

David Sellers

From: David Sellers
Sent: Monday, June 21, 2021 9:52 AM
To: Anthony Te
Cc: Stroupe, Ryan; skoli@trccompanies.com; jmacquiddy@exploratorium.edu
Subject: RE: EBCx 16 notes - Group Exercise
Attachments: Impeller Trim v1.xlsx; Adding A VFD - Low Bid v1.xlsx; Adding A VFD v1.xlsx; Replace an Evaporator Pump v1.xlsx; Adding an Evaporator Pump v5.xlsx; Motor Replacement 10 hp.xlsx

Hi Anthony,

I had a very nice weekend, thanks for asking. We went to a family birthday celebration down in Salem so it was good to see everyone.

As a point of clarification, I mistakenly dragged the "Bids" folder over into the materials I provided for you when I uploaded the materials for the class. The idea was for you to ask for bids and then I would give you the appropriate files with an explanation, which is what I will do now so you know how to interpret the numbers. So sorry for creating some confusion there.

For starters, I took a look at your savings projections and your approach is reasonable as are the numbers you came up with for the impeller trim and the right sized pump. But your VSD number is significantly high. I think the issue is related to the head you used as well as the pump efficiency. A few clues to point you in the right direction:

1. The VSD option moves the pump down the system curve from the wide open operating to the same operating point that you targeted with the impeller trim.
2. The VSD preserves the pump efficiency at the point where the system curve crosses the impeller line at the wide open operating point.

If you have questions about those items, I am happy to type or talk with you about them further.

With regard to the motor question; there are two considerations and I am not sure which one you are referencing, so I will mention them both.

One is that in certain circumstances, it will turn out that the speed reduction you need falls on or very near the speed reduction you could achieve by changing a motor from one synchronous speed to a different synchronous speed. For instance, you may discover that if you replace an existing motor rated 1,750 rpm (1,800 rpm synchronous speed) with a motor rated 1,150 rpm (1,200 rpm synchronous speed), then the operating point is where you need it to be without using a VSD to accomplish the speed change.

This approach will only work if you are making a one time speed reduction of course. In other words, if there are operating modes where you need to vary the speed to follow the load or go back up to the

original speed to allow the pump to work in parallel with other higher head pumps, then you will need the VSD. But there are several potential benefits to this approach if it happens to be possible.

1. It eliminates the cost and complexity of a VSD.
2. It will be more persistent; to change the speed from the desired reduction, you would have to change the motor vs. twisting a knob or changing a setting on the VSD.
3. It eliminates the efficiency loss in the VSD.
4. You may be able to pick up a percent or so efficiency improvement in the new motor if the existing motor is an older motor.
5. The change can often be made by the operating team since it is basically a normal maintenance activity to replace a motor. In contrast, many operating groups do not have the skills in house that would be needed to run the conduit and wire, etc. necessary to install a VSD and/or may be prohibited from doing it due to code requirements for a licensed electrician to do the work or union work rules.

The other reason for changing the motor if you applied a VSD, in particular, a VFD (Variable Frequency Drive, which is a type of Variable Speed Drive) it is that the existing motor is not VSD rated. So, if you applied a VSD to it, there is the potential that you could cause the bearings or windings to fail due to the voltages and harmonics created by a VFD.

That is a very motor/drive specific thing and in the past, I have applied VSDs to non-VSD rated motors (especially before I realized that there was an issue) and not had problems. But (prior to realizing there was an issue), in hindsight, there were a couple of motor failures a year or two after we retrofitted a VSD that, in hindsight, were probably because of these interactions.

So, the point is to make an informed decision. In other words, if the chosen path is to apply a VSD and the cost of replacing a motor along with the VSD is going to put the project simple pay-back outside of the range the Owner will consider, then you may want to defer the motor replacement and only do it if issues emerge. But you want that to be an informed decision.

Meaning that you present it that way so the operating team knows there is the potential for it and can watch for it and plan what they will do if the failure happens. I have done this in the past; the operating group was happy to have the VFD and the savings it would deliver and the simple payback with out the motor in it allowed them to do a capital project to add the drive when they otherwise would not have been able to do it. If the motor failed, that would be considered an operations and maintenance cost and they could address it out of that budget. If the motor didn't fail, then all the better.

If you want some additional insight into this, if you go to the Cx resources website, you will find an appendix in the NBCIP Return Fan Capacity Control Guide that discusses this.

<https://www.av8rdas.com/nbcip-reports.html> (Look in Appendix 6)

Let me know if you have questions about any of that.

With regard to the bids, I am going to provide a bid summary and also the bid breakdowns. Normally, when playing this "game", unless folks ask for line item break downs when they ask for the bids, I don't initially provide them

Part of the lesson is to realize that there is a pretty significant bid spread for some items that needs to be understood. So, I give them the bid summary and wait for them to recognize the issue and ask for the breakdowns (or not).

But since I let the proverbial cat out of the bag when I accidentally gave you all of the bids and since at this point, in terms of the class date, time is pressing, I am going to give you both.

As a starting point, here are the bid results for the options you asked for.

<i>Bid Results - San Francisco, CA</i>			
	Bidder 1	Bidder 2	Bidder 3
Impeller Trim	\$2,941	\$4,253	\$4,466
Variable Speed Drive	\$9,017	\$17,657	\$17,215
Redundant Right Sized Pump	\$87,140	\$95,854	\$85,397
Replace Pump with Right Sized Pump	\$16,242	\$17,054	\$30,280
Motor Change - 10 hp	\$2,312	\$3,248	\$2,968

With regard to the right sized pump, I was not sure if you were asking for a pump that is installed in place of one of the existing pumps or a pump that was added in addition to the existing pumps, so I gave you the bids for both options.

The files that are attached are the breakdowns, which I will explain next. In the real world, sometimes, if you ask for breakdowns, especially if that is not called out when the scope of work is issued, the contractor is reluctant to give them to you. That, right there, is a bad sign.

In any case, as you can see there is some significant bid spread between prices for the various options you wanted to explore. This is often there because of the lack of specifics. But in my experience, there are other reasons it can happen.

- The bidders don't read the specifics; basically they just toss a number out there.
- The bidder unintentionally underbids the job because they read the scope but do not fully appreciate what it will take to do the work.
- The bidder has a good relationship with the customer and has done work with them before, thus knows what they really want and includes the necessary work. Unfortunately, if the necessary work is not detailed in the scope, other bidders who are less familiar and/or simply bid exactly what is asked for come in lower. In other words, a bidder can be high because they "know too much". For instance, in a nicely color coded plant, the knowledgeable bidder might include painting the new insulation to match the existing piping, But if it was not in the scope, another

bidder could (legitimately) not include that work since it was not asked for. That may have been the Owner's intent; i.e. they figured their guys could do the painting. Or, they may have wanted it done by the contractor but failed to specify it.

- The bidder wants the work and "buys" the job by underbidding it and hoping it leads to future work with the customer.
- The bidder intentionally underbids the work, planning to go after change-orders that exploit perceived loop-holes in the way the scope of work has been defined.

To my way of thinking, you would like to see the bids all be with-in 8-10% or so of each other. Usually (but not always) that is a reasonable indication that the contractors all saw the job the same way and are bidding the same scope. (Note that just because they saw the scope the same way does not mean the scope is the correct scope; more on that in the next exercise we will do).

So, if there is a big spread, it is best to try to understand why it exists before you just go with the low bid. Asking for line item breakdowns is a good way to accomplish that.

It could turn out that the low bid is exactly what you asked for and there are reasons the others are high. But it also could be that the low bid is the wrong number and things will "unwind" if you give the job to the low bidder. I have seen this manifest itself in a bunch of ways.

- You actually get a good job because the contractor, while realizing they messed up, wants to build the relationship and do the right thing in terms of meeting the specified requirements, even though they missed something or misinterpreted something. In other words they "eat" the loss. Sometimes, you can meet them half way to help out. For instance, if your scope of work had them handling all of the draining, filling and venting of piping that needed to be done for a modification, you could offer to handle that if your crew had time.
- You get an inferior installation where corners are cut when the contractor realizes they missed something and is trying to cut their losses. I have seen contractors walk away from significant retentions that are being held to ensure that they complete the work because they can make more money moving on to the next job and abandoning the retention. For instance, your requests for them for a time they can come on site to support the commissioning process after the installation is done may go unanswered or may be answered with vague responses like "we will have to get back to you" and then they never do.
- You are bombarded with change orders and delays and the job ends up costing more; sometimes more than the high bid.
- The contractor goes bankrupt in the middle of the job because of how wrong they were; pretty severe but it happens, including to me on a project in the early 1980's. We were really worried that they had underbid the job and discussed our concerns with them and offered them an opportunity to withdraw their bid. But they insisted they could do the work for the amount of their bid and meet all of our scope items because they were just smarter about it and harder working than the other bidders. But they were not it turned out.

In any case, I am providing the attached files to provide the additional information. Ultimately, I want to have actual "fake" letters and take-off sheets for the different bidders. But given all of the possible options and the four locations, it takes 92 similar but slightly different documents to do that and I am not at that point in the development. So I am providing the spreadsheets behind the numbers, which should give you what you need to know to make your decisions. (Note that many have multiple tabs.)

A few things you need to know to assess the information in the attached spreadsheets.

1. To come up with the prices in various locations, I did the cost projections based on labor and materials in the San Francisco markets. In other words, there is not a take-off for adding a VFD in San Francisco and different ones for Sacramento, Honolulu, and St. Louis. Rather there is one take-off that I then "tweak" to provide (what I believe are) reasonable numbers for the other locations. Not a real issue for you folks since Ryan assigned San Francisco for your project location.
2. To create costs for other locations, I looked at things like the cost of living index, the purchasing power index and the RS Means City Index to adjust the San Francisco based values to the other locations.
3. Bid spreads are created in two different ways.
 - a. One way is by doing a take-off that misses something that should have been included, so basically, the "wrong answer".
 - b. The other is to take the result of the "correct" take-off and apply a multiplier to it in the range of +/-8 to 10%; in other words, create a spread on the "right answer" that would likely exist because of how different contractors "see" things. For instance, one contractor may use a low profit margin and contingency because they would like the work. Another might use a high profit margin and contingency because they want to be responsive, but if they actually got the job, it might cost them more to do it because of having to pay overtime or bring in additional help.

Here are what the files represent (Note that some of these spreadsheets have multiple tabs).

- Adding A VFD - Low Bid v1.xlsx and Adding A VFD v1.xlsx are the files behind the different VFD prices.
- Impeller Trim v1.xlsx is the file behind the impeller trim numbers.
- Replace an Evaporator Pump v1.xlsx is the file behind replacing an existing pump with the new, right sized pump.
- Adding an Evaporator Pump v5.xlsx is the price to install a new, more efficient pump in parallel with the existing evaporator pumps.

- Motor Replacement 10 hp.xlsx has the detail behind the various motor bids.

I think the attached will give you what you need to make your decisions, but let me know if you have more questions.

See you later this week,

David

Senior Engineer

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View *A Field Perspective On Engineering* and past posts from

A Field Guide for Engineers at <http://av8rdas.wordpress.com/>

View *The Other Side of Life* at <https://av8rdaslife.wordpress.com/>

From: Anthony Te <anthony.te@p2sinc.com>

Sent: Sunday, June 20, 2021 9:56 PM

To: David Sellers <dsellers@facilitydynamics.com>

Cc: Stroupe, Ryan <R2S2@pge.com>; skoli@trccompanies.com; jmacquiddy@exploratorium.edu

Subject: RE: EBCx 16 notes - Group Exercise

Hello David,

I hope you had a good weekend. We are Group 3, and our building location is in San Francisco. We would like bids for:

1. Trimming the impeller (10" impeller for the e-1510 6G, 1150 rpm pump)
2. Reducing the pump speed (VFD for 15-hp motor)
3. Right sizing the motor (10-hp motor)
4. Right sizing the pump (1,100 gpm at 28 TDH)

Also, we could not figure out the calculation approach for right sizing the motor. Does that require looking at a different pump curve with a lower RPM? Any direction would be helpful. I've attached the spreadsheet in case you wanted to see the calculations.

Thanks,

Anthony Te, PE | Mechanical Engineer

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From: David Sellers <dsellers@facilitydynamics.com>

Sent: Saturday, June 19, 2021 11:36 AM

To: Stroupe, Ryan <R2S2@pge.com>; atafocus@yahoo.com; avril@pointenergyinnovations.com; Fortunato@ForStrategy.com; for2un@gmail.com; gori_zoolander@hotmail.com; smarin@cimgroup.com; mpanossian@exploratorium.edu; jmacquiddy@exploratorium.edu; Anthony Te <anthony.te@p2sinc.com>; skoli@trccompanies.com; janecito@ableserve.com; bvanblargan@hotmail.com; Eric Dupuis <edupuis@mazzetti.com>; andreas.winardi@siemens.com; jnavar@efficiencycx.com; alishirazi_ez@yahoo.com

Subject: RE: EBCx 16 notes - Group Exercise

Warning Outside Sender

Hi all,

Just touching bases on this. As of a few minutes ago, I believe I am current in terms of responding to questions, providing bids for different options, providing links to videos of one-on-one sessions we had that I remembered to record, etc.

But let me know if I missed something, like an e-mail from one of you asking for additional information or with a question.

See you all next week.

David

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A Field Guide for Engineers at <http://av8rdas.wordpress.com/>

View *The Other Side of Life* at <https://av8rdaslife.wordpress.com/>

From: Stroupe, Ryan <R2S2@pge.com>

Sent: Tuesday, May 18, 2021 4:18 PM

To: atafocus@yahoo.com; avril@pointenergyinnovations.com; Fortunato@ForStrategy.com; for2un@gmail.com; gori_zoolander@hotmail.com; smarin@cimgroup.com; mpanossian@exploratorium.edu; jmacquiddy@exploratorium.edu; anthony.te@p2sinc.com; skoli@trccompanies.com; janecito@ableserve.com; bvanblargan@hotmail.com; Eric Dupuis <edupuis@mazzetti.com>; andreas.winardi@siemens.com; jnavar@efficiencycx.com; alishirazi_ez@yahoo.com

Cc: David Sellers <dsellers@facilitydynamics.com>

Subject: EBCx 16 notes

EBCx year 16 participants,

The recording of the May 6 class is posted here:

<https://bcove.video/3waXxWY>

David's discussion of the homework assignment begins at 3:46:56 in the recording. Here are the climate zones assignments for each group:

Group 1: Honolulu, HI

Gordon Ludwick

Avril Levasseur

Robert Fortunato

Group 2: San Francisco, CA

Michael Long

Santiago Marin

Marie Panossian

Group 3: San Francisco, CA

Jesse MacQuiddy

Anthony Te

Srushti Koli

Group 4: Sacramento, CA

Jeff Anecito

Bob VanBlargan

Eric Dupuis

Group 5: St. Louis

Andreas Winardi

Javier Navar Payan

Ali Shirazi

For the owner scenarios provided, each team is to consider all the different scenarios and determine which are viable. David discusses this in the class recording.

Also we had issues with the recording of the webinar again. Some of the morning portion of the last class was not captured. I redid my parts, but the three student presentations from the morning are not included in the recording. Sorry.

Ryan Stroupe

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