efficiency level to buy? *<encode response>*

   ☐ No particular policy regarding energy use
   ☐ Consider trade-offs between efficiency level and price
   ☐ Buy regular
   ☐ Buy motors billed as "energy efficient", no particular attention to whether they are NEMA premium efficiency motors
   ☐ Specify NEMA premium efficiency motors
   ☐ The plant does not stock any back-up motors
   ☐ Don't know

5. Consider the most recent five motors you ***special-ordered*** during the past 3 years**.** How many were specifically ordered to be premium efficiency motors? How many were not premium efficiency?

   ☐ None bought Special ordered_____ (0 to 5)

   Premium efficiency_____ (0 to 5) Non-premium efficiency_____ (0 to 5)

   ☐ Not sure, this is a rough estimate ☐ Don't know

   Check to make sure premium + non-premium sum to special-ordered

6. How many 50 or more hp motors did you buy in the last 3 years including ***packaged equipment, inventory replacement motors*** and ***special ordered motors***?

   _____ motors ☐ Rough Estimate

   ☐ Don't Know

7. How many motors at least 1 hp and less than 50 hp did you buy in the last 3 years including ***packaged equipment, inventory replacement motors*** and ***special ordered motors***?

   _____ motors ☐ Rough Estimate

   ☐ Don't Know

8. Please estimate the ***source of motors*** bought for your facility in the last 3 years:

   ____ hp - ***packaged equipment motor hp*** as part of packaged equipment (like Q3)
   ____ hp – ***inventory replacement motor hp*** such as stocked in an on-site store room (like Q4)
   ____ hp - ***special-ordered motor hp*** other than out of stock in hand (like Q5)

   Check for consistency with responses to Q6 and Q7.

9. Do you ever send motors to an electrical shop for rewinding or do you always replace broken motors?

   ☐ Sometimes rewind
   ☐ Always replace (*Skip to Q14)*
   ☐ Not sure (*Skip to Q14)*

10. When you choose to rewind, what are the main reasons you do so? Check all that apply.

    ☐ Lower first cost
    ☐ Faster turnaround time
    ☐ To keep older motors, which are built better than new ones
    ☐ Rewinding doesn't require funds from the capital budget
    ☐ We rewind pre-EPAct (1997) motors only, because they are cheaper to rewind
    ☐ To adjust from nameplate voltage to our actual plant voltage
    ☐ Other _____
    ☐ Not sure

11. What is the smallest size motor that you rewind, not counting unique or "special application" motors?

    _____ hp ☐ Not sure, this is a rough estimate

    ☐ Don't know

12. Consider the last five motors that needed to be replaced. How many were rewound?

_____ (0 to 5) ☐ Not sure, this is a rough estimate

☐ Don't know

13. When you have a motor rewound, do you require the rewind shop to provide any quality assurance features? What do you require? (check all that apply)

	Required	Not Required	Not Sure
Delivery of oven chart recorder burnout temperature	☐	☐	☐
Repair report	☐	☐	☐
Winding resistance test results	☐	☐	☐
Core loss test results	☐	☐	☐
Identical materials replacement	☐	☐	☐
Lap windings instead of concentric windings	☐	☐	☐
Other (specify)	☐	☐	☐

14. First, consider all of your pumps and fans in the plant. Now just consider those pumps and fans where you adjust the flow rate. What is the total horsepower of those units? *<Adjustable-flow applications for process use (e.g. boiler draft fans) and non-process use (e.g. VAV HVAC fans) should both be counted.>*

☐ _____ hp total ☐ Not sure, this is a rough estimate
☐ _____ hp to _____ hp

☐ Don't know.

15. Of the total HP in Q.14, how many horsepower are controlled by variable speed drives? (O*ther types of controls are throttles, bypasses, dampers, and similar controls. Control with a throttle or damper is typical. A pump permanently set to 85% flow does not count.)*

☐ _____ hp total ☐ Not sure, this is a rough estimate
☐ _____ hp to _____ hp

☐ Don't know.

Answer must be less than or equal to Q14 answer.

<Skip to Q19 if Q15 was "0" or "Don't know.">

16. Of the total HP in Q.15 how many HP were bought in the last 3 years*?*

☐ _____ hp ☐ Not sure, this is a rough estimate
☐ _____ hp to _____ hp

☐ Don't know

Answer must be less than or = Q15 answer.

17. What are factors you consider in deciding whether to buy a VSD for a variable-flow application motor? *<Allow the respondent to come up with factors. Do NOT prompt for the answers below. Check all that apply.>*

	Q17 CHECK BOX	**Q18 CHECK BOX**
☐	Don't generally consider buying motors with VSDs	☐
☐	It's generally not worth thinking about adding VSD's to motors	☐
☐	Existing VSDs are not performing satisfactorily	☐
☐	VSDs are expensive	☐
☐	VSDs offer better control of the motor	☐
☐	VSDs allow for energy savings	☐
☐	VSDs often cause synchronization problems	☐
☐	Suitability of VSD for the process run by the motor	☐
☐	Whether or not the motor is compatible with a VSD	☐
☐	Other:	☐

_____

_____

<If more than one factor indicated:>

18. Is one of the factors more important than the rest? *<If so, check the corresponding box to the right above (only1).>*

19. Who most often specifies motor attributes (efficiency, features) when purchased?

- ☐ President
- ☐ Plant engineer
- ☐ Plant electrician
- ☐ Operations manager
- ☐ Maintenance supervisor
- ☐ Facilities manager
- ☐ Purchasing department
- ☐ Other _____
- ☐ Not sure

20. From whom do you most often buy motors? *<Lowest bidder can be chosen along with one of the other choices.>*

- ☐ Lowest bidder
- ☐ National distributors (Grainger, Graybar, etc.)
- ☐ Manufacturer's representative
- ☐ Local or regional distributor/supplier (Wesco, etc.)
- ☐ Other _____
- ☐ Not sure

21. Please tell me how you think premium efficiency motors compare to standard motors in each of the following categories:

a. How long it takes to procure them:
- ☐ Longer
- ☐ Shorter
- ☐ About same
- ☐ Don't know

b. Cost of installation
- ☐ Higher
- ☐ Lower
- ☐ About same
- ☐ Don't know

c. Cost of maintenance
- ☐ Higher
- ☐ Lower
- ☐ About same
- ☐ Don't know

22. How do you become aware of new products and product improvements related to motors? <*Check all that apply*.>

- ☐ Read about them in trade journals
- ☐ Sales personnel
- ☐ Utility staff/programs
- ☐ Business associates
- ☐ Trade shows
- ☐ Other _____

☐ Not sure

23. For this question, the following procedure applies:

Note: No. of motors sampled greater than or equal to 50 hp and No. under 50 hp must be consistent with Q6, Q7 and sampling rules provided, or note reason for inconsistency in notes or reasons space for selected motor on pp. 17, 19.

10 MOTORS MAXIMUM TO BE SAMPLED

A. If the customer can provide you some form of a list of motors:

1. Sample motors 50 HP or larger bought in last 3 years first.

   a. If 5 or less motors, record data for all motors.

   b. Sample 5 motors at random. Use table of random numbers to determine which 5 motors to sample.

2. Sample motors at least 1 HP but under 50 HP bought in last 3 years next.

   a. If none, return to motors 50 HP or larger to complete table.

   b. If 5 or less, record all motors and then return to 50 HP or more to complete table.

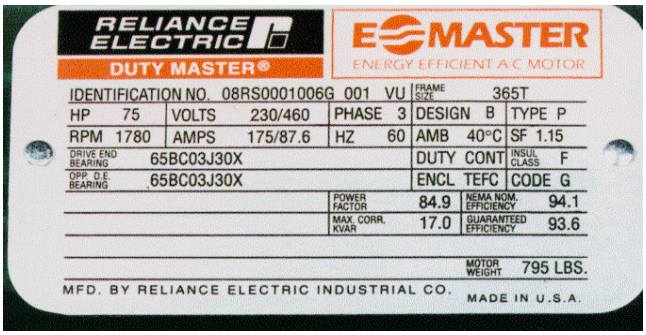
   c. If more than 5, use table of random numbers to determine which 5 motors to sample.

B. If the customer cannot provide you some form of a list of motors:

Please turn in the random number table and the sketch you used with the questionnaire.

1. Sketch a diagram of the facilities.
2. Partition the facilities into 16 parts.
3. Randomly select one of the partitions using the random number table.
4. For the motors in the selected partition, create 2 lists of the motors that were bought in the last 3 years – 1 of those 50 HP and above, the other of those less than 50 Hp, but greater than 1 HP.
5. Randomly select from those motors using the procedures outlined for when a list is available.

6. Go back to step 3 until 10 motors are chosen.



What Do All Those Things on an AC Motor Nameplate Mean?

Introduction:
Ever order a motor on power, speed, and enclosure? PO says maybe "5 hp, 1,800 rpm, TEFC." New-motor nameplate says "HP 5, RPM 1748, Enclosure TEFC, Des B, Frame 184T, Amps 7.0, PH 3, HZ 60, Duty Cont, Volts 460, Type P, Amb 40 C, SF 1.15, INS CL F, EFF 82.5, P.F. 80, DE bearing 35BC02JGG30A26, ODE bearing 3OBC02JGG3OA26."

Should you reject the motor because it is not rated at 1,800 rpm? What does all that extra information on the nameplate mean? Do you care? The answers are "maybe," "we'll discuss it in a minute," and "you probably should."

To define the basic performance and mounting parameters of a motor, the National Electrical Manufacturers Association (NEMA) defines some basic design and dimensional parameters in NEMA Standard MG 1. These parameters are then coded onto the motor nameplate to give you a basic definition of what you have received. Manufacturers often include additional information to further define some key motor features.

Section MG 1-10.40, "Nameplate Marking for Medium Single-Phase and Polyphase Induction Motors," of the NEMA standard requires that "The following minimum amount of information shall be given on all nameplates of single-phase and polyphase induction motors. For abbreviations, see MG 1-1.80."

* Manufacturer's type and frame designation
* Horsepower output.
* Time rating. (See MG 1-10.36.)
* Maximum ambient temperature for which motor is designed. (See Note I of MG 1-12.43.)
* Insulation system designation.
* RPM at rated load.
* Frequency.
* Number of phases.
* Rated load current.
* Voltage.
* Code letter for locked rotor kVA. (See MG 1-10.37.)
* Design letter for medium motors. (See MG 1-1.16.)
* NEMA nominal efficiency when required by MG 1- 12.55
* Service factor if other than 1.0.
* For motors equipped with thermal protectors, the words "thermally protected" if the motor provides all the protection described in MG 1-12.52. (See MG 1-1.71 and MG 1-1.72.)

Enter answer from Q6 (p. 8): ________________
Enter answer from Q7 (p. 9): ________________

	Motor Number				
	1	2	3	4	5
Location					
Motor Make					
Motor Model No.					
VSD in Use?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Variable-flow pumps and fans?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Year Bought					
Motor Year of Manufacture on Nameplate					
Output power hp (or note if kW)					
Enclosure	☐ Open Drip Proof (ODP) ☐ TEFC ☐ Other ☐ Cannot be determined	☐ Open Drip Proof (ODP) ☐ TEFC ☐ Other ☐ Cannot be determined	☐ Open Drip Proof (ODP) ☐ TEFC ☐ Other ☐ Cannot be determined	☐ Open Drip Proof (ODP) ☐ TEFC ☐ Other ☐ Cannot be determined	☐ Open Drip Proof (ODP) ☐ TEFC ☐ Other ☐ Cannot be determined
RPM					
Volts (V)					
Phase					
Efficiency (%) (nominal)					
Power Factor (%)					
Motor *(Only)* Purchase Price					
Why bought?	☐ New replacement motor ☐ Used, newly rewound replacement motor only ☐ Came with new industrial equipment ☐ Came with used industrial equipment just bought	☐ New replacement motor ☐ Used, newly rewound replacement motor only ☐ Came with new industrial equipment ☐ Came with used industrial equipment just bought	☐ New replacement motor ☐ Used, newly rewound replacement motor only ☐ Came with new industrial equipment ☐ Came with used industrial equipment just bought	☐ New replacement motor ☐ Used, newly rewound replacement motor only ☐ Came with new industrial equipment ☐ Came with used industrial equipment just bought	☐ New replacement motor ☐ Used, newly rewound replacement motor only ☐ Came with new industrial equipment ☐ Came with used industrial equipment just bought

	Motor Number				
	1	2	3	4	5
Reason(s) bold field(s) missing	☐ Not on nameplate ☐ Not legible ☐ Nameplate data not visible ☐ Other (specify in notes)	☐ Not on nameplate ☐ Not legible ☐ Nameplate data not visible ☐ Other (specify in notes)	☐ Not on nameplate ☐ Not legible ☐ Nameplate data not visible ☐ Other (specify in notes)	☐ Not on nameplate ☐ Not legible ☐ Nameplate data not visible ☐ Other (specify in notes)	☐ Not on nameplate ☐ Not legible ☐ Nameplate data not visible ☐ Other (specify in notes)
Notes on condition, use, etc. *Can use back also.*					

	Motor Number				
	6	7	8	9	10
Location					
Motor Make					
Motor Model No.					
VSD in Use?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Variable-flow pumps and fans?	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No	☐ Yes ☐ No
Year Bought					
Motor Year of Manufacture on Nameplate					
Output power hp (or note if kW)					
Enclosure	☐ Open Drip Proof (ODP) ☐ TEFC ☐ Other ☐ Cannot be determined	☐ Open Drip Proof (ODP) ☐ TEFC ☐ Other ☐ Cannot be determined	☐ Open Drip Proof (ODP) ☐ TEFC ☐ Other ☐ Cannot be determined	☐ Open Drip Proof (ODP) ☐ TEFC ☐ Other ☐ Cannot be determined	☐ Open Drip Proof (ODP) ☐ TEFC ☐ Other ☐ Cannot be determined
RPM					
Volts (V)					
Phase					
Efficiency (%) (nominal)					
Power Factor (%)					
Motor *(Only)* Purchase Price					
Why bought?	☐ New replacement motor ☐ Used, newly rewound replacement motor only ☐ Came with new industrial equipment ☐ Came with used industrial equipment just bought	☐ New replacement motor ☐ Used, newly rewound replacement motor only ☐ Came with new industrial equipment ☐ Came with used industrial equipment just bought	☐ New replacement motor ☐ Used, newly rewound replacement motor only ☐ Came with new industrial equipment ☐ Came with used industrial equipment just bought	☐ New replacement motor ☐ Used, newly rewound replacement motor only ☐ Came with new industrial equipment ☐ Came with used industrial equipment just bought	☐ New replacement motor ☐ Used, newly rewound replacement motor only ☐ Came with new industrial equipment ☐ Came with used industrial equipment just bought

	Motor Number				
	6	7	8	9	10
Reason(s) bold field(s) missing	☐ Not on nameplate ☐ Not legible ☐ Nameplate data not visible ☐ Other (specify in notes)	☐ Not on nameplate ☐ Not legible ☐ Nameplate data not visible ☐ Other (specify in notes)	☐ Not on nameplate ☐ Not legible ☐ Nameplate data not visible ☐ Other (specify in notes)	☐ Not on nameplate ☐ Not legible ☐ Nameplate data not visible ☐ Other (specify in notes)	☐ Not on nameplate ☐ Not legible ☐ Nameplate data not visible ☐ Other (specify in notes)
Notes on Condition, use, etc. *Can use back also.*					

<If "Came with used equipment just bought" was chosen for any of the sampled motors:>

24. Who have you bought used equipment from in the last 3 years?

☐ Salvage, i.e. from competitor or other industry participant liquidating assets
☐ Reconditioned equipment supplier
☐ Other. Explain: _____

_____

_____

Trimming Impellers
Impeller trimming is the process of machining the impeller on the pump as a method of controlling pump flow to rated design requirements. Trimming the impeller is an alternative to throttling as a method to control pump flow.

PROCESS FLUID PUMPING SYSTEMS

Industrial process fluid pumping systems deliver fluids such as water, oil or adhesive and typically use centrifugal pumps. Industrial pumping applications can be quite varied. Examples include pumps that move molten glue in a plywood factory to pumping milk in dairy. Exclude process refrigeration pumps as well as non-process pumps. For example exclude power generation pumps and HVAC pumps.

1. Given the definition above, does this facility use pumps that together total at least 50 hp, excluding backup pumps?

   ☐ Yes ☐ No – *Skip to the next technology form*

2. Please estimate the total pumping horsepower for process pumping loads at this facility, excluding redundant standby pumps.

   ☐ _____ hp ☐ Not sure, this is a rough estimate
   ☐ _____ hp to _____ hp

   ☐ Don't know

   Do not include HVAC, power generation, refrigeration or standby* pump horsepower

***** Most industrial pumps have 100% redundancy. Do not include the standby pump

3. How many pump impellers were trimmed or pumps downsized in the last 3 years?

   ☐ None *(Skip to Q5)*

   _____ ☐ Not sure, this is a rough estimate

   ☐ Don't know

4. Please estimate the total pump horsepower that had impellers trimmed or pumps downsized in the last three years.

   _____hp ☐ Not sure, this is a rough estimate

   ☐ Don't know

5. Please indicate which of the following other industrial pumping system upgrades have ever been performed at this plant, ***as well as*** whether they were performed in the last 3 years. *<Check all that apply.>*

Changes made in the pumping system		Were these changes made in the last 3 years?		
☐ Trimmed pump impellers	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Installed or modified pump control systems	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Redesigned pipe layout to reduce friction losses	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Replaced with higher efficiency pumps	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Increased piping diameter	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Replaced worn impellers, replaced worn bearings	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Other:				

_____
_____
_____
_____
_____
_____

Notes: Please write down any relevant notes regarding the pumping system

_____
_____
_____
_____
_____
_____

Modulating compressor
When a facility has a compressed air plant with multiple compressors running simultaneously to supply air to a single distribution system, usually operation is configured so that all compressors run at full capacity except one unit that varies output with air demand. This compressor is called the modulating compressor, the swing compressor, or the topping compressor. Modulation can be with either cycling or proportional control.

Minimum discharge pressure
This is the air pressure at the discharge port of the compressor. For compressors with control systems that cycle between high and low setpoints, this is the low setting. For sequenced or staged compressor systems with different pressure settings for each compressor, this is the minimum pressure setting for the compressor most often running as the modulating compressor.

Intermediate flow controller
Intermediate flow controllers are electronically-controlled valves installed between one or more air compressors and the compressed air distribution system. They monitor air requirements and adjust compressor pressure settings to meet anticipated demand with minimal energy use. Conservair, Zeks' Xpandair, Honeywell's XCEED, and Kaeser's flow controller are examples of such devices.

COMPRESSED AIR SYSTEMS

Industrial compressed air systems deliver air to power tools and pneumatic equipment that require air in the range of 20 to 150 psig. Compressors for such systems are typically reciprocating, screw, or centrifugal type units.

1. Given the definition above, does this facility use compressors that together total at least 50 hp, excluding backup compressors?

   ☐ Yes ☐ No – *Skip to the next technology form*

COMPRESSORS

2. Please list and describe all of your air compressors in the table below.
<Surveyor should collect data on all compressors.>

No.	Compressor Motor Horsepower	Typical Operating Condition (Choose one per compressor)			Check if Variable Speed Drive Control
		Base Unit Runs at Full Load	Modulating Unit*	Back-Up Unit	
1		☐	☐	☐	☐
2		☐	☐	☐	☐
3		☐	☐	☐	☐
4		☐	☐	☐	☐
5		☐	☐	☐	☐
6		☐	☐	☐	☐
7		☐	☐	☐	☐
8		☐	☐	☐	☐
9		☐	☐	☐	☐
10		☐	☐	☐	☐
11		☐	☐	☐	☐
12		☐	☐	☐	☐

***** Almost all compressors can modulate. What we want checked here is only the compressor that actually modulates while in use. When in use, all but one compressor typically run fully loaded. If this "topping" unit is rotated among the stock, check the compressor modulating at the time of the site visit. Check that multiple compressors modulate ONLY if there are multiple unique distribution systems, each with their own set of compressors, or if facility managers run their compressors with multiple units modulating simultaneously.

3. What type of part load control does the modulating unit employ?
   <If there is more than one modulating compressor, enter for the largest unit that is modulating at the time of the site visit.>

   ☐ Throttle (or other variable inlet pressure device on screw compressors)
   ☐ Slide, poppet, or turn valve (or other variable inlet volume device on screw compressors)
   ☐ Cycling
   ☐ Variable speed drive
   ☐ Bypass or none (rare, centrifugal only)
   ☐ Other _____
   ☐ Not sure

4. Do you use automatic controls to optimally sequence multiple air compressor operation?

   ☐ Yes
   ☐ No
   ☐ Not sure

COMPRESSED AIR DISTRIBUTION SYSTEM

5. Do you have multiple compressed air distribution systems that maintain different pressure levels?

   ☐ Yes
   ☐ No
   ☐ Not sure

6. Does your distribution system include an intermediate air flow controller? This question does not refer to fixed pressure regulators.

   ☐ Yes
   ☐ No
   ☐ Not sure

7. What is the highest air pressure required by air-using equipment such as drills, nozzles, or pneumatic pumps?

   _____ psig ☐ Not sure, this is a rough estimate

   ☐ Don't know

   Normally observable at regulator on the equipment. Not the pressure on the compressor itself.

8. What is the minimum discharge pressure setting on the compressor?
<If the minimum pressure setting varies over the course of a production day, answer for the highest minimum pressure setting. If there are multiple compressed air systems, answer for the largest system.>

_____ psig ☐ Not sure, this is a rough estimate

☐ Don't know

Must be greater than or equal to Q7 answer.

<If more than 10 psi difference between answers>

9. Why is the difference greater than 10 psi?

_____
_____
_____

10. Have you increased or decreased the discharge pressure in the last two years? If there are multiple compressed air systems, please answer for the largest system.
<If respondent knows pressure has been increased/decreased but doesn't know amount, mark increased or decreased box and leave the psig blank.>

☐ No, it has stayed the same
☐ Increased pressure from _____ psig to the discharge pressure noted in Q8.
☐ Decreased pressure from _____ psig to the discharge pressure noted in Q8.
☐ Not sure

<If Decreased >

11. Why were you able to reduce the pressure? Check all that apply.

☐ Eliminated air-using equipment:
___ Process being performed by air-using equipment no longer performed
___ Process activity still performed, but now with non-pneumatic equipment
___ Amount of processing decreased, reducing need for air-using equipment
___ Other:
_____
_____
_____

☐ Eliminated leaks
☐ Process or tool changes reduced air pressure requirements
☐ Added receiver(s)
☐ Added, joined, or increased diameter of distribution headers
☐ Added an intermediate flow controller
☐ Installed dryers or coolers with reduced pressure drop compared to previous
☐ Other
_____

12. How often do you search for air leaks?

- ☐ Never <*Skip next 2 questions.*>
- ☐ When compressors start to have trouble meeting air requirements
- ☐ Regularly but not often; once a year or less
- ☐ Regularly; more than once per year
- ☐ Not sure

13. Is an ultrasonic leak detector used?

- ☐ Yes
- ☐ No
- ☐ Don't know

14. Has your compressed air system received a systematic compressed air leak audit in the last two years?

- ☐ Yes
- ☐ No
- ☐ Don't know

EQUIPMENT USING COMPRESSED AIR

15. Have you replaced any electric equipment with pneumatic equipment in the last two years? *(Examples include: Fluid agitation, conveyance, electrical cabinet coolers, diaphragm pumps, power tools)*

- ☐ Yes – Estimated electric horsepower removed: _____ hp
- ☐ No. <*Skip next question.*>
- ☐ Not sure <*Skip next question.*>

16. Why was this change made?

_____

_____

_____

17. Conversely, have you replaced any pneumatic equipment with electric equipment in the last two years?

☐ Yes – Estimated electric horsepower installed: _____ hp
☐ No <*Skip next question.*>
☐ Not sure <*Skip next question.*>

18 Why was this change made?

_____

_____

_____

19 Have you installed engineered nozzles or air knives to reduce air flow rates or increase air velocity in the last two years?

☐ Yes – nozzles on clean up hoses
☐ Yes – nozzles or air knives or similar device on process equipment
☐ No. If no, why not?
  ☐ Don't have any
  ☐ Installed already
  ☐ No. But planning to install
  ☐ Don't see any benefits
  ☐ Other. Explain_____
☐ Not sure

GENERAL

20 Please estimate the total amount you have spent over the last two years on compressed air systems to reduce energy costs (*such as new controls, leak reduction, nozzles, studies)*:

$_____ ☐Not sure, this is a rough estimate
☐ Don't know

21 How do you become aware of new products and product improvements related to compressed air?

Check all that apply

- ☐ Read about them in trade journals
- ☐ Sales personnel
- ☐ Utility staff/programs
- ☐ Business associates
- ☐ Trade shows
- ☐ Training
- ☐ Paid consultants
- ☐ Other _____
- ☐ Not sure

22 Do you regularly perform any of the following services to monitor the efficiency of your compressed air system? *(Check all that apply)*

- ☐ Measure compressor power consumption
- ☐ Measure air flow rates in cfm
- ☐ Check line pressure at various points in the distribution system
- ☐ Use an electronic maintenance or compressor management system
- ☐ Inventory compressed air using equipment and compare nameplate air demand with compressor output capacity
- ☐ Other

  _____

Full-time equivalents
Number of people working expressed as if everyone worked 40 hours per week. For example, five people working 48 hours per week each, would be 5 * (48/40) = 6.0 FTEs; 20 people working, half of which worked 20 hours per week, would be 10 + 10 * (20/40) = 15 FTEs.

Blower
In this survey industrial blowers are defined as *air-moving devices that operate in the range of 1-20 psi.* They are generally centrifugal or positive-displacement types, and they are typically used for agitation, material conveying, or forced-draft combustion. Blowers **do not** include fans that move air at less than 1 psi (27.70 inw) static pressure difference.

Automated lubrication
Automated lubrication systems apply grease, oil, or other fluids to bearings and other mechanical devices to minimize or eliminate manual lubrication requirements. Examples of types of automated systems are drip lubrication, pressurized oil systems, and automated greasing systems.

Maintenance Policies
As Needed
Typically run equipment until noticeable performance loss or failure, then repair or replace it.

Unscheduled Preventive Maintenance
Perform preventive maintenance when convenient or when the need for it arises, but do not follow a formal schedule to do so. May use rules of thumb to occasionally spot check equipment condition.

Limited Scheduled Preventive Maintenance
Maintain key process equipment on a schedule. Other equipment may be informally maintained or repaired as needed.

Aggressive Scheduled Preventive Maintenance
Maintain most or all equipment on a preventive maintenance schedule. Likely use a computer tracking program to manage the effort. Either in-house or contracted staff perform the work.

Predictive Maintenance
Maintain most or all equipment on a preventive maintenance schedule. Likely use a computer tracking program to manage the effort. Likely use permanent instrumentation to monitor equipment performance during routine operation. Likely to use observed changes in equipment performance data to forecast occurrences of equipment failures, and predict when maintenance needs to be supplied. Example predictive maintenance tools include vibration and ultrasonic monitors and built-in manometers.

MAINTENANCE PRACTICES

1. What type of maintenance policy does your company follow for each of the following types of equipment? *Please see the Glossary for definitions.*

Equipment	As Needed	Unscheduled Preventive	Limited Scheduled Preventive	Aggressive Scheduled Preventive	Predictive	Not Applicable	Don't Know
Motor lubrication	☐	☐	☐	☐	☐	☐	☐
Bearing lubrication	☐	☐	☐	☐	☐	☐	☐
Motor belt replacement	☐	☐	☐	☐	☐	☐	☐
Fan/blower blade cleaning	☐	☐	☐	☐	☐	☐	☐
Fan/blower wheel balancing	☐	☐	☐	☐	☐	☐	☐
Fan/blower airflow test	☐	☐	☐	☐	☐	☐	☐
Air compressor intake filters	☐	☐	☐	☐	☐	☐	☐
Compressed air water traps & pressure regulators	☐	☐	☐	☐	☐	☐	☐

2. What is the size of your maintenance staff?

_____ Full Time Equivalents ☐ Not sure, this is a rough estimate

☐ Don't know

See previous page for definition of full-time equivalents.

3. Over the last two years, has maintenance staffing—including contracted labor—increased, decreased, or stayed the same?

☐ Increased substantially
☐ Increased somewhat
☐ Stayed the same
☐ Decreased somewhat
☐ Decreased substantially
☐ Don't know

4. Over the last two years, has maintenance effort on ***energy-related issues*** such as compressed air, blowers, and lubrication, increased, decreased, or stayed the same?

- ☐ Increased substantially
- ☐ Increased somewhat
- ☐ Stayed the same
- ☐ Decreased somewhat
- ☐ Decreased substantially
- ☐ Don't know

<If increased or decreased>

5. Why do you think that is?

_____

_____

_____

6. Who in your company makes the decisions that affect maintenance policies the most?

- ☐ Maintenance staff
- ☐ Facilities or plant engineer
- ☐ Engineering manager
- ☐ Plant manager
- ☐ Off-site corporate office
- ☐ Other _____

☐ Not sure

7. Please estimate the total horsepower of your fans and blowers.

- ☐ _____hp
- ☐ _____hp to _____hp
- ☐ None
- ☐ Not sure

8. Some mechanical devices such as bearings, gears, chains, and pulleys require lubrication to run properly. Automated lubrication systems minimize or eliminate manual lubrication. Do you use automated lubrication systems in your facility?

   ☐ Yes
   ☐ No – <*Skip to Q13*>
   ☐ Not sure – <*Skip to Q13*>

9. Please estimate the total horsepower of motors at your facility that are automatically lubricated or drives equipment that is automatically lubricated.

   _____ hp ☐Not sure, this is a rough estimate

   ☐ Don't know

10. Why did your firm install the lubrication system(s)? *Check all that apply.*

   ☐ Reduce maintenance time spent manually lubricating
   ☐ Reduce maintenance time/money spent on equipment repair
   ☐ Increase equipment reliability or productivity
   ☐ Energy savings→ Can you estimate the amount expected ? _____
   (*write respondent's answer including "no" or qualifiers like "about")*
   ☐ It came with new equipment being installed
   ☐ Other _____
   ☐ Don't know

11. Are the lubrication system(s) working as designed?

   ☐ Yes
   ☐ No
   ☐ Not sure

12. Have you realized any benefits of auto lubrication since installation? <*Do not read list – listen to respondent – check all that apply or write other*>

- ☐ Reduce maintenance time spent manually lubricating
- ☐ Reduce maintenance time/money spent on equipment repair
- ☐ Increase equipment reliability or productivity
- ☐ Energy savings: _____ (estimated amount saved per year (kW or $); *write respondent's answer including "no" or qualifiers like "about"*)
- ☐ Other _____
- ☐ Don't know

13. Which maintenance functions are done in-house vs. contracted out:

	In-house	Contracted Out	Mixture of Both	New Equipment/ Not Applicable
Motors	☐	☐	☐	☐
Compressors	☐	☐	☐	☐
Compressed Air Distribution System	☐	☐	☐	☐
Refrigeration	☐	☐	☐	☐
Lights	☐	☐	☐	☐
HVAC	☐	☐	☐	☐
Automatic lubrication	☐	☐	☐	☐

14. How do you become aware of new products and product improvements related to maintenance?

Check all that apply

- ☐ Read about them in trade journals
- ☐ Sales personnel
- ☐ Utility staff/programs
- ☐ Business associates
- ☐ Trade shows
- ☐ Training
- ☐ Paid consultants
- ☐ Other _____
- ☐ Not sure

GLOSSARY – ELECTRONIC PROCESS CONTROL

Electronic Control of Process Equipment
For the purposes of this survey, electronic control of process equipment specifically refers to controls that unload or turn off process equipment when the equipment is not in use. It also includes process controls that provide energy management or load shedding capabilities. For the purposes of this questionnaire, process controls exclude HVAC and compressed air controls.

Load Shedding
Intentionally turning off equipment to reduce electrical demand during peak load periods to reduce utility demand charges.

ELECTRONIC CONTROL OF PROCESS EQUIPMENT

For the purposes of this survey, electronic control of process equipment specifically refers to controls that unload or turn off process equipment when the equipment is not in use. For example, a line that runs for two shifts and is off during a third could be controlled to automatically shut down after 15 minutes of non-use. It also includes process controls that provide energy management or load shedding capabilities. For the purposes of this questionnaire, process controls exclude HVAC and compressed air controls.

1. Do you have any electronic controls on process equipment that *(check all that apply):*

   ☐ Unload or turn off equipment to save energy during idle periods?
   ☐ Manage process equipment operation to minimize peak demand?
   ☐ Have other energy management capabilities?
   ☐ Not sure -- (Skip *to the Water Re-Use section)*
   ☐ None -- (Skip *to the Water Re-Use section)*

2. Why did you install the control system(s)? *Check all that apply.*

Q2 CHECK BOX	**Q3 CHECK BOX**
☐ To extend machine life	☐
☐ To increase process reliability	☐
☐ To increase product quality	☐
☐ Came with purchased equipment	☐
☐ For energy savings. Please compare savings with original expectations:	☐
☐ Savings more than expected	
☐ Savings meet expectations	
☐ Savings fall short of expectations	
☐ Savings fall far short of expectations	
☐ No reliable way to tell energy savings	
☐ Don't know what original expectations were	
☐ Other	☐

_____

_____

☐ Not sure

<If more than one reason chosen>

3. Was one of the reasons most important? *<If so, check the corresponding box above to the right (only 1).>*

4. What is the approximate total electrical demand of the process(es) under automatic control?

   _____ hp ***OR*** _____ kW ☐ Not sure, this is a rough estimate

   ☐ Nothing
   ☐ Don't know

5. What is the approximate electrical demand that the controls can turn off to save energy?

   _____ hp ***OR*** _____ kW ☐ Not sure, this is a rough estimate

   ☐ Not controlled to save energy
   ☐ Nothing
   ☐ Don't know

6. Do you maintain your control system, or do you contract for maintenance services?

   ☐ Maintain it ourselves
   ☐ Use outside maintenance services
   ☐ Combination of both
   ☐ Don't know

7. Do you regularly recalibrate or recommission the control system to ensure peak performance?

   ☐ Yes – every _____ months
   ☐ Yes – when performance appears to degrade
   ☐ Yes – when something fails
   ☐ No – let it run as installed
   ☐ No – no longer using system
   ☐ Other:

   _____

8. Who sold you the control system?

- ☐ Engineering firm
- ☐ Controls contractor or Systems Integrator
- ☐ Control Manufacturer
- ☐ Manufacturer of equipment being controlled
- ☐ Developed in-house
- ☐ Other – specify_____
- ☐ Don't know

9. Who initiated the idea to install your power control equipment?

- ☐ We initiated the idea and sought suppliers.
- ☐ Supplier's representatives approached us.
- ☐ Corporate or other central planning entity directed us to install or consider installing.
- ☐ Other, explain

  _____
- ☐ Don't know

10. Who in your firm decided on the design of the control system ?

- ☐ Operator of the process
- ☐ Plant engineer
- ☐ Plant maintenance
- ☐ Plant Manager
- ☐ Other – please specify_____
- ☐ Don't know

11. Who in your firm gave final approval to purchase the control system?

- ☐ Plant Manager
- ☐ Corporate Manager
- ☐ Plant engineer
- ☐ Purchasing Dept
- ☐ Other – please specify _____
- ☐ Don't know

12. Please briefly describe the process(es) being controlled

_____

_____

_____

_____

_____

_____

13. Let's talk now just about your most recently purchased electronic process control system. Are the controls dedicated to energy savings, or is the energy-saving feature part of a more complex control system?

☐ Dedicated energy saving controls
☐ Part of more complex system
☐ Both
☐ Not sure

<If "Dedicated">

14. About how much did the most recently purchased control system cost?

$_____ ☐ Not sure, this is a rough estimate

☐ Nothing
☐ Don't know

<If "Part of a more complex system" or "Both">

15. About how much extra did you have to pay for the energy saver feature of your most recently purchased electronic process control system?

$_____ ☐ Not sure, this is a rough estimate

☐ Nothing
☐ Don't know

16. How do you become aware of new products and product improvements related to process controls?

Check all that apply

- ☐ Read about them in trade journals
- ☐ Sales personnel
- ☐ Utility staff/programs
- ☐ Business associates
- ☐ Trade shows
- ☐ Training
- ☐ Paid consultants
- ☐ Other _____

☐ Not sure

GLOSSARY – GAS PROCESS HEATING

Boiler Oxygen
Generally refers to the percentage of oxygen in the exhaust from the boiler.

Turbulators
Turbulators are devices that increase turbulence in the fire tube to reduce flue gas exit temperatures and increase heat transfer.

GAS PROCESS HEATING

Industrial gas process heating applications can be quite varied. Examples include gas-fired steam boilers that produce steam for a paper mill to gas fired kilns for a cement factory. The gas usage for power generation, space heating, refrigeration, or for powering fork lifts and small vehicles do not fall under this category.

1. Given the definition above, does this facility use gas for industrial process heating that is at least 10,000 therms/year or $5,000/year in gas bills?

   ☐ Yes
   ☐ No – *Skip to the next technology form*

2. Please estimate the total amount in dollars/year for gas process heating loads at this facility.

   ☐ $_____ ☐ Not sure, this is a rough estimate
   ☐ $_____/year to $ _____ /year

   ☐ Don't know

   Do not include power generation, HVAC, refrigeration or transportation gas use

3. What is your best estimate of your gas rate in $/therm, $/MCF or $/CCF?

   ☐ $_____/therm ☐ Not sure, this is a rough estimate
   ☐ $_____/MCF
   ☐ $ _____/CCF
   ☐ Don't know

4. Please describe your two largest gas process heating systems at the facility:

   _____

   _____

   _____

   _____

   _____

   _____

   _____

5. Please indicate the gas usage for process heat at the facility by the following categories. Please write the other gas process heat categories in the spaces provided. If percent gas use is not known or is approximated please indicate.

	Present or not?	Check largest gas use (check only one)
Gas Fired Boiler	Yes No	☐ Yes ☐ No ☐ Not sure
Gas Furnace	Yes No	☐ Yes ☐ No ☐ Not sure
Gas Kiln	Yes No	☐ Yes ☐ No ☐ Not sure
Gas Dryer	Yes No	☐ Yes ☐ No ☐ Not sure
Gas Ovens	Yes No	☐ Yes ☐ No ☐ Not sure
OTHER		
1		☐ Yes ☐ No ☐ Not sure
2		☐ Yes ☐ No ☐ Not sure
3		☐ Yes ☐ No ☐ Not sure
4		☐ Yes ☐ No ☐ Not sure

<Skip to Q8 if no gas-fired boiler.>

6. Which of the following industrial gas process heating energy efficiency options are installed on the boiler? Please also indicate whether the option was installed in the last 3 years.

Measure present		Added in the last 3 years?		
☐ Stack heat recovery	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Condensate heat recovery	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Other heat recovery	☐ Don't know	☐ Yes	☐ No	☐ Don't know
_____				
☐ Automated tuning (O_2 trim control)	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Electronic ignition	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Turbulators for firetube boilers	☐ Don't know	☐ Yes	☐ No	☐ Don't know

7. Please indicate which of the following changes were ever made to the boiler after installation and also please indicate whether the change was made in the last 3 years.

Change ever made		Change made in the last 3 years?		
☐ Increased pipe and boiler jacket insulation	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Reduced boiler blow-down cycle	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Reduced steam pressure	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Variable speed fans on larger forced-draft and induced-draft fans	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Automatic flue damper	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Smaller boiler for low load conditions	☐ Don't know	☐ Yes	☐ No	☐ Don't know
☐ Other _____	☐ Don't know	☐ Yes	☐ No	☐ Don't know

8. Which of the following maintenance measures do you perform on your gas process heat system?

☐ Combustion efficiency test (manual tune-up)	☐ Don't know
☐ Steam trap maintenance	☐ Don't know
☐ Cleaning the boiler fireside & waterside and distribution system	☐ Don't know
☐ Provide sufficient boiler room ventilation for adequate draft	☐ Don't know
☐ Maximize condensate return	☐ Don't know
☐ Annual water testing and boiler water treatment	☐ Don't know
☐ Other _____	☐ Don't know
☐ Not sure	

Notes: Please write down any relevant notes regarding the gas process heating

_____
_____
_____
_____
_____
_____

GLOSSARY – WATER RE-USE AND RECYCLING

Water recovery and reuse
Any process that filters, recovers, and reuses water-based discharge fluids from a facility, thereby reducing or eliminating wastewater.

Discharge flow rate from the facility before it is recycled
The total flow rate in gallons per day of water-based effluent that would leave the plant property if there was no water re-use.

WATER RECOVERY AND RE-USE

1. What is the approximate waste-water flow from this facility?
   Only answer once.

   Most desirable:
   ☐ _____ gallons / day

   Next most desirable:
   ☐ Not sure, ***rough estimate*** _____ gallons per day

   Third most desirable, if can't estimate a specific flow rate:
   ☐ Less than 10,000 gallons per day (less than 10 gpm for 16 hr/day or equivalent)
   ☐ 10,000 to 25,000 gallons per day
   ☐ 25,001 to 100,000 gallons per day
   ☐ 100,001 to 200,000 gallons per day
   ☐ 200,001 to 500,000 gallons per day
   ☐ 500,001 to 1,000,000 gallons per day
   ☐ over 1,000,000 gallons per day, ***discharge flow rate*** _____ gallons per day

   Last option:
   ☐ Don't know

2. Please briefly describe the source of your wastewater flow:

   _____

   _____

3. How do you become aware of new products and product improvements related to water treatment and disposal?

   Check all that apply
   ☐ Read about them in trade journals
   ☐ Sales personnel
   ☐ Utility staff/programs
   ☐ Business associates
   ☐ Trade shows
   ☐ Training
   ☐ Paid consultants
   ☐ Other _____
   ☐ Not sure

4. Do you have a water recovery and reuse system at your facility?

☐ Yes
☐ No – *Skip rest of Water Recovery and Reuse*

5. What is the approximate temperature (typically) of the wastewater?

____ degrees F C *(circle F or C)* ☐ Don't know

☐ Same as ambient

6. What is the flow of the recovered water?

☐ ***Recycled flow rate*** _____ gallons per day

☐ Not sure, ***rough estimate*** _____ gallons per day
☐ 0-10% of wastewater flow
☐ 11-30% of wastewater flow
☐ 31-50% of wastewater flow
☐ 51-70% of wastewater flow
☐ 71-90% of wastewater flow
☐ 91-100% of wastewater flow
☐ Don't know

OR

_____ gallons per minute for _____ hours per day

7. Does your wastewater recovery system feature heat recovery?

☐ Yes
☐ No
☐ Don't know

<If yes>

8. What is the estimated heat recovery rate from your wastewater?

   _____ Btu/hr

   ☐ Don't know

9. Please briefly describe what the recycled water is used for:

   _____

   _____

10. When was this plant's water recovery and reuse system installed?

    ☐ Month (if available): _____ Year: _____
    ☐ Within the last year
    ☐ 1 to 2 years ago
    ☐ 2 to 10 years ago
    ☐ Over 10 years ago
    ☐ Not sure

11. About how much did the water recovery and reuse system cost to buy and install?

    $_____ ☐ Not sure, this is a rough estimate
    ☐ Don't know

12. What company sold your firm the system that was installed? Where are they based?

    _____

13. What is the total cost savings associated with the installation of the water recovery and reuse system? This includes energy, water, operational, and regulatory cost savings.

    ☐ Measured and verified at $_____per year
    ☐ Estimated at $_____per year (by facilities staff or by vendor)
    ☐ Don't know
    ☐ Decline to state

14. Who initiated the idea to install your water re-use equipment?

- ☐ We initiated idea and sought suppliers
- ☐ Supplier's representatives approached us
- ☐ Corporate or other central planning entity directed us to install or consider installing.
- ☐ Other, explain

  _____
- ☐ Don't know

15. Who in your firm decided on the design of the water re-use system ?

- ☐ Operator of the process
- ☐ Plant engineer
- ☐ Plant maintenance
- ☐ Plant Manager
- ☐ Other – please specify_____
- ☐ Don't know

16. Who in your firm made the final decision to purchase the water re-use system?

- ☐ Plant Manager
- ☐ Corporate Manager
- ☐ Plant engineer
- ☐ Purchasing Dept
- ☐ Other – please specify _____
- ☐ Don't know

17. Why was the water re-use system installed? *Check all that apply.*

- ☐ Lack of available water supply
- ☐ High wastewater treatment costs
- ☐ Local wastewater treatment facility out of capacity
- ☐ Lack of local wastewater treatment facility
- ☐ Energy costs
- ☐ Energy supply concerns
- ☐ Environmental concern
- ☐ Other(s) ***describe:***

_____

_____

☐ Don't know

<If more than one box checked in previous question>

18. Was one of those reasons more important than the rest, and if so, which one?

- ☐ None most important.
- ☐ Lack of available water supply
- ☐ High wastewater treatment costs
- ☐ Local wastewater treatment facility out of capacity
- ☐ Lack of local wastewater treatment facility
- ☐ Energy costs
- ☐ Energy supply concerns
- ☐ Environmental concern
- ☐ Other(s) ***describe:***

_____

_____

☐ Don't know

<If "Energy costs" checked in either of previous 2 questions.>

19. Are you realizing the energy cost savings originally envisioned when you installed your water reuse system?

- ☐ Yes – saving more than expected
- ☐ Yes – savings meet expectations
- ☐ No – savings fall short of expectations
- ☐ No – savings fall far short of expectations
- ☐ Don't know – did not install water re-use system for energy savings purposes
- ☐ Don't know – no reliable way to tell energy savings.
- ☐ Don't know – don't know what original expectations were.
- ☐ Other - explain*:*

_____

_____

GLOSSARY - REFRIGERATION

Refrigeration
For the purpose of this survey, refrigeration is defined as any mechanical cooling system 20 horsepower or over with a primary purpose other than air conditioning for human comfort. Skip this section if the facility is not primarily in the business of food processing (SIC 20).

Floating Head Control
Compressors run more efficiently when the refrigerant pressure and temperature leaving the compressor and entering in the condenser is as low as possible. When very hot outside this is not possible but during moderate weather lowering discharge pressure is an option on some types of systems. Floating head pressure controls such as liquid pumps and electronically controlled expansion valves allows the discharge pressure to drop significantly lower than without such controls.

Halocarbon
A class of refrigerant. A halocarbon is a halogenated hydrocarbon (compound containing only the elements hydrogen and carbon) containing one or more of the three halogens: fluorine, chlorine, and bromine. Hydrogen may or may not be present (EPA definition).

Heat Recovery
Heat recovery means capturing and reusing otherwise wasted heat from the discharge line or compressor heads, for example. Liquid to suction heat exchangers are not considered heat recovery.

REFRIGERATION

For the purposes of this survey, refrigeration is defined as any mechanical cooling system 20 horsepower or over with a primary purpose other than air conditioning for human comfort.

1. Do you have any refrigeration systems sized 20 hp or greater, at your facility?

   ☐ Yes
   ☐ No – *Skip Refrigeration section.*

HEAT RECOVERY SYSTEMS

2. Was a refrigeration heat recovery system purchased for this plant in the last 5 years?

   ☐ Yes. What year was the last purchase? _____
   ☐ No
   ☐ Don't know *<Skip to Floating Head Control, at Q9 >*

   <If no:>

3. Was a refrigeration heat recovery system considered for this plant in the last 5 years?

   ☐ Yes. What year was the last consideration?_____
   ☐ No *<skip to Floating Head Control, at Q9.>*
   ☐ Don't know *<skip to Floating Head Control, at Q9.>*

4. What factors affected the decision regarding purchase?
<Check all that apply. Do NOT prompt with items from the list.>

Pros	Q5 check box
☐ Energy cost savings	☐
☐ Maintenance or other cost savings	☐
☐ Increased system capacity	☐
☐ Improved reliability	☐

Cons

☐ Long delivery time	☐
☐ Increased maintenance or other costs	☐
☐ Decreased equipment reliability	☐
☐ Capital cost too high	☐
☐ Payback too long/savings too low/rate of return too low	☐
☐ Recovered heat not hot enough	☐
☐ Physical restrictions of the plant	☐
☐ No application for recovered heat	☐
☐ Restricts use of floating head	☐

Other

☐ Expertise of maintenance staff	☐
☐ Environmental compliance concerns	☐
☐ It was included in the refrigeration system we bought	☐
☐ Corporate policy	☐
☐ Other:	☐

_____

_____

☐ Don't know

<If more than one answer given>

5. Was one of the reasons most important? *<Check corresponding box to right above if so.>*

6. The heat recovery was:

☐ An original design component
☐ Added (or to be added) at a later date
☐ Don't know

7. Which of the following best describes how the recovered heat is (or would have been) used?

☐ To heat domestic hot water
☐ To heat air for human comfort
☐ To defrost refrigeration coils
☐ To preheat make-up water
☐ Other
describe_____

☐ Don't know

8. About how much did (or would have) the heat recovery equipment cost? Include installation costs if it would have been a retrofit.

$_____ ☐ Not sure, this is a rough estimate

☐ Don't know

FLOATING HEAD CONTROL

9. Has this plant purchased floating head control for any of its refrigeration systems within the last 5 years? For the purposes of this survey, condensing temperatures must be allowed to float below 80°F to be considered.

☐ Yes. What year was the last purchase? _____
☐ No
☐ Don't know *<Skip to Ammonia, at Q14..>*

<If no:>

10. Has this plant considered purchasing floating head control in the last five years?

☐ Yes. What year was the last consideration? _____
☐ No <Skip *to Ammonia, at Q14.>*
☐ Don't know *<Skip to Ammonia, at Q14.>*

11. What factors affected the decision regarding purchase?
<Check all that apply. Do NOT prompt with items from the list.>

Pros	Q12 check box
☐ Energy cost savings	☐
☐ Maintenance or other cost savings	☐
☐ Increased system capacity	☐
☐ Improved reliability	☐
Cons	
☐ Long delivery time	☐
☐ Increased maintenance or other costs	☐
☐ Decreased equipment reliability	☐
☐ Capital cost too high	☐
☐ Payback too long/savings too low/rate of return too low	☐
☐ System's expansion device will not allow use	☐
☐ Problems with oil return	☐
☐ Incompatible with heat recovery	☐
☐ Incompatibility with compressor	☐
Other	
☐ Expertise of maintenance staff	☐
☐ Environmental compliance concerns	☐
☐ It was included in the refrigeration system we bought	☐
☐ Corporate policy	☐
☐ Other:	☐

_____

_____

☐ Don't know

<If more than one answer was given*>*

12. Was one of the reasons most important? *<Check appropriate box to right above if so.>*

13. About how much did (or would have) the floating head control equipment cost? Include installation costs if it would have been a retrofit.

$_____ ☐ Not sure, this is a rough estimate

☐ Don't know

AMMONIA REFRIGERATION

14. Was an ammonia-based refrigeration system purchased for this plant in the last 5 years?

☐ Yes. What year was the last installation? _____
☐ No
☐ Don't know *<Skip to VSDs, at Q19>*.

<If no>

15. Was an ammonia-based refrigeration system considered for this plant in the last 5 years?

☐ Yes. What year was the last consideration? _____
☐ No *<Skip to VSDs, at Q19>*.
☐ Don't know *<Skip to VSDs, at Q19>*.

16. What factors affected your decision regarding purchase?
<Check all that apply. Do NOT prompt with items from the list.>

Pros	Q17 check box
☐ Energy cost savings	☐
☐ Maintenance or other cost savings	☐
☐ Increased system capacity	☐
☐ Improved reliability	☐
Cons	
☐ Long delivery time	☐
☐ Increased maintenance or other costs	☐
☐ Decreased equipment reliability	☐
☐ Capital cost too high	☐
☐ Payback too long/savings too low/rate of return too low	☐
Other	
☐ Expertise of maintenance staff	☐
☐ Environmental compliance concerns	☐
☐ It was included in the refrigeration system we bought	☐
☐ Corporate policy	☐
☐ Other:	☐

_____

_____

☐ Don't know

<If more than one answer given>
17. Was one of the reasons most important? *<Check appropriate box to right above if so>*

18. About how much did (or would have) the ammonia system or conversion process cost?

$_____ ☐ Not sure, this is a rough estimate

☐ Don't know

VARIABLE SPEED COOLING TOWER FANS

19. Has your plant purchased variable speed controls for any of the refrigeration system cooling towers in the last 5 years?

☐ Yes. What year was the last purchase? _____
☐ No
☐ Don't know <*Skip to Capacities section, at Q24.*>

<*If no*>

20. Has your plant considered variable speed controls for refrigeration system cooling towers in the last five years?

☐ Yes. What year was the last consideration? _____
☐ No <Skip *to Capacities section, at Q24.*>
☐ Don't know <*Skip to Capacities section, at Q24.*>

21. What factors affected the decision regarding purchase?
<Check all that apply. Do NOT prompt with items from the list.>

Pros	Q22 check box
☐ Energy cost savings	☐
☐ Maintenance or other cost savings	☐
☐ Increased system capacity	☐
☐ Improved reliability	☐
Cons	
☐ Long delivery time	☐
☐ Increased maintenance or other costs	☐
☐ Decreased equipment reliability	☐
☐ Capital cost too high	☐
☐ Payback too long/savings too low/rate of return too low	☐
Other	
☐ Expertise of maintenance staff	☐
☐ Environmental compliance concerns	☐
☐ It was included in the refrigeration system we bought	☐
☐ Corporate policy	☐
☐ Other:	☐

_____

_____

☐ Don't know

<If more than one answer given>
22. Was one of the reasons most important? *<Check appropriate box to right above if so.>*

23. About how much did the variable speed control cost?

$_____ ☐ Not sure, this is a rough estimate

☐ Don't know

REFRIGERATION SYSTEM CAPACITIES

Please list total hp of each of the following refrigeration systems. If not applicable, put NA. Ranges are acceptable. (Note-if you use process chillers, please list the capacity in tons.)

24. Total refrigeration at facility _____hp **or** _____tons

25. Refrigeration with heat recovery _____hp **or** _____tons

If Q2 = Yes, make sure Q25 does not = 0

26. Refrigeration with floating head control _____hp **or** _____tons

If Q9 = Yes, make sure Q26 does not = 0

27. Ammonia refrigeration _____hp **or** _____tons

If Q14 = Yes, make sure Q27 does not = 0

28. Screw compressor capacity _____hp **or** _____tons

29. Screw compressor w/ VSD _____hp **or** _____tons

30. Cooling towers fan total power _____hp **or** _____tons

31. Cooling tower fans w/ VSD _____hp **or** _____tons

If Q19 = Yes, make sure Q31 does not = 0

32. For any major changes or redesigns to your process refrigeration, who performs the engineering work?

- ☐ Done in-house
- ☐ Done by contracted refrigeration consultant
- ☐ Done by refrigeration equipment manufacturer's representative
- ☐ Done by local mechanical contractor
- ☐ Don't know

POWER GENERATION

Power generation refers to equipment on-site that generates electricity for use elsewhere in the facility. The source of energy can be fossil fuel, solar cells or other renewable sources, fuel cells, cogeneration, or batteries that store energy. Power generation does not include wires, transformers, or other distribution equipment.

1. Do you have a back-up power supply as an ***emergency*** source of electricity?

   ☐ Yes
   ☐ No *(Skip to Q4)*
   ☐ Don't know *(Skip to Q4)*

2. What type is it? *Check all that apply.*

   ☐ Uninterruptible power supply (UPS) or other battery storage
   ☐ Gas engine
   ☐ Diesel engine
   ☐ Gas turbine
   ☐ Steam turbine
   ☐ Fuel cell
   ☐ Renewable, such as wind or solar
   ☐ Other _____

   ☐ Don't know

<If other than UPS>

3. How big is it, in kW?

   _____ kW ☐ Not sure, this is a rough estimate

   ☐ Don't know

4. Do you have a power supply that you use ***regularly*** to generate electricity?
   Do not count UPS for this question.

   ☐ Yes
   ☐ No – *Skip to Q12.*
   ☐ Don't know – *Skip to Q12.*

5. What is the source of energy?
Check all that apply.

- ☐ Gas engine
- ☐ Diesel engine
- ☐ Gas turbine
- ☐ Steam turbine
- ☐ Fuel cell
- ☐ Renewable, such as wind or solar
- ☐ Other _____

☐ Don't know

6. Was the power generation capacity installed within the last 2 years?

- ☐ Yes
- ☐ No
- ☐ Don't know

7. Do you use the energy source to simultaneously generate thermal energy used at the plant (cogeneration)?

- ☐ Yes
- ☐ No
- ☐ Don't know

8. How big is the plant, in kW?

_____ kW ☐ Not sure, this is a rough estimate

☐ Don't know

9. How many hours per week would you estimate the generation or cogeneration plant runs, on average?

_____ hr/wk (1 to 168) ☐ Not sure, this is a rough estimate

☐ Don't know

<If not 168 hours per week>

10. Do you use the system specifically for "peak shaving," to reduce your monthly electric utility demand charge? *<If the respondent needs a definition: Peak shaving is the practice of reducing electrical load at the facility for the express purpose of lowering facility's monthly maximum billed demand (kW). Energy savings is not the goal, although savings may occur.>*

    ☐ Yes
    ☐ No
    ☐ Don't know

11. How do you become aware of new products and product improvements related to power generation?

    Check all that apply
    ☐ Read about them in trade journals
    ☐ Sales personnel
    ☐ Utility staff/programs
    ☐ Business associates
    ☐ Trade shows
    ☐ Training
    ☐ Paid consultants
    ☐ Other _____
    ☐ Not sure

12. Are you **currently planning** to install additional generation capacity?

    ☐ Yes
    ☐ No – *Skip to Refrigeration*

13. How much are you planning to install and when?

    _____ kW Month/Year_____

CLOSING

1. As a token of thanks, we could benchmark your energy use per dollar value of your output as compared to your peers. Would you like us to do that?

   ☐ Yes <*Q2 is for benchmarking.*>
   ☐ No <*Skip to Q3 .*>

2. What was the approximate dollar value of raw materials, not including manufacturing equipment that was used to produce goods at this site during the last 12-months (or other recent 12-month period for which data are available)? <*This is useful for benchmarking.*>

   $ _____

3. Would you like a copy of the final report on the findings of the study? (This is a report we're delivering to the CEC summarizing the findings for all the customers. It is likely to be a large document.)

   ☐ Yes
   ☐ No

4. Would you like a copy of your filled-out questionnaire?

   ☐ Yes
   ☐ No

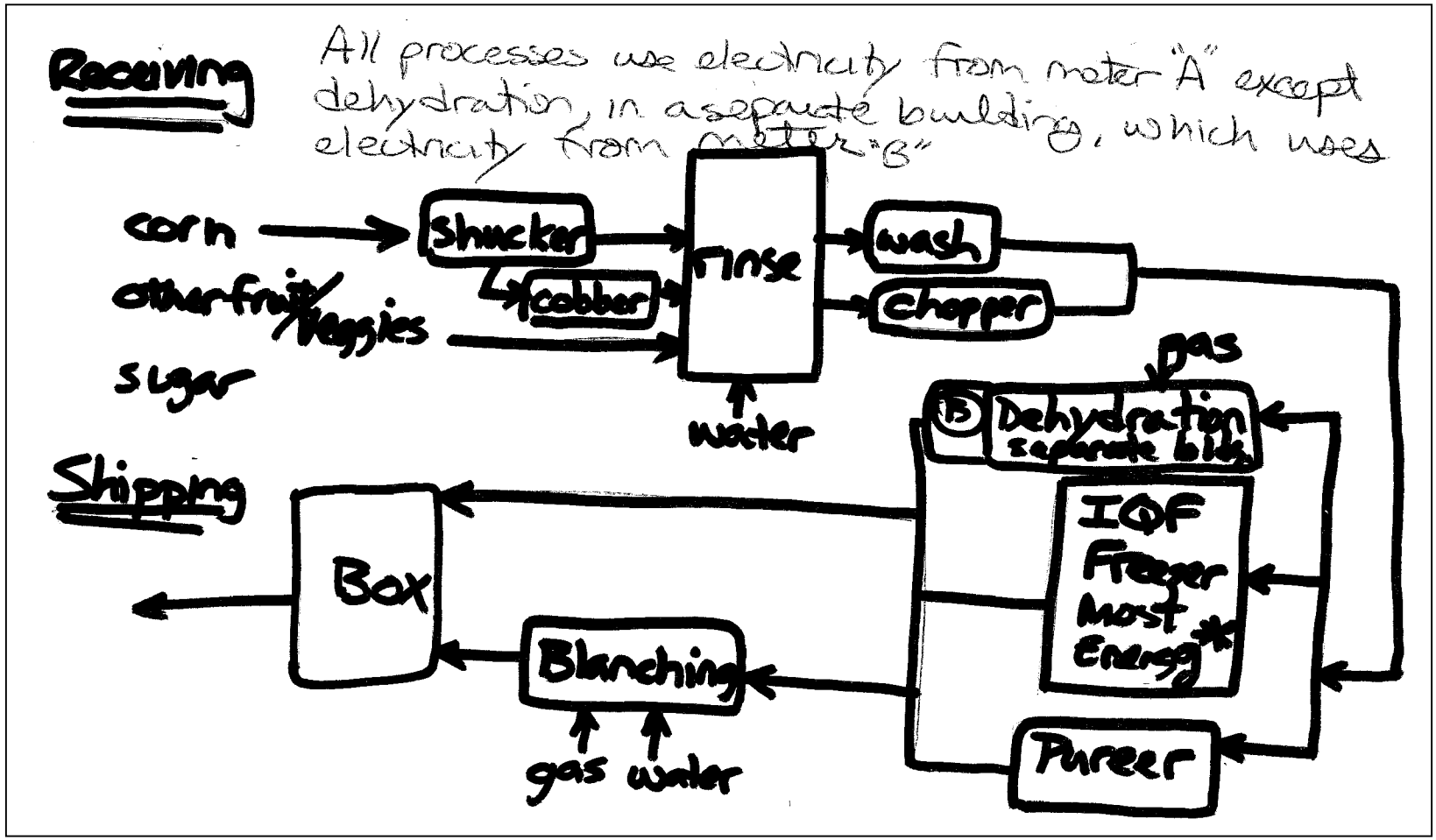
PROCESS FLOW DIAGRAM

Surveyor should provide a process flow diagram of the facility surveyed in the space below. Limit your process to approximately 8 steps. For each step of the process, label the process, fuels used, and the electric meter associated with the space.

Reminder: *A manufacturing establishment is defined as "all buildings in a contiguous area that are controlled by a common decision-maker regarding energy." It may produce one or multiple products. There typically is one plant manager, and one maintenance staff.*

Example process flow diagram:

Plant receives printed circuit boards and microchips, presses boards together for multilayer boards, and mounts the chips on the boards. The boards after mounting go to inspection where automated inspection is performed. Presses require heat and compression; surface mount machines all are automated and powered by fractional hp motors and compressed air.



Appendix: Example of random motor selection procedure:

A	B	C	D	E	F	G	H	I	J	K	L	M	N
18	3	15	6	46	14	40							2
7	33	30	32	17	29	41							6
9	45	17	21	6	25	41							37
40	18	27	15	38	20	27							36
36	25	10	34	5	21	24							10
47	8	46	32	25	44	35							17
46	11	46	4	10	6	18							45
4	23	50	20	30	47	4							38
18	14	40	24	41	17	29							40
39	25	35	50	11	25	50							21
33	16	39	1	7	19	50							1
15	15	42	7	39	24	14							16
3	33	46	19	16	21	1							50
14	11	9	36	7	42	38	42	4	11	19	5	1	1
43	29	35	1	33	24	9					50	46	44
6	1	14	7	15	30	27					42	35	44
8	44	41	44	27	21	14					42	36	50
7	8	47	5	50	46	24					40	19	22
4	39	19	7	6	48	50					50	4	20
44	6	8	21	48	50	10					9	12	7
29	7	17	29	42	26	1					12	41	6
45	2	22	19	31	6	21					18	7	3
11	48	20	46	31	5	19					36	1	19
10	12	23	1	20	18	32					23	27	12
41	13	32	29	18	31	32					37	36	9
47	24	4	38	33	24	24	14	29	40	19	31	33	44
31	29	27	19	17	50	15	28	29	1	30	43	20	8
23	24	49	19	48	12	40							21
30	15	1	47	35	2	3							5
38	48	25	46	9	47	23							7
18	25	23	44	26	4	45							3
1	7	44	48	1	43	15							5
36	43	2	21	45	18	21	23	26	50	48	3	2	44

EXAMPLE:

STEP 1

We're given a stack of invoices for motors-this constitutes our "list".

There have been (16) motors purchased in the last two years over 50 HP & none smaller.

We will need to randomly select (10) motors from the list. First invoice will be motor 1, second invoice motor 2, etc.

Go down a column you have not yet used on a survey (column A in this example). Skipping numbers larger than the total count of motors (16), circle the first 10 eligible numbers. Skip numbers that are repetitions of already circled numbers.

Record each number that qualifies

STEP 2

The selected numbers are:

STEP 3

7, 9, 4, 15, 3, 14, 6, 8, 11, 16

Record the motors from the list that correspond to the selected numbers

To be completed after the survey (not in the presence of the respondent). Based on your impressions of the respondent's expertise in the questions s/he chose to answer, how much faith do you have in the accuracy of the respondent's answers? Assess whether the responses seem to be:

- ☐ Probably very reliable. (Respondent appeared highly knowledgeable about the questions s/he answered.)
- ☐ Probably reliable for the most part.
- ☐ Questionable reliability.