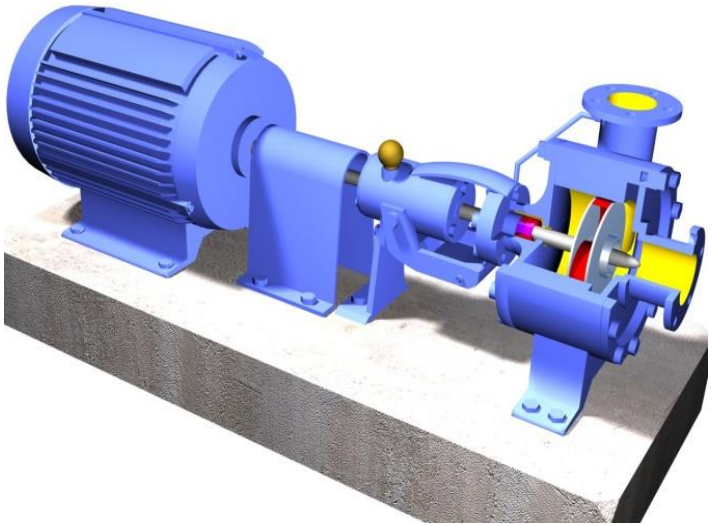
ASRAC Pumps Working Group

Engineering Analysis Update







U.S. DEPARTMENT OF ENERGY | Energy Efficiency & Renewable Energy

BUILDING TECHNOLOGIES PROGRAM

May 27, 2014

Engineering Analysis Updates

The upcoming slides will cover the following:

- Updates made to End Suction and Inline analyses since the conclusion of the April 30th meeting
- Results of the VT-S analysis
- Results of the RS-V analysis
- Update to MSP vs. Efficiency Relationship

End Suction and Inline Updates

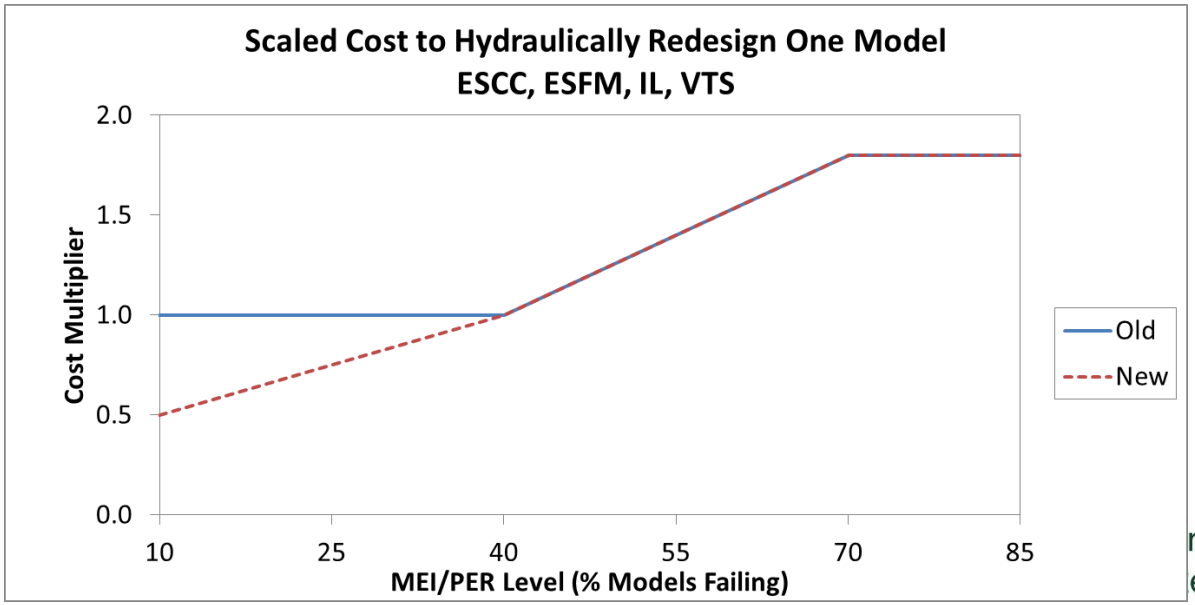
1. Percent of models eligible to be polished was adjusted:
   - End Suction: From 6% to 3.6%
   - Inline: From 6.5% to 3.9%
   - Comments from C. Cappellino (May 4, 2014) suggested that we were over-estimating the efficiency gains available from polishing impellers.
     - Available gains from polishing were effectively cut in half, because we will not be polishing volutes. EU study on polishing was used as guidance.
2. Additional capital conversion cost required to change to advanced casting reduced by approximately half
   - Corrects an invalid assumption in the original method
     - The original method scaled up the total pattern and tooling costs, when only the impeller pattern and tooling costs should be scaled up.

End Suction and Inline Updates

3. Hydraulic Redesign cost decreased by 15%
   - Original HI survey included “Cost of Capital” category
     - 20% of the total cost
     - 25% of the Redesign, Tooling, Testing, and Marketing Cost.
   - Defined as "Cost of money to finance upgrades, and Inventory (Cost, Rework Transition, Inventory for legacy support.)"
   - Cost of money is covered by the WACC discount rate.
     - Because this is covered in the WACC already, any financing costs must be backed out.
     - We propose leaving in 25% of the provided “Cost of Capital” dollar value, and attributing this to Inventory costs, which would likely impact CGS.
     - We proposed backing-out 75% of the provided “Cost of Capital” dollar value, which works out to 15% of the total Hydraulic Redesign Cost
       - That put the cost of financing at 18.75% of the upfront costs.
         - » Between 3 and 4 years worth of financing costs with a WACC of 11.8%

End Suction and Inline Updates

4. Updated number of End Suction and Inline pump models in the industry, based on HI Survey data
   - End Suction Changed from 2050 to 2398
   - IL changed from 739 to 808
5. Cost of redesign per-unit adjusted to decrease linearly from PER40 to PER10
   - Previously modeled the manufacturers' plans to redesign to PER 40 for any standard less than or equal to PER 40
   - Changed to model the actual cost of redesigning to PER 10 or 25 in order to fairly examine economic justification for those efficiency levels



End Suction and Inline Updates

6. Updated model counts based on newly released HI data

7. Costs at each EL now based on the exact percent of models failing as well as the average design cost for the actual population of failing pumps.
   - Results are now more precise

End Suction and Inline Updates

Summary of Results: Total Cost of Redesign to Industry (Aggregate)

ESCC/ESFM	Efficiency Level					
	PER 10 ($MM)	PER 25 ($MM)	PER 40 ($MM)	PER 55 ($MM)	PER 70 ($MM)	PER 85 ($MM)
April 30, 2014	$24.4	$65.1	$110.7	$213.1	$348.8	$423.6
May 14, 2014	$12.3	$49.0	$111.1	$213.9	$350.0	$425.0
May 27, 2014	$12.2	$48.6	$108.9	$207.3	$339.6	$403.2
% Diff. (4/30 to 5/27)	-50%	-25%	-2%	-3%	-3%	-5%

IL	Efficiency Level					
	PER 10 ($MM)	PER 25 ($MM)	PER 40 ($MM)	PER 55 ($MM)	PER 70 ($MM)	PER 85 ($MM)
April 30, 2014	$10.60	$28.20	$47.90	$92.20	$150.90	$183.30
May 14, 2014	$5.0	$19.8	$45.0	$86.5	$141.6	$172.0
May 27, 2014	$5.0	$19.7	$44.6	$86.8	$141.7	$170.1
% Diff. (4/30 to 5/27)	-53%	-30%	-7%	-6%	-6%	-7%

Please note: The original results, released on 5/2/14, and listed in the presentation "Final_Eng_Analysis_Slides_2014-04-30_w-revisions.pptx" contained a typographical error that shifted the columns of some of the results. The above row, titled April 30, 2014 presents the proper, correct results for that date.

End Suction and Inline Updates

Summary of Results: Industry Cost of Redesign as % of Revenues

ESCC/ESFM	Efficiency Level					
	PER 10 ($MM)	PER 25 ($MM)	PER 40 ($MM)	PER 55 ($MM)	PER 70 ($MM)	PER 85 ($MM)
April 30, 2014	18%	47%	80%	155%	253%	308%
May 14, 2014	9%	36%	81%	155%	254%	309%
May 27, 2014	9%	35%	79%	150%	247%	293%
% Diff. (4/30 to 5/27)	-50%	-25%	-2%	-3%	-3%	-5%

IL	Efficiency Level					
	PER 10 ($MM)	PER 25 ($MM)	PER 40 ($MM)	PER 55 ($MM)	PER 70 ($MM)	PER 85 ($MM)
April 30, 2014	22%	58%	98%	189%	309%	375%
May 14, 2014	10%	41%	92%	177%	290%	352%
May 27, 2014	10%	40%	91%	178%	290%	348%
% Diff. (4/30 to 5/27)	-53%	-30%	-6%	-6%	-6%	-6%

Please note: The original results, released on 5/2/14, and listed in the presentation "Final_Eng_Analysis_Slides_2014-04-30_w-revisions.pptx" contained a typographical error that shifted the columns of some of the results. The above row, titled April 30, 2014 presents the proper, correct results for that date.

End Suction and Inline Updates

Additional considerations for the working group:

- Simplify the cost of redesign model:
  - Remove polishing as a design option
    - <2% of population is currently polished in the model
  - Ignore the effects of changing to advanced casting
    - This would reduce total cost by approximately 0.3%

VT-S and RS-V Results

VT-S Results

Key Assumptions

- Only 2-Pole models analyzed
- No models dropped
- All failing models hydraulically redesigned
- 40% of total MSP attributed to motor price
- 70% shipments sold with motor
- Cost to redesign a model reduced linearly below PER 40
- End Suction/Inline Price-Efficiency relationship applied to VT-S

Results:

VT-S	Efficiency Level					
	PER 10 ($MM)	PER 25 ($MM)	PER 40 ($MM)	PER 55 ($MM)	PER 70 ($MM)	PER 85 ($MM)
Industry Cost of Redesign	2.5	9.3	19.2	37.8	61.3	75.2
Percent of Revenues	8%	28%	57%	113%	184%	226%

RS-V Results

Key Assumptions

- All available 2-Pole models are available as 4-Pole
- Limited additional cost necessary to convert a 4-Pole Model
  - 10% of the already redesigned 2-Pole (basic model) model
    - 25% of marketing and testing cost.
- No models dropped
- All failing models hydraulically redesigned
- 40% of total MSP attributed to motor price
- 70% shipments sold with motor
- Cost to redesign a model reduced linearly below PER 40
- Marketplace baseline set at PER40 which is equivalent to EU MEI40
  - No price efficiency relation applied, because PER40 is in the flat portion of the curve.

Results:

RS-V	Efficiency Level					
	PER 10 ($MM)	PER 25 ($MM)	PER 40 ($MM)	PER 55 ($MM)	PER 70 ($MM)	PER 85 ($MM)
Industry Cost of Redesign	[redacted]	[redacted]	5.5	10.6	17.3	21.0
Percent of Revenues	[redacted]	[redacted]	9%	18%	30%	36%

Summary of All Equipment Classes

Total Cost of Redesign	Efficiency Level					
	PER 10 ($MM)	PER 25 ($MM)	PER 40 ($MM)	PER 55 ($MM)	PER 70 ($MM)	PER 85 ($MM)
ESCC/ESFM	$12.2	$48.6	$108.9	$207.3	$339.6	$403.2
Inline	$5.0	$19.7	$44.6	$86.8	$141.7	$170.1
VT-S	$2.5	$9.3	$19.2	$37.8	$61.3	$75.2
RS-V	[redacted]	[redacted]	$5.5	$10.6	$17.3	$21.0
Total	$19.7	$77.6	$178.2	$342.5	$560.0	$669.6

Cost of Redesign as Percent of Revenues	Efficiency Level					
	PER 10	PER 25	PER 40	PER 55	PER 70	PER 85
ESCC/ESFM	9%	35%	79%	150%	247%	293%
Inline	10%	40%	91%	178%	290%	348%
VT-S	8%	28%	57%	113%	184%	226%
RS-V	[redacted]	[redacted]	9%	18%	30%	36%
Total	7%	28%	64%	123%	202%	241%

Updates: MSP vs Efficiency Relationship

Updates: MSP vs Efficiency Relationship

Basic methodology has not changed. The following change has been implemented to improve precision.

- The MSP premium relationship (and ultimately markups) now relies a pump's relative market score (PER %), rather than absolute C-Value
  - Relative market score (PER %) is more easily and accurately comparable across equipment's classes
    - Inline MSP vs. Efficiency (PER %) relationship is now mapped to other equipment classes more consistently
  - Allows for more accurate analysis of the combined 2- and 4-Pole Inline data set
    - Each pump is now assigned its specific PER %, which is dependent on speed.
    - Previously all C-Values were lumped together.

Updates: MSP vs Efficiency Relationship

MSP vs Efficiency (PER %) Relationship