Creating Pump Standards Since 1917

September 16, 2011

Ms. Brenda Edwards
U.S. Department of Energy
Building Technologies Program
Mailstop EE-2J
RFI for Commercial & Industrial Pumps
EERE-2011-BT-STD-0031 and/or RIN 1904-AC54
1000 Independence Avenue, SW
Washington, DC 20585-0121

Dear Ms. Edwards:

Subject: DOE 10 CFR, Part 431; Docket EERE-2011-BT-STD-0031; RIN 1904-AC54

---- Hydraulic Institute (HI) Response to DOE Request for Information ----

This letter is our second response to the U.S. DOE's referenced Request for Information, as published in the Federal Register on June 13, 2011. We are doing so, at this date, in response to the response deadline extension to September 16, 2011 as granted by DOE.

In our previous letter dated July 11, 2011, which we incorporate by reference herein, we responded with considerable information on most of the topics listed below, largely with the exception of #2, where we noted that the Hydraulic Institute had little in the way of independent information:

1.) **Definition(s) of pumps, pump product classes, and diversity of pump types within the pump industry**

2.) **Energy use by pumps as summarized in Table 3.1**

3.) **Overview of the industrial and commercial pump market, including shipments and efficiency ranges:**

4.) **Availability and applicability of U.S. and international test procedures for pumps:**

5.) **Assistance and resources available from stakeholders, states, local jurisdictions, and others**

We have, subsequent to our last submission on July 11th th, had more time to carefully review the citations made by the U.S. DOE, in the June 13th RFI, justifying the need for pump efficiency rule-making. Strikingly, we find that in almost every instance the cited justifications focus on pump systems energy savings opportunities vs. pump energy savings opportunities. Evidence is overwhelming, as explained in our previous letter that DOE should focus on systems vs. pumps.

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HI recommendations, in this regard, are based on the following findings from the cited DOE references, and others that we've found, in the June 13, 2011 Request for Information.
DOE cited literature confirms the following:

1. The greatest gains in energy savings, in absolute numbers, are to be found in pump systems efficiency improvements and not in improvement of the efficiency of the pump component itself.

2. The most cost-effective gains in energy savings are to be found in pump systems efficiency improvements.

3. Energy savings are concentrated in eight industrial sectors.

Based on these three points, HI argues that the efficiency gains which will be economically viable are concentrated in pump systems in targeted industrial sectors. Thus, an approach that is targeted only on the pump component itself will not achieve the greatest energy savings gains for the United States and is not financially viable for the U.S. pump industry. An approach that treats all pump-using industrial sectors equally will also miss opportunities for greater systems savings, which we've documented based on DOE's own data, in eight major industrial sectors. And, as we've noted in our previous letter, there are significant energy saving in the water and wastewater sectors as well, which were not addressed in the DOE RFI, focusing on pump *systems* optimization.

In sum: a targeted *systems* approach has the greatest pay-off for efficiency improvements in pumping systems and any new or expanded national initiative should focus on systems vs. any one component (e.g. pumps) in the system.

<u>Point One</u>: Greatest Gains, in Absolute Numbers, are in Pump *Systems* Efficiency Improvements

In the U.S. Department of Energy's 2002 "*Electric Motor Systems Opportunities Assessment*" (cited in the DOE's RFI on June 13, 2011 on page 34193), the DOE found that the greatest energy savings opportunities for motor systems was in system efficiency measures and not motor efficiency measures.

The DOE estimated that motor systems improvements represented a potential savings of 37 to 79 billion kWh per year, while motor efficiency upgrades represented a potential savings of 19.8 to 24.6 billion kWh per year (DOE 2002:2). For pump motor systems, it was estimated that systems efficiency improvements had energy savings potentials of up to 50 percent, whereas replacing the pump component with a more efficient model represented, at best, a 2 percent improvement (DOE 2002:18). It is important to emphasize that the DOE has been a leader in studying and also advocating for a *systems approach* to energy efficiency. More information on DOE's initiatives in this regard, and complimentary efforts by the Hydraulic Institute and Pump Systems Matter is provided in Point Four below.

In this 2002 document, the DOE explained that its "primary strategy [was] to support plant managers in applying a systems approach to specifying, purchasing, and managing electric motors…" (DOE 2002:1). The DOE estimated that 62 percent of all potential savings were found in improvements to the major fluid systems—pumps, fans, and air compressors (DOE 2002:7). It added that, "The technical aspects of optimizing pump, fan, and air compressor systems are well understood (if not widely implemented)" (DOE 2002:7).

The DOE itemized energy saving opportunities in pump systems in Table E-7 (DOE 2002:18), below:

Table E-7: Energy Saving Opportunities in Pump Systems

Equipment Group/Efficiency Measure	Range of Savings (Percent of System Energy)
Process System Design	
Reduce Overall System Requirements	
• Equalize flow over production cycle using holding tanks.	10%–20%: depends on variation in flow.
• Eliminate bypass loops and other unnecessary flows.	10%–20%: depends on initial system design.
• Increase piping diameter to reduce friction.	5%–20%: depends on initial system design.
• Reduce "safety margins" in design system capacity.	5%–10%
• Reduce system effects due to piping bends.	
Match Pump Size to Load	
• Install parallel systems for highly variable loads.	10%-30%: depends on initial system design.
Reduce or Control Pump Speed	
• Reduce speed for fixed loads: trim impeller, lower gear ratios.	5%–40%: depends on initial system design.
• Replace throttling valves with speed controls to meet variable loads.	5%–50%: depends on initial system design.
Component Purchase	
• Replace typical pump with most efficient model.	1%–2%
• Replace belt drives with direct coupling.	About 1%
• Replace typical motor with most efficient model.	1%–3%
Operation and Maintenance	
• Replace worn impellers, especially in caustic or semi-solid applications.	1%–5%

The three general areas of improvement, all of which are systems approaches, that resulted in the greatest gains in efficiency were:

- Reducing Overall System Requirements (Range of Savings: 5 to 20 percent)
- Matching Pump Size to Load (Range of Savings: 10 to 30 percent)
- Reducing or Controlling Pump Speed (Range of Savings: 5 to 50 percent)

Significantly, replacing a pump with the most efficient model, on the other hand, had a range of savings of 1 to 2 percent of system energy use.

Changing the operating point by reducing the speed for a fixed load by adjusting the gear ratios or by trimming the impeller had an even wider range of savings, 5 to 40 percent of system energy. And replacing throttling valves with speed controls to meet variable loads similarly represented a savings range of 5 to 50 percent.

Other examples, as part of reducing the overall system requirements, include using holding tanks to equalize the flow over the production cycle had a range of savings of 10 to 20 percent of system energy use and eliminating bypass loops and other unnecessary flows had a range of savings of 10 to 20 percent of system energy use.

A study by the International Energy Agency (2007) corroborates the findings of the earlier study by the DOE. IEA estimated that the potential savings for motor systems improvement, worldwide, ranged from 20 to 25 percent, much higher than the potential savings from systems components. The IEA stated that, "At present, most markets and policy makers tend to focus on individual system components, such as motors or pumps, with an improvement potential of 2 – 5% instead of optimizing systems" (IEA 2007:219).

The Europump document, "European Guide to Pump Efficiency for Single Stage Centrifugal Pumps," (cited in the DOE's RFI on June 13, 2011 on page 34195) urged potential customers, "It is likely that the design of the pumping system and the way the pump is operated will have a greater impact on the energy consumption than the pump efficiency alone. You should carry out an LCC analysis to compare different technical alternatives of designing, operating and maintaining a pumping system" (Europump 2003:6).

The writers of a 2006 article on global energy management standards in electric motor and steam systems have argued that the improvement potential for complete systems ranges between 20 and 50%, as shown by programs in the U.S, U.K., and China, whereas the focus of policymakers and markets have been focused exclusively on individual components, with an improvement potential of only between 2 and 5%. (Williams et al. 2006). Based on a pilot program in China described in that article, the payback period for pump systems improvements in a hospital and pharmaceutical industry was only 2 years. The strong consensus in the DOE (2002), IEA (2007), and Europump (2003) documents - to consider pump systems efficiency, rather than just individual pumps efficiency as the proper approach to improving energy and cost savings - is corroborated by engineers and other scientists who have worked on specific kinds of pump systems (See also da Cunha et al. 2008).

For example, a 2010 document (Kranz 2010) that analyzed the performance of irrigation pumping plants found that: "pumping costs continue to increase due to rising fuel costs which have overshadowed improvements in pumping plant components. That said, more efficient irrigation pumping plants still could save an average of 25-30 percent of the energy used to pump irrigation water through properly matching and adjusting the pump and motor to current operating conditions. In Nebraska alone, improvement in pumping plant performance will reduce energy costs by up to $40 million per year" (Kranz 2010:52). Kranz listed nine frequently cited causes of pumping plant inefficiency - all were systems efficiency concerns (e.g. mismatched systems components, such as a too-large power unit; worn pump impellers; power source not operating at most efficient speed) and none was a complaint about inefficient pumps.

Don Casada, a DOE pump and energy expert (and creator of the well-established DOE "Pumping System Assessment Tool" (known as PSAT), dedicated a 2009 *DOE Energy Matters* newsletter article to the matter of "optimizing industrial pump systems" in which he strongly endorses the DOE's approach of advocating for systems efficiency and the Pumping System Assessment Tool (PSAT) as a method for determining the efficiency of a system. He also clearly states, in anticipation of Point Three (below) that, "not all pumping systems are equal—and neither are the opportunities for improvement" and advocates focusing on those systems that use the most energy (Casada 2009).

<u>Point Two</u>: Cost-Effective Gains in Pump Systems Efficiency Improvements

It has been shown that the most cost-effective energy savings are to be found in improvement in pump systems efficiency, not merely pump efficiency improvements. A recent study by UNIDO (McKane and Hasanbeigi 2010, cited in the DOE's RFI on June 13, 2011 on page 34193) found that of ten pump system efficiency measures, four were cost-effective (Table ES-2 MacKane and Hasanbeigi 2010:4):

1. Using pressure switches to shut down unnecessary pump
2. Isolating flow paths to non-essential or non-operating equipment
3. Trimming or changing impeller to match output to requirements
4. Installing variable speed drives

This UNIDO study found that "replacing pump with more energy efficiency type" was **NOT** a cost effective energy efficiency measure. In fact, replacing pumps with more energy efficient pumps was one of the least cost effective measures that could be taken, as will be shown in more detail below.

A measure was cost effective if its **cost of conserved energy** (CCE) was lower than the **unit price of electricity**. The Cost of Conserved Energy was calculated using the following equation (McKane and Hasanbeigi 2010:25):

CCE = (Annualized capital cost + Annual change in O&M costs)/Annual energy savings
For ten pump system efficiency measures, the CCE was calculated and then compared to the unit price of electricity in the US, which was 70.1US$/MWh in 2008.

The report, "Motor System Efficiency Supply Curves UNIDO," Dec. 2010, determined the final cost of conserved energy (CCE) for ten pumping system efficiency measures. When the CCE (in US$/MWh-saved) was less than 70.1 US$/MWh, the energy efficiency measure was deemed cost effective. The following is from Table 14 on page 39 of the report, demonstrating the CCE for a variety of different pump systems energy efficiency measures:

Pump System Energy Efficiency Measure	Final CCE (US$/MWh-saved)
1. Isolate flow paths to non-essential or non-operating equipment	0.0
2. Install variable speed drive	44.5
3. Trim or change impeller to match output to requirements	57.0
4. Use pressure switches to shut down unnecessary pumps	65.7
5. Fix leads, damaged seals, and packing	84.1
6. Replace motor with more energy efficient type	116.9
7. Remove sediment/scale buildup from piping	126.3
8. Replace pump with more energy efficient type	132.2
9. Initiate predictive maintenance program	189.0
10. Remove scale from components such as heat exchangers And strainers	330.9

As noted, Table 14, from the "Motor Systems Efficiency Supply Curves UNIDO," Dec. 2010, report clearly demonstrates these points, as follows:

Table 14: Cumulative Annual Electricity Saving and CO_2 Emission Reduction for Pumping System Efficiency Measures in the US Ranked by their Final CCE

No.	Energy Efficiency Measure	Cumulative Annual Electricity Saving Potential in Industry (GWh/yr)	Final CCE (US$/MWh-Saved)	Cumulative Annual Primary Energy Saving Potential in Industry (TJ/yr)	Cumulative Annual CO_2 Emission Reduction Potential from Industry (kton CO_2 /yr)
1	Isolate flow paths to non-essential or non-operating equipment	10,589	0.0	116,265	6,382
2	Install variable speed drive	23,295	44.5	255,784	14,040
3	Trim or change impeller to match output to requirements	33,279	57.0	365,405	20,057
4	Use pressure switches to shut down unnecessary pumps	36,148	65.7	396,905	21,786
5	Fix leaks, damaged seals, and packing	37,510	84.1	411,855	22,607
6	Replace motor with more energy efficient type	39,084	116.9	429,138	23,555
7	Remove sediment/scale buildup from piping	42,523	126.3	466,906	25,628
8	Replace pump with more energy efficient type	48,954	132.2	537,516	29,504
9	Initiate predictive maintenance program	52,302	189.0	574,280	31,522
10	Remove scale from components such as heat exchangers and strainers	54,023	330.9	593,171	32,559

According to the research of this UNIDO study, replacing pumps with more energy efficient models had a CCE almost **twice** the unit cost of electricity in the United States, resulting in this approach being one of the least cost-effective options. The cost of replacing pumps with a more energy efficient type is substantially higher than most other efficiency improvements identified. The report recognized that there were 7 other pump systems efficiency improvements that were less costly than replacing the pump with a more efficient type (likely one that is application specific, where efficiency gains are associated with better matching the Best Efficiency Point of a pump with the system requirements). Focusing only on pump efficiency vs. pump systems efficiency is misdirected effort, as the UNIDO report provides support. China, as example, has shown a strong interest in U.S. motor system optimization programs (DOE Motor Challenge and BestPractices programs) - taking advantage of pumping systems efficiency improvements that are most cost-effective. (CERF-IIEC 2002:4; McKane et al 2003).

<u>Point Three</u>: Energy Savings Potentials in Eight Sectors above the Industry Average

The American Council for an Energy Efficient Economy (ACEEE) found that potential for pump energy savings were concentrated in a handful of industries.

In a 2003 document (cited in the DOE's RFI on June 13, 2011 on page 34193), the ACEEE estimated that six industries represented 84 percent of total potential energy savings in pump and industrial fan systems (ACEEE 2003:5):

Industry	Potential Savings (million kWh, % of total)	
1. Chemical Manufacturing	10,959	23%
2. Paper Manufacturing	10,527	22%
3. Petroleum and Coal Products Manufacturing	8,812	19%
4. Mining	4,873	10%
5. Food Manufacturing	2,162	5%
6. Primary Metal Manufacturing	2,070	4%

In the DOE 2002 "U.S. Industrial Electric Motor Systems Opportunities Assessment," Dec. 2002, cited the following systems improvement opportunities by manufacturing SIC:

Table E-6: Potential Systems-Level Motor Energy Savings by Manufacturing SIC and Application

		Estimated Savings (GWh/Year)								
SIC	Industry Category	Fan System	Pump System	Compressed Air Systems	Other Proc. Systems	Motor Upgrade	Motor Downsizing	Replace vs. Rewind	All Systems	As % of Total Energy
20	Food and Kindred Products	157	1,250	494	517	1,376	585	295	4,674	12.4%
21	Tobacco Products									
22	Textile Mill Products	170	593	408	166	743	305	121	2,506	15.0%
23	Apparel & Other Textile Products	1	0	68	15	47	22	8	162	13.9%
24	Lumber and Wood Products	153	243	324	341	432	336	184	2,013	8.8%
25	Furniture and Fixtures	87	5	78	33	173	68	26	471	12.7%
26	Paper and Allied Products	1,082	6,293	773	881	3,197	845	870	13,942	14.0%
27	Printing and Publishing	52	17	74	90	305	153	39	731	12.3%
28	Chemicals and Allied Products	942	7,556	6,813	994	4,219	1,409	1,255	23,188	16.1%
29	Petroleum and Coal Products	271	6,159	1,352	169	1,736	459	453	10,599	20.4%
30	Rubber and Misc. Plastics Products	113	1,851	813	411	1,498	435	303	5,424	14.8%
31	Leather and Leather Products	27	0	0	0	22	6	3	58	11.8%
32	Stone, Clay, and Glass Products	31	18	96	20	117	45	14	343	15.4%
33	Primary Metal Industries	738	1,537	2,150	1,085	3,199	983	749	10,441	11.9%
34	Fabricated Metal Products	34	181	303	80	298	195	46	1,137	15.6%
35	Industrial Machinery and Equipment	28	195	200	94	368	208	44	1,138	15.4%
36	Electronic and Other Electric Equipment	18	1,554	513	43	609	222	93	3,053	23.1%
37	Transportation Equipment	353	1,109	941	242	1,195	340	235	4,415	14.9%
38	Instruments and Related Products	71	119	123	78	263	169	39	862	13.3%
39	Misc. Manufacturing Industries									
	All Industry Groups	*4,330*	*28,681*	*15,524*	*5,259*	*19,799*	*6,786*	*4,778*	*85,157*	*14.8%*

In summary, the DOE (2002) study found that most of the potential for energy savings in pump systems is concentrated in eight industrial categories:

1. Food and Kind Products: 1,250 GWh/Year Potential Estimated Savings in Pump Systems
2. Paper and Allied Products: 6,292 GWh/Year Potential Estimated Savings in Pump Systems
3. Chemicals and Allied Products: 7,556 GWh/Year Potential Estimated Savings in Pump Systems

4. Petroleum and Coal Products: 6,159 GWh/Year Potential Estimated Savings in Pump Systems
5. Rubber and Misc Plastics Products: 1,851 GWh/Year Potential Estimated Savings in Pump Systems
6. Primary Metal Industries: 1,537 GWh/Year Potential Estimated Savings in Pump Systems
7. Electronic and Other Electric Equipment: 1,554 GWh/Year Potential Estimated Savings in Pump Systems
8. Transportation Equipment: 1,109 GWh/Year Potential Estimated Savings in Pump Systems

It is, however, clear from the previously cited studies and reports (from the DOE's RFI of June 13, 2011 and others) that the significant pump related opportunities for energy savings in these industries is from pump systems improvements – not from pump efficiency improvements or new pump efficiency standards or labeling schemes. Because these eight industrial sectors offer the greatest opportunity for improvements in efficiency, HI strongly recommends a pump systems approach that focuses on these sectors. This is consistent with the DOE's own program priorities, as detailed in Point Four below.

Focusing on cost-effective systems improvements in these eight sectors ensures the greatest pay-off for investments in energy savings. Again, as noted in our letter to the DOE dated July 11th , 2011, we would point out that the other major markets of water and wastewater are not mentioned and/or included in the comparison or the DOE RFI, but also represent significant energy savings opportunities through pump systems optimization.

Point Four: As part of DOE's Energy Efficiency and Renewable Energy organization, the DOE Industrial Technology Program has a well-established and diverse approach to energy efficiency and energy savings associated with systems optimization, including pumping systems. Extensive work, over a period of 20 years, as well as DOE staff effort/budget, has been devoted to these important initiatives. While DOE rule-making staff should be well aware of such initiatives, it is possible that on an inter-agency basis the overwhelming focus on DOE on systems approaches was not apparent, and we felt it important to call out this issue herein. DOE leadership in pump systems is well established, and this program engages the broader affiliated community of DOE laboratories, university based industrial assessment centers (IACs), state energy offices, electric power utilities and other stake-holders through partnerships (including the Hydraulic Institute as well as Pump Systems Matter).

The following summarizes just some of the significant efforts of DOE, of which the Hydraulic Institute is aware and has in some way been a part either directly or with our Pump Systems Matter organization, to help pump end-users increase energy savings and pump systems efficiency through pump systems optimization:

- The Hydraulic Institute, in 1993, signed onto the DOE's Motor Challenge Program as a Charter Sponsor – supporting initiatives associated with this program.
- The Hydraulic Institute, in 1996, under a grant from the DOE developed a video-based training program on "Seven Ways to Save Energy with Pumping Systems."

- During the period, 1998 – 2000, the Hydraulic Institute, Europump cooperated in writing a landmark guidebook on “Pump Life Cycle Costs: A Guide to LCC Analysis for Pumping Systems,” with DOE staff participating including authoring the Executive Summary which was subsequently co-branded between HI, Europump and DOE.
- The Hydraulic Institute, in 2000, signed an Allied Partner Agreement with the DOE’s Industrial Technology Program collaborating in multiple ways to promote pump systems energy efficiency, particularly through increased awareness, education and training in subsequent years.
- During the period, 2001 – 2005, the Hydraulic Institute and Europump cooperated in writing “Variable Speed Pumping: A Guide to Successful Applications” with DOE staff participating including authoring the Executive Summary which was subsequently co-branded between HI, Europump and DOE.
- DOE created a “Pumping System Assessment Tool,” know as PSAT, and an associated user and expert-level training program, to evaluate pumping systems for energy savings (in both dollars and energy savings) opportunities. The Hydraulic Institute cooperated in the review of the PSAT software tool, provided the data for pump efficiency predication and support education/training of pump OEMs and end-users in the use of the tool. Literally thousands of individuals have been trained in the use of the PSAT tool, contributing to identifying energy savings opportunities with pumping systems. As noted on the DOE Best Practices website: “PSAT helps users assess energy savings opportunities in pumping systems, relying on field measurements of flow rate, head, and either motor power or current to perform the assessment. Using algorithms from Hydraulic Institute standards and motor performance characteristics from DOE's MotorMaster+ database, PSAT quickly estimates existing pump and motor efficiency and calculates the potential energy and cost savings of a system optimized to work at peak efficiency.”
- The Hydraulic Institute staff and members contributed to the review and improvement of a DOE “Sourcebook for Industry on Pumping Systems.”
- The DOE ITP’s core initiatives, reported to HI members during an HI meeting in February 2007 by then DOE Program Manager Doug Kaempf, were to “provide tools and resources to foster success” of pump end-users such as: 1.) Resources to identify and implement cost-effective energy savings measures; 2.) Energy management best practices; 3.) Assessments of energy systems; 4.) Training and technical assistance, and 5.) Information on emerging technologies.
- According to a DOE study, during the period 2003 – 2006, PSAT contributed the following to the end-user pumping systems that were evaluated: 1.) Implemented: 1.6% annual energy costs; 2.) Identified: 3.6% annual energy costs; 3.) Implemented energy savings: 3.8 TBtu, and 4.) Implemented costs savings: $68 million. [*Source: ORNL Training and Software Tools Analysis, 2008*]
- According to DOE, during 2007 – 2008 pumping system assessments using the PSAT tool identified: $3.7 million pumping systems cost savings; over 266,000 MMBtu energy savings; 48,000 metric tons carbon dioxide emissions avoided which was the equivalent to taking 9,600 cars off the road each year [*Source: Doug Kaempf presentation to HI members, Feb., 2008*]
- Over the course of a number of years, the DOE EERE Industrial Technology Program (ITP) has published a series of “Tip Sheets” on ways that pumping systems can be optimized. These address such topics as 1.) systems analysis, 2.) adjustable speed pumping, 3.) control strategies, 4.) energy savings opportunities in control valves, 5.) matching pumps to system

requirements, 5.) optimizing parallel pumping systems, 6.) pump selection considerations, 7.) reducing pumping costs through optimum pipe sizing, 8.) selecting an energy efficiency centrifugal pump, 9.) test for pump systems efficiency, 10.) trim or replace impellers on over sized pumps, etc. For more details on individual DOE Tip Sheets see: http://www1.eere.energy.gov/industry/bestpractices/tip_sheets_pumps.html

- The DOE has worked closely with industrial end-users to demonstrate the benefits of Corporate Energy Management including assessing energy usage across a variety of systems, (including pumping systems), and creating pilot programs to review the applicability of new systems assessment and energy management standards.
- DOE has funded plant and systems assessments to demonstrate energy savings potential of systems improvements including, but not limited to: identifying opportunities, conducting energy audits and assessments, funding/implementing projects and monitoring/tracking progress.
- DOE's Industrial Assessment Center (IAC) database contains actual results of approximately 7,000 assessments conducted by the IACs. The database includes details such as fuel type, base plant energy consumption, and recommended energy-efficiency improvements, in addition to projected energy savings, cost savings, implementation cost, and simple payback.
- The DOE has worked closely with electric power utilities, partnering to engage them in pro-active programs to improve energy efficiency of industrial customers, and to engage them in the use of DOE systems tools, training and use of qualified specialists in their pumping systems energy reduction initiatives.
- The DOE has worked closely with state energy offices to fund energy efficiency programs and encouraged the adoption of the Superior Energy Performance program, with 19 states signing on in the first year in 1997.
- The DOE has worked aggressively on a worldwide basis to advocate for systems assessments and energy management standards. In 2007, the Hydraulic Institute appointed subject matter experts to work with DOE in the creation of a Pump Systems Assessment Standard, working through the American Society of Mechanical Engineers (ASME).
- In 2010, with the DOE's leadership and support, the American Society of Mechanical Engineers (ASME) published EA-2-2009, the "Energy Assessment of Pumping Systems" standard. This standard is in the process of being reviewed and adopted as an ISO standard, with the Hydraulic Institute playing a key role in representing interests of the United States.
- The Hydraulic Institute and Pump Systems Matter have created a series of webinars based on this standard (ANSI/ASME EA-2-2009), and have been actively promoting its use among end-users, with promotional support of the DOE with great success.
- In 2010 the Hydraulic Institute and Pump Systems Matter applied to become DOE ALLY organizations, in support of a new initiative yet to be formally launched by DOE in support of DOE's Save Energy Now program. As noted in the DOE flyer for this program: "Energy savings in industry can be achieved cost-effectively today using proven technology with economically attractive rates of return. As a result, industrial energy efficiency can contribute to energy cost savings and improved productivity while reducing the nation's carbon footprint and preserving jobs."
- In 2011, with the leadership and support of the DOE, and in cooperation with the American National Standards Institute (ANSI), ISO published the first global energy management standard, ISO 50001. HI and Pump Systems Matter have incorporated information on this

standard in our existing day-long course on “Pump Systems Optimization: Energy Efficiency and Bottom-Line Savings.”

- HI and Pump Systems Matter have been organizing and running day-long courses on “Pump Systems Optimization: Energy Efficiency and Bottom-Line Savings” since the fall of 2009, and have trained hundreds of pump users in energy efficiency improvements and energy savings using a systems approach.
- DOE is planning to introduce new personnel certification program, associated with energy management and systems standards. The program will be built around the ISO Energy Management standard (ISO 50001) and a series of four systems assessment standards (published by ANSI as ANSI/ASME Energy Assessment standards, including the pump systems assessment standard, ANSI/ASME EA-2-@)
- HI and Pump Systems Matter have met with DOE staff in 2011 about our organizational interest in expanding education/training capacity and roles in support of the anticipated DOE personnel certification program associated with pump systems assessment professionals.

DOE Energy Efficiency and Renewable Energy (EERE) and Industrial Technology Programs (ITP) organizations are clearly focused on systems approaches as being among the most productive industrial energy-saving and energy efficiency improvement opportunities in the United States. For twenty years the U.S. DOE has focused on systems approaches – and engaged stakeholders from virtually every segment of society where impacts of this effort could be leveraged. Sustaining and strengthening this effort will have the largest impact on the nation’s opportunities to save energy with pumping systems – not dealing with the discrete pump component as part of the system.

The Hydraulic Institute, over a period of eighteen years has been a partner with the U.S. DOE to advance these causes, as noted, serving as a Charter Partner of the Motor Challenge Program and subsequently as an Allied Partner of the DOE’s SEP or Superior Energy Performance program.

Clearly, as an industry group, HI and its pump OEM members have been at the forefront of efforts with the U.S. DOE to advocate for and advance energy efficiency improvements with pumping systems – where both DOE and HI agree the largest benefits and the quickest returns to the nation may be found.

Point Five: The DOE rule-making is a misguided effort in terms of the total energy savings to be achieved for our nation from improving the efficiency of pumps vs. working toward programs to optimize existing pumping systems and design new pumping systems with energy efficiency and life cycle cost approaches.

A systems approach will provide benefits that are ten or twenty-fold times the benefits of re-designing pumps to achieve minimal efficiency gains. DOE’s own studies (2002) confirmed this, and unequivocally state that “replacing a pump with the most efficient model, on the other hand, had a range of savings of 1 to 2 percent of system energy use” vs. potential savings of 20% to 40% by optimizing pumping systems as indicated in other studies.

The majority of the pumps sold in today’s market, based on years of hydraulic research and manufacturing advancements, are inherently efficient machines at converting or transferring mechanical energy, principally from electric motors, into fluid movement. Should manufacturers be required, under a new DOE pump efficiency rule-making, to re-design literally thousands of pump lines to increase efficiency by incremental (e.g. 1 or 2) percentages, there will be considerable burdensome costs to the pump manufacturing industry in the U.S., with little benefit to the nation, and with potential adverse consequences to the international competitiveness of these companies as well as to the employment base that they represent.

The Hydraulic Institute, as first noted in our letter of June 13, 2011, requests and reserves the right to meet with the DOE rule-making staff to explain and expand upon our positions more fully. We welcome a dialogue on this issue.

HI believes, as noted herein and in our previous letter, that with regard to a pump efficiency rule-making:

- DOE staff is focusing on the wrong issue, given the nature of pumps and how they work in a system. Clearly this is not understood by DOE rule-making staff or consulting organizations engaged to support DOE in this regard. The correct focus for improving energy efficiency of pumping in the United States is to focus on improving existing and new systems – with 20% to 40% energy savings possible. DOE EERE and ITP (e.g. Advanced Manufacturing Office) initiatives, papers, tools, case studies on pump systems optimization projects, advocacy efforts with industry, states, utilities and others as well as independent industry projects, have consistently demonstrated this point.
- Even if pump efficiency standards were adopted, without adequate education/training and/or systems standards (on which HI is currently working), engineering consulting organizations, pump end-users and others will continue to mis-apply, oversize, mis-use or fail to properly maintain pumps so that they don't operate at their designed Best Efficiency Point (BEP).
- Adoption of a pump efficiency standard will be substantially burdensome to the U.S. pump industry, and will add substantial cost, in the tens of millions of dollars, to re-designing and manufacturing of thousands of pump lines to achieve very small (1% - 2%) improvements in pump efficiency.

The Hydraulic Institute, and our Pump Systems Matter organization through expanded education and training efforts and other appropriate initiatives like tools, energy management and systems assessment standards, stand ready to assist DOE in strengthening pump systems efficiency and energy savings in ways that reduce America's dependence on foreign energy and improves the competitive posture of U.S. industry.

The Hydraulic Institute and our Pump Systems Matter organization are ready to engage further with DOE's Energy Efficiency and Renewable Energy program and Advanced Manufacturing Office to expand awareness, education and training initiatives to advance pump systems energy savings opportunities. It is clear to us, and also to the leadership of DOE's systems focused programs that such collaboration with non-profit organizations (like HI and Pump Systems Matter), industry and academic institutions make sense to maximize industrial systems efficiency transform markets to achieve the greatest energy savings possible

HI and PSM are also willing to engage in a meaningful discussion around the subject of pump systems standards which could serve as a basis of improving the performance of pumping systems, while achieving much more significant energy savings than would ever be possible by pump efficiency gains through pump efficiency standards, labeling requirements or associated and costly product re-designs.

HI has been a leader in the creation of pump test standards since its founding in 1917, and in our previous letter of July 11th th summarized our many initiatives in this regard. If there is a need for further consideration of changes to these standards, the Hydraulic Institute is willing to explore such discussions with the U.S. Department of Energy. HI is also willing to explore the subject of systems test standards, as a means of providing additional tools to pump users to strengthen energy savings based upon a systems approach.

On behalf of the Board of Directors of the Hydraulic Institute, we welcome further dialogue in this regard.

Sincerely,

Robert K. Asdal
Executive Director
Hydraulic Institute, Inc.
Pump Systems Matter, Inc.

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