

NONRESIDENTIAL MARKET SHARE TRACKING STUDY

APPENDIX I PHASE 1 LIST OF QUALITY CONTROL CHECKS

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CONSULTANT REPORT

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Appendix I. List of Quality Control Checks—Phase 1

CEC Industrial On-Site Questionnaire Question-By-Question QC Checks

Aspen will be verifying that completed questionnaires meet the below quality assurance checks so that we can be confident that the data used in analysis for the CEC is of high quality. There are five general types of quality checks that Aspen is applying:

1. Completeness checks

Ensure questions are answered.

Example: Have you received energy training in the last two years...? Must be answered with exactly one box checked: Yes, No, or Not Sure.

2. Skip checks

Ensure that the surveyors asks appropriate questions based on response to initial questions.

Example: If customer does not buy rewind motors, questions about rewinding practices should be skipped.

3. Range checks

Ensure that numeric answers are in a plausible range. May be a function of answers to multiple questions.

Example: How many of the last 5 motors....? Answer must be between 0 and 5.

Example: Motor efficiency must be at least as high as CFR required minimums for new motors. The minimum is a function of motor hp and year of manufacture.

4. Cross checks

Ensure that answers to questions make sense with one another, particularly multiple choice questions.

Example: If optimal compressor sequencing controls are used, multiple compressors should be listed in the inventory.

Example: Motor year of manufacture should not be later than year bought.

5. Ratio checks

Ensure that numeric answers to questions are of the right magnitude relative to one another.

Example: Total new motor hp installed in the last 3 years does not exceed estimated total plant hp.

Compare Screener Responses of Technologies On-Site with those Recorded in the On-site Questionnaire

First look at the screener responses to find out which technologies the respondent said they had of motors >1 hp, electronic process control, power generation, refrigeration, and water recovery. Check for the corresponding section completion in the questionnaire. If not completed, look for explanation in the margin of the first page of that section.

Cover Page

Biz name	Must be completed.
Address	Must be completed.
location id	Less than or equal to 99999.
SIC	2000-3999 Note: Check with project manager if not provided by the surveyor.
site date	Between 8/20/01 and 12/31/01.
time arrived	Must be completed.
time left	Must be completed. Looking for some diversity
site visit contact name	Must be completed.
Phone	Must be completed.

General

- Detailed product (not process) description is included. Sufficient for 4-digit not 2-digit SIC coding.
 - Process description completed.
 - Year 1900 to 2001.
 - FTEs makes sense for product type and annual revenue in closing section. Greater than 0. Note: Program in the closing section with Q5. [Annual revenue\$ (Closing Q2) – Raw material value (Closing Q5, use 0 if no value provided)] / \$20,000 > FTE (General section Q4).
 - 1-3 shifts/day and 1-7 days/week. Fractions okay.
 - Only 1 box checked, preferably. If Other is completed, can it be better fit into one of the existing options.
 - Exactly one checked box.
 - Should be a number, or “Don’t know.” Not “N/A.” If owner approves every expenditure, \$0 is the right answer.
 - Exactly one checked box.
 - At least one box checked if Q8=“Yes.” Again, if “Other” in, make sure doesn’t overlap with existing choices.
 - At least one box checked. Corresponding numbers completed.
- Desc. Included if Q2 is too abbreviated, or if Electric Meter table column 3 is unclear. Okay if blank otherwise.

Motors

- Exactly one boxed checked.
- Exactly one boxed checked.
Even if there is no set policy, they could still have bought motors
- “None,” “Don’t know,” or a number between 0 and 5 is filled in.
- Skipped if Q3=None bought. Between 0 and 5. Sum of Q3 + Q4 is no more than 5.
- Completed. Reasonable size compared to facility size. See Additional Range Checks below.
- 3rd blank is 0 if Q3 + Q4 is 0. 3rd blank is not 0 if Q3 + Q4 is 1 to 5. Skipped altogether if Q5=None but only if so.
Sum of 6a + 6b + 6c = 100% exactly (or 0% if no motors replaced).
- Exactly one boxed checked.

- 8 Q8 - Q13 blank if Q7 is “always replace with new”
 Note: if enter “Always replace with new” or “Not sure”, send check directly to Q14 is fine.
- 9 Not a firm rule, but peculiar if number is less than 5 hp, and would like marginal comment if less than 1 hp.
 Note: No need to check. No need to add a field. This comment is only for human reviewers
- 10 0-5 or “Don’t know” box is checked.
- 11 Exactly one boxed checked.
- 12 Skipped if Q11 is “No” or “Not Sure.” Dubious but possible if all rows have a checked box.
- 13 Exactly one boxed checked.
- 14 answered. If range is written in it is written in the range row.
- 15 Q15 is less than or equal to Q14.
- 16 Q16 is less than or equal to Q15. Not mandatory hard rule because could have non variable flow VSDs, but likely.
 Note: If there is a place to put flags that are not errors but are cautions, put it there, otherwise just skip the check.
- 17 answered.
- 18 If “Other” make sure can’t fit reasonably in an existing category.
 Note: Okay if unable to program this QC check
- 19 Blank if Q18 has only one box checked. Exactly one box checked otherwise. Q19 is included in Q18 boxes checked.
 Note: Could you code it: $Q18a + Q18b + Q18c + \dots = 1$, then $Q19a + Q19b + \dots$ Must equal 0. If not, okay to skip. We can clean it up afterwards.
- 20 If “Other” make sure can’t fit reasonably in an existing category.
 Note: Okay if unable to program this QC check
- 21 Strong preference for only one box checked, not counting “lowest bidder”
- 22 1-5 range expected. Allow to be higher.
 Note: Not an error necessarily if greater than five. Could be higher. Program it in that the allowable range is 1 to 9. Anything bigger is likely to be a key entry error.
- 23 A box checked for each of the three sub-questions
- 24 At least one box checked
- 25 & 26 Q25 and Q26 make sense compared to Q5. “0” not “None bought.”
 $Q5 > (Q25 * 50 + Q26 * 1)$
 $Q5 < (Q25 * 200 + Q26 * 40)$
- 27 Right number of motors inventoried according to Q25, Q26, and sampling rules
 No. of Q27 motors at least 50 hp is the same as Q25, or 5 max, or 6-10 depending on no. of <50 hp motors & sampling.
 No. of Q27 motors under 50 hp is the same as Q26, or 5 max, or 6-10 depending on no. of ≥ 50 hp motors & sampling.
 Need written explanation if motors are lacking.
Formula version of the above:
 count qty of motors in Q27 that are ≥ 50 hp. I will call this Qty50+.
 if $Q25 \leq 5$ then “Qty50+” = Q25
 if $Q25 > 5$ and $Q26 \leq 5$ then “Qty50+” = the greater of (Q25 and 10-Q26)
 if $Q25 > 5$ and $Q26 > 5$ then “Qty50+” = 5
- count qty of motors that are < 50 hp. I will call this Qty50-.

if Q26 <= 5 then “Qty50-” = Q25

if Q26 >5 and Q25 <=5 then “Qty50-” = the greater of (Q26 and 10-Q25)

if Q26 >5 and Q25 >5 then “Qty50-” = 5

Most valuable parameters, in order, are hp, efficiency, rpm, enclosure, everything else.

Note: Do not need to code this one. It is for human review.

VSD & variable flow make sense for machine type (compressor, fan, press, etc.)

Note: Do not need to code this one. It is for human review.

Variable flow shouldn't have any boxes checked if no variable flow vsd in Q16.

Year of Manufacture 1900-2001 range. If <1998, flag as installation of a used motor.

If year manufactured is < 1998, then year bought >= 1998

Output power is completed with one number and units of kW or hp. At least 1 hp or at least 0.7 kW each.

Sum of hp for all columns is no more than 125% of Q5.

If less than all 10 columns filled, sum of hp for all columns is not less than 50% of Q5.

Flag, not a firm check.

Note: At least 1 hp or 0.7 kW is a required check. The second check should be a warning flag, but not necessarily an error.

Output power if no units provide, we will assume hp.

Note: If conversion is needed: 1 hp = 0.746 kW

Rpm is a number slightly less than 600, 900, 1200, 1800, or 3600 rpms

rpm is in the range 500-600, 800-900, 1100-1200, 1700-1800, or 3400-3600.

Note: The data entered should be a single number that falls within one of the specified ranges.

Volts is a single number, (usually the bigger of the two stamped numbers).

Volts common expected values: 110-120 for 1 hp motors, 230, 240, 460, 480 for all motor sizes. 460 most common.

=if hp >= 5 then volts (>=208 and <=240) or (>=440 and <= 480)

=if hp < 5 then volts (>=208 and <=240) or (>=440 and <= 480) or (>=110 and <=120)

Phase is 1 or 3

Amps is a single number (usually the smaller of two stamped numbers), greater than 1.0.

Amps is about 20% greater than hp for 460V motors; amps is about 140% greater than hp if 230V

Note: Do not need to code this one. It is for human review. Not consistent enough to be a programmed check.

Efficiency is at least that shown in table below and less than 100%.

Allow 5% less than table value if year of manufacture is <1998 AND year bought is >=1998.

Make sure data are key-entered with the proper order of magnitude (e.g. '0.85' and '85' both are entered as '85%').

Approximate formula format instead of table:

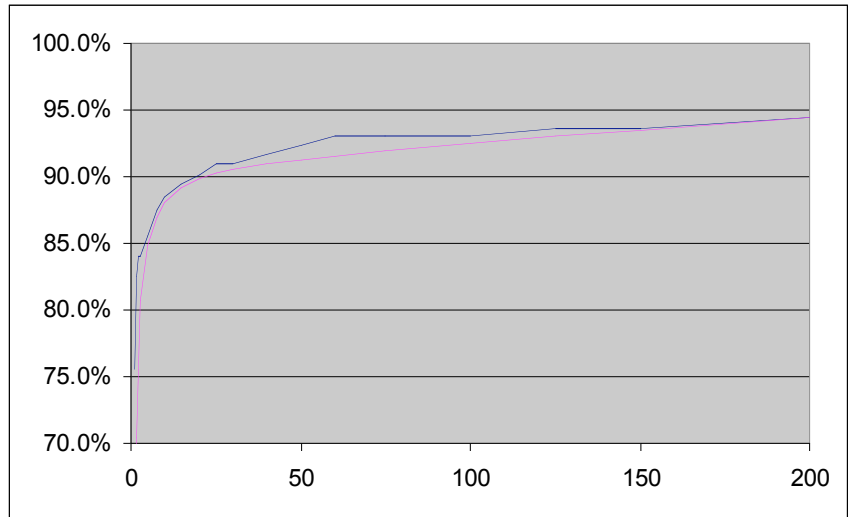
=if hp < 1.5, then eff >0.75

=if hp >=1.5 and hp < 5, then eff > 0.82

=if hp >=5 then eff >= 0.91+0.00018*hp - 0.31/hp

Motor Hp	Min Eff.
1	75.5%
1.5	82.5%
2	84.0%
3	84.0%
5	85.5%
7.5	87.5%
10	88.5%
15	89.5%
20	90.2%
25	91.0%
30	91.0%
40	91.7%
50	92.4%
60	93.0%
75	93.0%
100	93.0%
125	93.6%
150	93.6%
200	94.5%

0.600
0.704
0.755
0.807
0.849
0.870
0.881
0.892
0.898
0.902
0.905
0.909
0.913
0.916
0.919
0.925
0.930
0.935
0.944



Power factor is between 60% and 99%. Manual checks include expectations of lower values for smaller motors, bigger for bigger.

Make sure data are key-entered with the proper order of magnitude (e.g. ‘0.85’ and ‘85’ both are entered as ‘85%’).

Hours per week is no greater than 168.

Mo/yr bought is no earlier than 1998. Mo/yr bought is no earlier than “Year of manufacture.”

Purchase price is filled out at least sometimes. Price is in reasonable range and is not cost for entire packaged equipment.

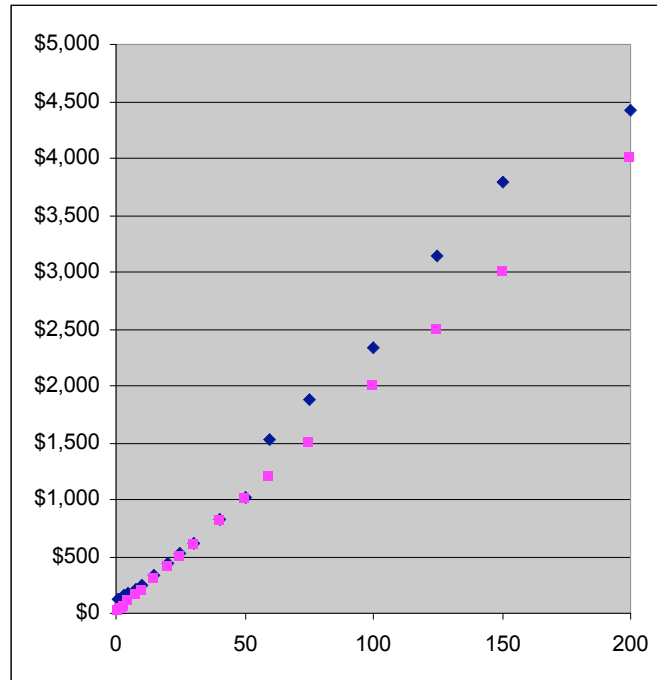
Price does not need to be completed. If it is completed, it needs to be in the reasonable range provided.

Approximate formula format instead of table:

price paid is $\geq 20 * hp$ and $\leq 80 * hp$

HP	Min	Max
	(40% of list)	(150% of list)
1	\$116	\$492
1.5	\$124	\$527
2	\$131	\$588
3	\$149	\$635
5	\$174	\$696
7.5	\$209	\$1,034
10	\$253	\$1,163
15	\$341	\$1,664
20	\$430	\$2,012
25	\$524	\$2,546
30	\$618	\$2,909
40	\$829	\$3,816
50	\$1,016	\$4,727
60	\$1,520	\$7,199
75	\$1,882	\$8,687
100	\$2,330	\$10,884
125	\$3,132	\$14,069
150	\$3,797	\$16,500
200	\$4,424	\$19,907
Over 200	\$4,424	\$41,770

115.6	492	
124.0	526.5	\$20
130.8	588	\$30
149.2	634.5	\$40
173.6	696	\$60
208.8	1034	\$100
252.8	1163	\$150
341.2	1664	\$200
430.4	2012	\$300
524.0	2546	\$400
618.0	2909	\$500
828.8	3816	\$600
1,016.4	4727	\$800
1,519.6	7199	\$1,000
1,881.6	8687	\$1,200
2,330.4	10884	\$1,500
3,131.6	14069	\$2,000
3,796.8	16500	\$2,500
4,424.0	19907	\$3,000
		\$4,000



Compressed Air System

- 1 One box is checked. Rest of section is blank if “No.”
- 2 hp totals at least 50 hp not counting backup units
 One operating condition per row
 In most cases expect exactly one modulating unit. In most cases one backup unit only.
 If VSD is checked then the motor hp is no more than the hp in motors section Q15 or Q16.
 In most cases no more than one compressor has VSD control
- 3 Exactly one checked.
 Typical control type by manufacturer
 (“P” primary or most common, “S” is secondary or less common for that brand)

Brand	Throttle	Slide/poppet/turn	Cycling	VSD	Bypass
			P	S	
Atlas-Copco					
Gardner-Denver		P		S	
Ingersoll-Rand			S		
Kaeser	P		P	S	
Quincy	S	S			
SullairP		P			
Centrifugal, all brands	S				P

- 4 Exactly one checked. If “Yes” or “Not sure,” more than one compressor must be listed in Q2.
- 5 Exactly one checked.
- 6 Exactly one checked.
- 7 Exactly one checked.
- 8 Completed. 60-160 psig is expected range.
- 9 Cannot exceed value than Q8. In 99% of the cases should be at least 1 psi less than Q8.
- 10 Completed if Q8-Q9 > 10
- 11 Exactly one checked. 11b is less than Q8. Or, Q11c is greater than Q8.
- 12 Blank if Q11 <> Decreased. Completed otherwise.
- 13 Exactly one checked.
- 14 Completed if Q13 <> Never
- 15 Completed if Q13 <> Never
- 16 Exactly one checked.
- 17 Exactly one checked.
- 18 Exactly one checked if Q17 is “Yes”
- 19 Exactly one checked. Hp is reasonable for plant size.
 Note: See the QC checks down at the bottom that are based on plant billing data.
 the annual kWh will be provided, and the formulas provide a way to get plant hp from annual kWh.
- 20 Completed if Q19=“yes”
- 21 Exactly one checked. Hp is reasonable for plant size. Less than or equal to Motor Q5.
 Use the same plant hp value.
- 22 Completed if Q21=“yes”
- 23 Exactly one checked.
- 24 Exactly one checked. Number is greater than 0%.
- 25 Completed (\$0 if none, not N/A)

Note: Can only be blank if “Don’t know” is checked.

26 At least one box checked most of the time. Not required.

Note: Do not need to code this check.

Maintenance

1 One box checked per row

2 Reasonable size compared to total number of employees (General Q4)--FTEs, not just total bodies that do some maintenance. Maint Q2 < General Q4 / 2

3 Exactly one checked.

4 Exactly one checked.

5 Completed if Q4 is “increased” or “decreased.”

6 Exactly one checked.

7 Exactly one checked.

8 Number is greater than 0 (if zero should check “None”) and small enough to fit with facility size (e.g. motor Q5).

Note: Use the same QC as described for Compressed Air Q19 & Q21. See the bottom of the QC spreadsheet.

9 Exactly one checked.

10 Skipped if Q9 is No or Not sure. Completed otherwise. Greater than 0. Small enough for facility size.

Note: Same as prior question.

11 Skipped if Q9 is No or Not sure. Completed otherwise.

12 Skipped if Q9 is No or Not sure. Exactly one checked otherwise.

13 Skipped if Q9 is No or Not sure. Exactly one checked otherwise.

14 Skipped if Q9 is No or Not sure. Exactly one checked otherwise. Energy savings has units marked.

15 One box checked per row. Refrigeration only checked if refrigeration Q1 is yes, or otherwise likely to have it.

Note: Do not program in that QC check in the Maintenance section that checked a refrigeration data entry.

It is not an absolute check and was intended for human consideration only.

(The subcontractor is using the same QC list for human pre-review).

Otherwise I wrote the QC with the intention that data be entered sequentially.

16 At least one box checked if Q15 “Contracted Out” column has any checks. Other description is not same as choices.

Note: Don’t need to program this.

17 Exactly one checked.

18 At least one box checked if Q17 is “Yes.”

19 Exactly one checked.

20 Exactly one checked.

Electronic Process Control

1 Exactly one checked. Rest of section blank if “None.” Okay if blank if “Not sure.”

Note: Allow to check all that apply as originally instructed, except if “None” is checked only that box can be checked.

- 2 At least one box checked. If “energy savings” box checked, at least one box is also checked in six savings sub-choices boxes.
- 3 Blank if Q2 has only one box checked. Exactly one box checked otherwise. Q3 is included in Q2 boxes checked.
- 4 Number written in or a box is checked. $Q4 < \text{plant hp and plant kW per Additional Range Checks below}$.
- 5 Number written in or a box is checked. $Q5 < Q4$.
- 6 Exactly one box checked.
- 7 Exactly one box checked. “Don’t know” is an acceptable “Other write-in, as the option was not provided.
If first box is checked, numeric field is completed. Fractional numbers okay. Flag for confirmation if greater than 36.
- 8 Exactly one box checked. “Don’t know” is an acceptable “Other write-in, as the option was not provided.
- 9 Exactly one box checked. “Don’t know” is an acceptable “Other write-in, as the option was not provided.
Make sure write-in is NOT a plant operator name or title. If so, strike out and check box 1 or 3 as appropriate.
- 10 Exactly one box checked. “Don’t know” is an acceptable “Other write-in, as the option was not provided.
Make sure write-in is NOT a plant operator name or title. If so, strike out and check appropriate box.
- 11 Exactly one box checked. “Don’t know” is an acceptable “Other write-in, as the option was not provided.
Make sure write-in is NOT a plant operator name or title. If so, strike out and check appropriate box.
- 12 Completed.
- 13 Exactly one box checked.
- 14 Completed if Q13=“Dedicated.” Exactly one box checked. Number makes sense compared to kW controlled.
- 15 Completed if Q13=“Both” or “Part of a more complex system.” One box checked. Cost makes sense compared to kW controlled.

Water Recovery

- 1 Exactly one box checked. If “No,” rest of section is blank.
- 2 Exactly one box checked. Volume makes sense for size of plant.
Note: We may be able to come up with one later relating to sales \$ but for now skip this as a human only check.
- 3 32-212 F, or 0-100 C
- 4 Not blank. Describes a source not a use of recycled water.
- 5 If gpd provided, same order of magnitude as Q2. Can be bigger or smaller.
At least one box or blank completed. No more than one of the ‘%’ blanks checked.
Note: $Q5 < 10 * Q2$ (meaning that they recover up to 91% of water that would have been discharged if there was no water recovery)
- 6 Exactly one box checked.

- 7 Answered if Q6='Yes.' $\text{Btu/hr} < (Q2 + Q5) * 8.33 * (212 - 50) / 24$. $\text{Btu/hr} > \min(Q2, Q5) * 8.33 * (212 - 50) / 24000$.
- 8 Not blank. Describes a use and not a source of recycled water.
- 9 Exactly one box checked. If completed year is between 1900 and 2001.
- 10 Number makes sense for water recovery rate gallons/day or "Don't know" is checked.
Note: We may be able to come up with one later relating to cost to gpd but for now skip this as a human only check.
- 11
- 12 Exactly one box checked. If number provided, it is less than $Q10 * 12$ (e.g. one-month payback time).
- 13 Exactly one box checked. If write-in, make sure words can't fit to a checked box.
Note: Okay if unable to program this QC check
- 14 Exactly one box checked. If write-in, make sure words can't fit to a checked box.
Note: Okay if unable to program this QC check
- 15 Exactly one box checked. If write-in, make sure words can't fit to a checked box.
Note: Okay if unable to program this QC check
- 16 If write-in, make sure words can't fit to a checked box.
Note: Okay if unable to program this QC check
- 17 Exactly one box checked if Q16 has more than one box checked. Checked box is also checked in Q16.
- 18 At least one box checked if "Energy costs" selected in Q16. Blank otherwise. If write-in, make can't fit to existing category.
Note: Okay if unable to program this QC check

Power Generation

- 1 Exactly one box checked.
- 2 At least one box checked if Q1=1. Blank otherwise.
- 3 Completed if Q2 has at least one box other than UPS checked. Also see Additional Range Checks below.
- 4 Exactly one box checked. Rest of section is blank if "No" or "Don't know."
- 5 At least one box checked. "Other" description is not better classified in existing categories.
- 6 Exactly one box checked.
- 7 Exactly one box checked.
- 8 Exactly one box checked. Also see Additional Range Checks below.
- 9 $0 < Q9 \leq 168$, or "Don't know."
- 10 If $Q9 > 168$, exactly one box checked.
- 11 Also no box checked, as "Don't know" was not provided as an option.
- 12 See Additional Range Checks below.
Note: Re Q8 & Q12 The 2 accounts for the conversion factor between kW and hp and adds a safety factor.

Refrigeration

- 1 Exactly one box checked. If "No" rest of section should be blank.
- 2 Exactly one box checked. If "No" rest of section should be blank.
- 3 Exactly one box checked. If "Yes," year range is 1996-2001
- 4 Exactly one box checked, but only if Q3="No.". If Q4="Yes," year range is 1996-2001.

- 5 At least one box checked if Q4 OR Q3 = "Yes."
- 6 Blank if Q5 has one or no boxes checked. Exactly one box checked otherwise. Q6 is included in Q5 boxes checked.
- 7 Exactly one box checked if Q4 OR Q3 = "Yes."
- 8 Exactly one box checked if Q4 OR Q3 = "Yes."
- 9 Completed if Q4 OR Q3 = "Yes." Cost makes sense compared to Q25, asked later.
- 10 Exactly one box checked. If "Yes," year range is 1996-2001
- 11 Exactly one box checked, but only if Q10="No.". If Q11="Yes," year range is 1996-2001.
- 12 At least one box checked if Q10 OR Q11 = "Yes."
- 13 Blank if Q12 has only one box checked. Exactly one box checked otherwise. Q13 is included in Q12 boxes checked.
- 14 Completed if Q10 OR Q11 = "Yes." Cost makes sense compared to Q25, asked later.
- 15 Exactly one box checked. If "Yes," year range is 1996-2001
- 16 Exactly one box checked, but only if Q15="No.". If Q16="Yes," year range is 1996-2001.
- 17 At least one box checked if Q15 OR Q16 = "Yes."
- 18 Blank if Q17 has only one box checked. Exactly one box checked otherwise. Q18 is included in Q17 boxes checked.
- 19 Completed if Q15 OR Q16 = "Yes." Cost makes sense compared to Q25, asked later.
- 20 Exactly one box checked. If "Yes," year range is 1996-2001
- 21 Exactly one box checked, but only if Q20="No.". If Q21="Yes," year range is 1996-2001.
- 22 At least one box checked if Q20 OR Q21 = "Yes."
- 23 Blank if Q22 has only one box checked. Exactly one box checked otherwise. Q23 is included in Q22 boxes checked.
- 24 Completed if Q20 OR Q21 = "Yes." Cost makes sense compared to Q25, asked later.
- 25 At least 20 hp and less than total plant hp. See Additional Range Checks below.
- 26 Less than or equal to Q25. Greater than 0 if Q3="Yes."
- 27 Less than or equal to Q25. Greater than 0 if Q10="Yes."
- 28 Less than or equal to Q25. Greater than 0 if Q15="Yes."
- 29 Less than or equal to Q25
- 30 Less than or equal to Q29
- 31 Less than or equal to $Q25 / 2$. Usually should be greater than 0 if $Q25 > 100$.
- 32 Less than or equal to Q31
- 33 Exactly one box checked.

Closing

- 1 Exactly one box checked. Q2-Q5 blank if Q1 is "No."
- 2 Makes sense for plant size. Must provide \$ to benchmark.
- 3 Completed and in reasonable range of General Q11. Okay to omit if General Q11 is completed.

Must have either General Q11, provided data, or permission to use utility data if benchmarking is requested.

Note: It specifically asks for annual energy, not monthly so don't allow the monthly option or kW, just allow annual kWh or annual kWh\$ (\$/yr).

First convert to common units. For comparison purposes only:

If General Q3a is answered, assume $\text{annual kWh\$} = \text{annual kWh} * \0.08 .

If General Q3b is answered, assume $\text{annual kWh\$} = \text{monthly kWh} * 12 * \0.08

If General Q3c is answered, assume annual kWh\$ = monthly kWh\$ * 12.

If General Q3d is answered use the annual kWh\$ answer directly.

If General Q3e is answered, assume annual kWh\$ = kW * 8760 * 0.6 * 12 * \$0.08.

If Closing Q3 answered in kWh, assume annual kWh\$ = annual kWh * \$0.08.

Use this instead of any General Q3 answer if answered both places.

If Closing Q3 answered in kWh\$ use this directly. Use in place of any answer given in General Q3.

Then compare annual kWh\$ to Closing Q2:

kWh\$ * 1000 > Closing Q2 > kWh\$ * 5

- 4 Needs value and units. Makes sense for facility size. If no consumption. "0" should be entered. If "Don't know," can't benchmark.

Note: First convert to the same unit MMBtu. 1 MMBtu =

1,000,000 Btu

1,000 MBtu

1,000 kBtu

10 therms

~6.7 gallons of oil

~11 gallons of propane

~\$5.00 of fossil fuel.

Then compare. Total MMBtu * \$5 must be less than Closing Q2

- 5 Optional.

- 6 Exactly one box checked.

- 7 Exactly one box checked.

=====

ADDITIONAL RANGE CHECKS.

There are additional range checks we will apply based on utility billing data that WW will not be able to screen for in advance of submission.

First Aspen will get the plant peak kW from the electric billing data. If kW is not available, we will estimate it from annual energy use.

If necessary,

$$\text{peak kW} = \text{annual kWh} / 8760 / 0.6$$

Aspen will then estimate likely total plant motor horsepower, based on a typical mixture of lighting, resistance heat, etc.

$$\text{plant hp} = \text{peak kW} \times 2 / 0.75$$

This parameter will be used for subsequent sanity checks that while they are not rigid requirements, will help flag grossly unusual data.

Motors

- 5 Less than plant hp

- 14 Less than plant hp

Compressed Air System

- 2 Total of all compressor hp is less than plant hp
- 19 Less than plant hp

Maintenance

- 8 Less than plant hp
- 10 Less than plant hp

Electronic Control

- 4 Less than plant hp or peak kW

Power Generation

- 3 Less than plant hp or plant kW.
- 8 Less than plant hp x 2
- 12 Less than plant hp x 2

Refrigeration

- 25 Less than plant hp