
ASW ENGINEERING MANAGEMENT CONSULTANTS

April 13, 2011

To: Matt Evans, Pierre Landry, Rich Pulliam, and Cassie Cuaresma
SCE

From: Dennis Rowan, PE
Mark Hinrichs
ASW Engineering

Re: Investigations of Energy Efficiency Measures and Industry Standard Practice (ISP)
[Compressed Air RCx Project ISP-0011]

Dear Matt, Pierre, Richard, and Cassie

ASW recommends that SCE considers this project is an early replacement project that is, in parts, industry standard practice, and in other parts, not industry standard practice. While ASW recommends that SCE consider the VSD measure is not industry standard practice, ASW recommends that SCE consider the receiver measure and supply line sizing measure to be industry standard practice.

Additionally, it was requested that compressor sequencing controls and cycling refrigerated dryer technologies be investigated as to the ISP issue. A telephone survey was conducted. This survey resulted in ASW's recommendation that SCE consider compressor sequencing controls to be industry standard practice, and that cycling refrigerated dryers should only be considered ISP on systems with flows greater than 200 ACFM.

PROJECT DISCUSSION

The Plant was operating multiple compressors, one large and two smaller compressors. The present system without an adequate storage capacity was operating in a very unsteady state with significant artificial air demand, and consequent unnecessary kW demands. The first order of priority was to create storage to avoid these fluctuations. A properly sized receiver was recommended for the system. The study indicates that air-flow data showed wide fluctuations in the baseline flow rate due to absence of a receiver in the system. At baseline conditions, the maximum air flow for the system was between 1000 and 1030 CFM. According to the Retro-commissioning study, with an adequate storage tank, the maximum flow would be, "anybody's guess".

The ideal system under the system conditions would consist of two operating compressors, with a "base-load" compressor and a "trim" compressor. The present large compressor would operate as the Base-load compressor. One of the present smaller compressors could be taken out and replaced by a new VSD compressor of equal size to the large compressor. This compressor will act as the "trim" compressor. The remaining smaller compressor could be left at its place for stand-by purposes.

The supply line (outer line) supplying the plant is a 2 ½ inch line. This is too constraining for the air demand on this line. At the present maximum flow conditions the pressure drop for a 1000 foot length of the 2 ½ inch line is estimated at about 14 psi. Design factor for similar systems is 1 psi pressure drop. To achieve that, the study recommends a 4 inch line. The study recommends that the facility address this issue.

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METHODOLOGY

The Plant was contacted to find out the thought process in selecting a VSD compressed air system with a receiver. A representative stated that the general decision to go with this particular system was due to the aging existing system in combination with the energy savings that the new compressed air system will provide. The existing system does not have a receiver and one of the compressors is nearing the end of its useful life. The system typically runs at 20% lower capacity during the night shift, which is why a VSD compressor seems like a good idea. In addition, he stated that the facility would most likely purchase a new receiver and VSD compressor in the absence of a utility-sponsored incentive due to the plant schedule and new compressed air system efficiency.

A local compressed air system supplier and facility auditor, was contacted. The respondent indicated that a compressed air system with a receiver tank is standard practice for industrial applications. In addition, when a new system is installed, the customer installs a VSD compressor 90% of the time due to the current utility incentive. In his opinion, there is excessive paperwork in obtaining the incentive from the utility; however, the payback for the customer is between 1 to 3 years with the incentive. The conversation indicated that a VSD compressor is selected due to the incentive.

A website that provides resources for plant maintenance professionals, including best practices, white papers, and training was researched. An article titled "A Critical Look at Variable-Speed-Drive Air Compressors" featured on the website specifically addresses the issues associated with the choice between a constant speed drive compressor and a VSD compressor in relation to compressed air systems. The author, Chris Beals, president of Air System Management, Inc. indicates that a variable-speed-drive (VSD) used in compressed air systems may provide the same annual energy costs when compared to using conventional, appropriately sized, constant speed compressors. In addition, the VSD system will have a higher capital cost. The article generally states that a VSD compressor may be a good option in a situation where a "trim" compressor is needed and a conventional constant speed compressor will be operating below 80% of its capacity. Although there might be annual energy savings attributed to the system with a VSD compressor, the actual payback may be excessive due to the high capital costs of the VSD technology.

ASW Engineering spoke with the principal of a compressed air system sales and service company, who stated that a VSD compressor is not the industry standard, however, a receiver tank is considered a standard practice. Most plants using a compressed air system operate with constant speed compressor with on/off capability. He stated that installing a VSD compressor might be a good idea at the plant due to the reduction in production throughout the evening hours, however, installing a VSD is not considered standard practice for all applications.

The compressor sequencing control option implied by the addition of a trim compressor was evaluated by the use of a telephone survey, as was the option of cycling refrigerated dryers. This survey contained pointed and directed questions specifically designed to query industry experts as to their perceptions regarding industry standard practice as it implies to the measures under investigation.

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We will need to examine the parts of this project individually:

First ASW presents the following matrix of factors for your consideration regarding the Compressed Air RCx Project: (VSD Option)

Table 1: Factors indicating Industry Standard Practice / Free Ridership

Factors Indicating Industry Standard Practice / Free Ridership	Significance (1 – 3) 1=low, 3=high	Significance Explanation
Trim compressors are not new technology and they are known to reduce energy industry wide	1	Although the technology is widely accepted as valid, the application is not global
Any system that drops below 80% load for the trim compressor can save with a VSD compressor	2	These systems are common and their nighttime loads use a lot of energy that can be saved with the VSD option

Table 2: Factors indicating Non-Industry Standard Practice / Not Free Ridership

Factors Indicating Non-Industry Standard Practice / Not Free Ridership	Significance (1 – 3) 1=low, 3=high	Significance Explanation
These VSD units do not fit every application and cannot be described as industry standard practice	3	Systems with steady predictable loads do not benefit from VSDs and so their application is not absolute
Many applications require the incentives to make the VSD payback in a reasonably attractive timeframe	2	Without the incentive, the VSD installation costs are often high enough to deter the installation since their incremental benefit is not always enough to support their installation without the incentive
A properly sized conventional compressor can deliver the same energy consumption as a VSD compressor in many installations	1	These systems are operating with high duty cycles and do not typically drop below 80%

The factors in Table 2 indicating the VSD Option of the project is Not Industry Standard Practice (ISP) outweigh the factors in Table 1 indicating VSD Option of the project is Industry Standard Practice. The primary consideration being that there are many instances where the operational efficiency in the absence of the VSD is a close enough match to the VSD that the VSD is not chosen. Furthermore, this technology often requires incentives to be implemented in these types of facilities. The customers are not always going to opt for the VSD in the absence of the incentives.

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Next ASW presents the following matrix of factors for your consideration regarding the Compressed Air RCx Project: (Receiver Option)

Table 3: Factors indicating Industry Standard Practice / Free Ridership

Factors Indicating Industry Standard Practice / Free Ridership	Significance (1 – 3) 1=low, 3=high	Significance Explanation
Typical air system installations include a receiver as part of their standard installation package	3	Experts agree that these systems include this option as standard practice.
These receivers eliminate the artificial loads that cause the excess energy use at these plants	2	Not having this option invites extreme fluctuations and higher energy costs

Table 4: Factors indicating Non-Industry Standard Practice / Not Free Ridership

Factors Indicating Non-Industry Standard Practice / Not Free Ridership	Significance (1 – 3) 1=low, 3=high	Significance Explanation
Not all systems have these and we need to motivate customers to upgrade to them	1	This might apply to a small subset of the population

The factors in Table 3 indicating the Receiver Option of the project is Industry Standard Practice (ISP) outweigh the factors in Table 4 indicating Receiver Option of the project is not Industry Standard Practice. The primary consideration being that this technology is the standard and does not require incentives to be implemented in these types of facilities. These artificial loads are widely recognized as transient and these receivers are known to be the tools to remove them from the systems.

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Next ASW presents the following matrix of factors for your consideration regarding the Compressed Air RCx Project: (Supply Line Diameter Increase)

Table 5: Factors indicating Industry Standard Practice / Free Ridership

Factors Indicating Industry Standard Practice / Free Ridership	Significance (1 – 3) 1=low, 3=high	Significance Explanation
Proper sizing of supply lines is common practice in today's market	2	Unnecessary losses are typically addressed as part of standard practice
Any planned work on the system would address any deficiencies with the main supply line	2	There would not be a complete overhaul of the plant that ignored this simple fix

Table 6: Factors indicating Non-Industry Standard Practice / Not Free Ridership

Factors Indicating Non-Industry Standard Practice / Not Free Ridership	Significance (1 – 3) 1=low, 3=high	Significance Explanation
Typical operations stick with what they have and do not upgrade supply lines unless they are serious bottlenecks to production	2	There is an adage in the industry, "If it isn't broken, don't fix it"

The factors in Table 5 indicating the Supply Line Diameter Increase Option of the project is Industry Standard Practice (ISP) outweigh the factors in Table 6 indicating the Supply Line Diameter Increase Option of the project is Not Industry Standard Practice. The primary consideration being that the proper sizing of supply lines is the standard of construction for today's systems. While this may have been different in past markets when energy was not as much of a consideration, in today's market, unnecessary system losses are avoided through proper system design. Such upgrades to existing system deficiencies most commonly accompany system upgrades such as the VSD and receiver additions proposed in this study.

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The following discussion centers on compressor sequencing controls as these type of controls are implied when a trim compressor is connected as part of the air compression plant. A telephone survey was conducted and the following question was asked:

Would you consider that installing sequencing controls in a multiple compressor system retrofit project should be considered as an industry standard practice?

ASW presents the following matrix of factors for your consideration regarding the Compressed Air RCx Project: (Sequencing Controls Option)

Table 7: Factors indicating Industry Standard Practice / Free Ridership

Factors Indicating Industry Standard Practice / Free Ridership	Significance (1 – 6) 1=low, 6=high	Significance Explanation
Sequencing controls are easy to install, off the shelf components	3	Three contacts indicated ease of installation
EMS integration of these controls requires only standard programming protocols.	2	Two contacts indicated ease of programming
This is a common control measure	2	Two contacts indicated that this measure is common.
Good return on investment	2	Two contacts indicated good returns are expected.

Table 8: Factors indicating Non-Industry Standard Practice / Not Free Ridership

Factors Indicating Non-Industry Standard Practice / Not Free Ridership	Significance (1 – 3) 1=low, 3=high	Significance Explanation
Technology is expensive	1	One contact indicated that these controls are expensive to implement
Installation can be difficult	1	One contact indicated that these controls can be difficult to implement on some systems

The factors in Table 7 indicating the Sequencing Controls Option of the project is Industry Standard Practice (ISP) outweigh the factors in Table 8 indicating this option of the project is not Industry Standard Practice. The common viewpoint of the respondents was found to be in favor of considering that this technology is the standard and should not require incentives to promote implementation in these types of facilities.

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The following discussion centers on cycling refrigerated air dryers in conjunction with this project. A telephone survey was conducted and the following question was asked:

Would you consider that installing a cycling refrigerated air dryer in a retrofit project should be considered as an industry standard practice?

ASW presents the following matrix of factors for your consideration regarding the Compressed Air RCx Project: (Cycling Refrigerated Dryer Option)

Table 9: Factors indicating Industry Standard Practice / Free Ridership

Factors Indicating Industry Standard Practice / Free Ridership	Significance (1 – 3) 1=low, 3=high	Significance Explanation
ISP applies when considering plants over 200 CFM	3	Four respondents indicated this viewpoint.

Table 10: Factors indicating Non-Industry Standard Practice / Not Free Ridership

Factors Indicating Non-Industry Standard Practice / Not Free Ridership	Significance (1 – 3) 1=low, 3=high	Significance Explanation
Best practice is to size the dryer for maximum load and use hot gas bypass when needed.	1	One respondent indicated this viewpoint.
Too expensive	1	One respondent indicated this viewpoint

The factors in Table 9 indicating the Cycling Refrigerated Dryer Option of the project is Industry Standard Practice (ISP) outweigh the factors in Table 10 indicating this option of the project is not ISP. The common viewpoint of the respondents was found to be in favor of considering that this technology is the standard for larger systems (greater than 200 ACFM) and should not require incentives to promote implementation in those facilities, but these same respondents also consider that the Option is not ISP when applied to smaller air compression plants.

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CONCLUSIONS

- Early or Normal Replacement
 - ASW recommends that SCE consider all aspects of this project as early replacement since the units that are being replaced are functioning and would continue to operate for at least a year.

- Industry Standard Practice / Free Ridership
 - ASW recommends that SCE considers that the VSD option of the project is not industry standard practice. There are many instances where the operational efficiency of a properly sized system, in the absence of the VSD, is equal to that of a system with a VSD. The VSD is more applicable to systems with substantial load variability.
 - ASW recommends that SCE considers that the receiver option of the project is industry standard practice since this technology does not require incentives to be implemented.
 - ASW recommends that SCE considers that the supply line diameter increase option of the project is industry standard practice since proper sizing of supply lines is the standard of construction for today's systems.
 - ASW recommends that SCE considers that the sequencing controls option of the project is industry standard practice since a significant majority of the survey respondents indicated that they consider the technology to be industry standard practice.
 - ASW recommends that SCE considers that the cycling refrigerated dryer option of the project is industry standard practice for systems greater than 200 ACFM. ASW also recommends that SCE considers that the cycling refrigerated dryer option of the project is not industry standard practice for systems greater than 200 ACFM. The common viewpoint of the respondents was found to be in favor of considering that this technology is the standard for larger systems (greater than 200 ACFM) and should not require incentives to promote implementation in those facilities, but these same respondents also consider that the Option is not ISP when applied to smaller air compression plants.

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