Cable Pressurization Labor Efficiency Indicator and System Quality Index

Critical Management Questions

Effective management of labor hours dedicated to a cable pressurization program is one of the most difficult tasks that an outside plant manager faces. The major problem is that there is no data available on which to base decisions and, without proper data, it is impossible to answer critical management questions, such as:

1) How do I size my work force? Do I have too many or too few people working in pressurization?

2) Are the technicians working efficiently? Is one office goldplated at the expense of another?

3) Are labor hours high as a result of goldplating or inefficient dispatching?

4) What type of savings can be expected if the system is managed at maximum effectiveness?

5) If the work force were reduced by 20 percent, what would be the impact of this reduction on the quality of cable protection?

The only way that these and similar questions can be answered is by accumulating accurate pressure and flow data, and using the data for tracking both the quality of cable protection and the efficiency of cable maintenance efforts.

Tracking System Quality and Labor Efficiency

The SQI and LEI

The System Quality Index (SQI) and Labor Efficiency Indicator (LEI) have been developed to answer important questions concerning the management of a pressurization system. The SQI gives an accurate picture of the quality of cable protection, as well as any trends that might be developing within the system. The LEI shows both the labor hours being spent in a system and the quality of cable protection being maintained.

System Quality Index

The Basis of the SQI Equation

It is of prime importance that the SQI be an accurate representation of the true pressure condition in the field. That is why the measurement is based upon minimum standard cable pressures and air flow per sheath mile of cable. The SQI can be improved by increasing cable pressure or reducing air consumption. The equation on which the SQI is based (Figure 1) uses the following minimum pressure and flow requirements:

Underground pressure transducers	5 Pounds per Square Inch (PSI)
Buried pressure transducers	3 PSI
Aerial pressure	2 PSI
Air Flow	30 Standard Cubic Feet per Day (SCFD) per sheath mile of 1.25 Standard Cubic Feet per Hour (SCFH)

These standards may be modified to meet area or local requirements.

The optimum SQI rating achieved by inserting the pressure and flow requirements in the equation in Figure 1 is 90. A rating below 90 is substandard; one above 90 is goldplating.

$$100 - \left(10 \left[\frac{\dfrac{\text{Total Flow of Office (SCFD)}}{\text{30 SCFD X Pressurized Sheath Miles}}}{\dfrac{\dfrac{\text{Total of All Aerial Pressure Transducer Readings}}{\text{2 PSI (Aerial Pressure Standard)}} + \dfrac{\text{Total of All Buried Pressure Transducer Readings}}{\text{3 PSI (Buried Pressure Standard)}} + \dfrac{\text{Total of All Underground Pressure Transducer Readings}}{\text{5 PSI (Underground Pressure Standard)}}}{\text{Aerial Count + Buried Count + Underground Count}}} \right] \right)$$

Figure 1—System Quality Index Equation

Determining Factors for the SQI

The SQI will change as the pressure and flow readings increase or decrease. It is important to note that an office with all pressure transducers meeting minimum pressure standards may have a low rating because of a high flow per sheath mile.

Month to month changes in the SQI are monitored in conjunction with the measuring of labor hour efficiency. For example, reducing maintenance hours on pressurization may look good initially, but it may not be in the long run if the system is severely degraded. The end result could be a massive number of hours required in the future to bring the system back to standard.

Labor Efficiency Indicator

The Basis of the LEI Equation

There are two input values required before the efficiency of a work force can be calculated: the amount of work being accomplished, and the amount of labor hours being invested. The SQI indicates the quality of the pressure system (the work being completed). The second requirement is to compute the total hours spent on cable maintenance.

Research proves that counting the number of pressurized sheath miles is the best method of projecting the number of labor hours required to maintain a cable pressurization system. It is determined that 0.7 labor hours is the per month requirement to maintain each sheath mile of cable. For example: a wire center with 100 sheath miles would require 70 hours of cable pressurization maintenance per month, and an office twice as large would require twice the hours.

> ***Note:*** The calculated labor hours for a wire center include dryer and monitoring system maintenance (i.e. all hours associated with cable pressurization for that wire center).

The LEI equation, shown in Figure 2, aims to motivate managers to achieve maximum effectiveness from cable pressurization technicians, at minimum cost. The LEI is based on the following:

1) **System Quality Index** (90 is standard)

2) **Labor rate** of $68.00 per hour (This rate can be changed to local rates.)

3) **Optimum labor hours** dedicated to the pressurization system (This figure is 0.7 labor hours per sheath mile per month and may also be modified.)

4) **Number of hours dedicated** to cable pressurization per sheath mile per month.

$$\underbrace{\left(\begin{array}{c}90 - SQI\\ \text{See Note}\end{array}\right)}_{\mathbf{X}} + \underbrace{\left(\left[\frac{TLH}{OSM} - .7\right] \times LR\right)}_{\mathbf{Y}} = LEI$$

Note: This "X" value is always positive

SQI	=	System Quality Indicator
TLH	=	Total Labor Hours
OSM	=	Office Sheath Miles
LR	=	Labor Rate
LEI	=	Labor Efficiency Indicator

Figure 2—LEI Equation

Performing an LEI Calculation

Following is the procedure for calculating the LEI:

Step 1 Calculate the difference between the SQI and the standard of 90. The result of the calculation (referred to as *X*) will always be a positive number. If the actual SQI is higher than 90, for example, subtract 90 from the larger number to obtain the X value. If the opposite is true, subtract the actual SQI number from 90.

Example: A district's SQI is 93. The X value for this district is 3. Example: A district's SQI is 83. The X value for this district is 7.

Step 2 Calculate the differences between labor hours spent per sheath mile per month and the optimum value of 0.7. This can be a negative number. Multiply the difference between the two by the labor rate ($68.00 per hour). This number will be referred to as *Y*.

Example: A district uses 0.9 labor hours per sheath mile.

0.9 - 0.7 = 0.2
0.2 x 68. = 13.6
Y = 13.6

The LEI will be as follows:

X + Y = LEI

The LEI standard is 0.0. A LEI above 0.0 is substandard.

Determining Factors for the LEI

As can be seen from the previous procedures, there are four variables that determine the LEI. Each one affects the LEI as follows:

1) System Quality Index

The optimum SQI is 90. The LEI equation perceives both a goldplated and substandard system as unsatisfactory. A SQI above 90 indicates that labor hours are being used inefficiently in an office that is already above standard.

2) **Labor Rate**

The LEI equation uses the labor rate to calculate technician efficiency. The assumption is made that with a rate increase, a corresponding increase in productivity per labor hour should occur. For example, if the labor rate goes up but the SQI stays the same, the LEI will increase. This indicates that technician productivity has decreased.

3) **Optimum Labor Hours**

The optimum number of labor hours per sheath mile per month (0.7) is an adjustable value. The value 0.7 has proven to be the best benchmark with which to begin.

4) **Dedicated Hours**

Dedicated hours is the most critical input value for the formula, and it has the biggest impact on the LEI. Complete accuracy is required when computing the total hours spent on cable pressurization per month.

Below are some LEI calculation examples.

LEI Examples

Example 1:

A district has an SQI of 95 (indicating goldplating), and it is using 0.9 labor hours per sheath mile. The LEI for this district would be 18.6. In this case, the LEI would drive the manager to reduce labor hours by letting the SQI drop to 90.

Example 2:

A district has an SQI of 80 and is using 0.5 labor hours per pressurized sheath mile. The LEI for this district would be -3.6. The LEI would drive the manager to invest more labor hours to bring the SQI up to 90.

Example 3:

A district has an SQI of 83 and is using 1.3 labor hours per pressurized sheath mile per month. The main problem with this district is the inefficiency of labor hours. This could be the result of poor dispatching, inefficient leak locating, or inadequate engineering. The LEI for this district would be 47.8.

Information generated by the SQI and LEI is listed on the LEI Calculation Worksheet (see Figure 3). The worksheet contains the following:

Labor Efficiency Indicator Calculation Worksheet

1) District or Force Group. This designation can represent district, area, foreman, etc.

2) Date, month, and year.

3) Standards. These are the standards by which the LEI is computed. This designation includes minimum pressure standards and flow rates, the existing labor rate, the SQI standard, and the optimum number of hours dedicated to air pressure per month.

4) Wire Center. Name of central office or wire center.

5) Sheath Miles. Total number of pressurized sheath miles in the office.

6) Hours Worked. Total number of hours spent on cable pressurization per wire center for the month.

7) Hours/Sheath Mile. Total number of hours dedicated to cable pressurization per sheath mile per month. It can be compared to the optimum labor hours per sheath mile per month (0.7) in the “Standards” section.

8) Dollars per Sheath Mile. Total dollars spent on cable pressurization maintenance per sheath mile per month. The optimum expenditure can be determined by multiplying optimum labor hours (0.7) by the current labor rate ($68.00).

9) System Quality Indicator. The optimum SQI is 90.

10) Labor Efficiency Indicator. This number is based upon a SQI of 90 and a labor hour per sheath mile per month standard of 0.7.

11) Summary. This line lists totals and averages for the figures in Columns 5 through 10. The figures in Columns 5 and 6 indicate district totals for the specified month. Summary Columns 7 through 10 list worksheet averages. These averages are weighted by sheath mileage so that accurate comparisons can be made from one district to the next.

Analysis

The offices in Figure 3 have been ranked by LEI from worst to best. It is possible to determine the cause of high LEIs in central offices by analyzing Columns 5 through 9. In most cases, the direct cause of a high LEI can be attributed to the number of hours dedicated to pressurization maintenance. It is important to note that maintenance hours per sheath mile might be higher for smaller offices due to greater travel, or windshield, time.

It also must be mentioned that the standard of 0.7 maintenance hours per sheath mile per month was established only after considerable analysis and adjustment. It has since proven to be a generally acceptable standard for measurement. One of the most important functions it serves is providing a target or goal for labor hour reduction efforts. The 0.7 standard does serve an important purpose because it acts as a target for everyone to aim at.

1 5

DISTRICT: CENTRAL DATE: DEC. 92

SYSTEM QUALITY AND LABOR EFFICIENCY INDICATOR
CALCULATION WORKSHEET

DEVELOPED BY SYSTEM STUDIES INCORPORATED
RELEASE 1.0 (PB)

2

STANDARDS

AERIAL TRANSDUCERS	2.0	S.Q.I. STANDARD	90.0
BURIED TRANSDUCERS	3.0	OPTIMUM LABOR/SH. MI.	0.7
UG TRANSDUCERS	5.0	LABOR RATE PER HOUR	$68.00
FLOW/SHEATH MILE	30.00	OPTIMUM DOLLAR/SH.MI	$47.60

3 WIRE CENTER	4 SHEATH MILES	6 HOURS WORKED	7 HOURS/ SH.MI.	8 $$$/ SH.MI.	9 S.Q.I.	10 L.E.I.
OFFICE 1	32.0	97.0	3.0	$206.13	71.00	248.53
OFFICE 2	283.0	727.0	2.6	$174.69	80.00	217.09
OFFICE 3	72.0	57.0	0.8	$53.83	73.00	96.23
OFFICE 4	73.0	57.0	0.8	$53.10	73.00	95.50
OFFICE 5	53.0	30.5	0.6	$39.13	85.00	81.53
OFFICE 6	56.0	0.0	0.0	$0.00	78.00	42.40
	0.0	0.0	0.0	$0.00	0.00	0.00
	0.0	0.0	0.0	$0.00	0.00	0.00
	0.0	0.0	0.0	$0.00	0.00	0.00
	0.0	0.0	0.0	$0.00	0.00	0.00
	0.0	0.0	0.0	$0.00	0.00	0.00
	0.0	0.0	0.0	$0.00	0.00	0.00
	0.0	0.0	0.0	$0.00	0.00	0.00
	0.0	0.0	0.0	$0.00	0.00	0.00
	0.0	0.0	0.0	$0.00	0.00	0.00
	0.0	0.0	0.0	$0.00	0.00	0.00
SUMMARY 11	569	968.50	1.7	$115.74	78.0	158.14

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Figure 3—SQI/LEI Worksheet