



**MOUNT VERNON FR**

Mount Vernon FR

# Understanding the Challenges of Selecting and Managing an Effective Flame Resistant Clothing (FRC) Program

A white paper for users of FRC

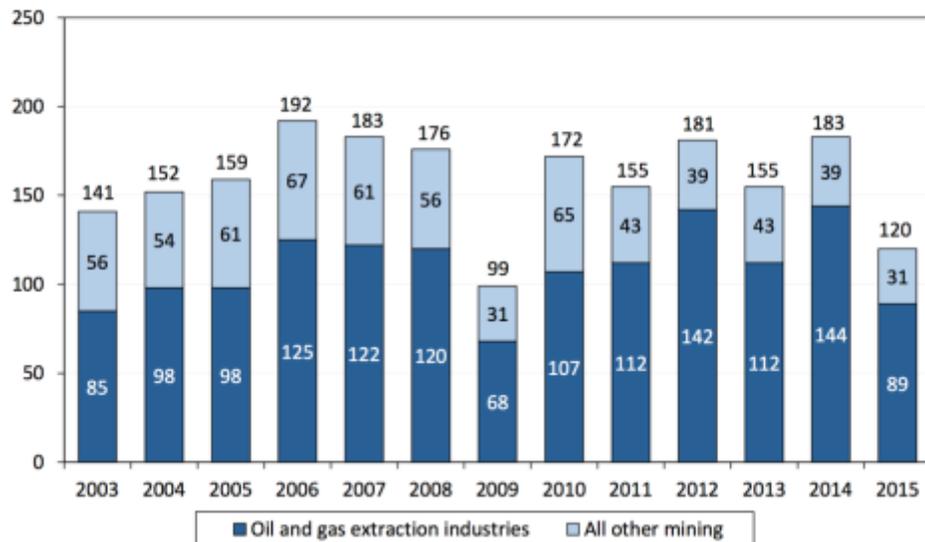
Developed in conjunction with the American Society of Safety Engineers  
June 2017

## Executive Summary

Selecting and managing an effective company-wide flame resistant clothing (FRC) program is a challenging task for Environmental, Health and Safety (EHS) professionals – the costs are high, and the risks and potential for injury are great.

There have been 1,141 fatal occupational injuries in the oil and gas extraction industries, which include oil and gas extraction, drilling oil and gas wells, and support functions for oil and gas operations, over the past 10 years. This industry sector represented nearly 2.5% of the total 49,515 fatal work injuries reported over the past 10 years.

**Fatal occupational injuries in the private sector mining, quarrying, and oil and gas extraction industry, 2003–15**



1,141

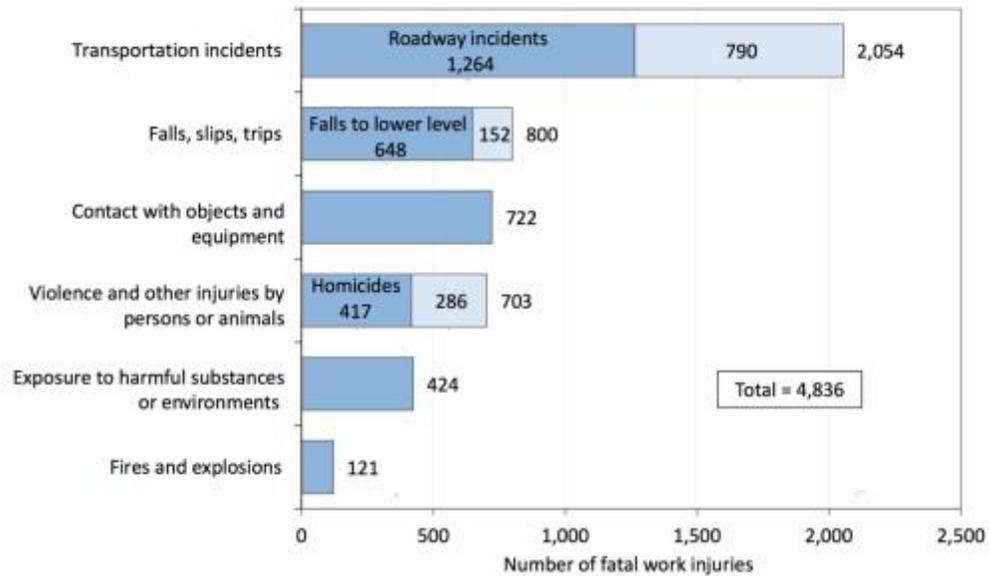
The number of fatal occupational injuries in the oil and gas extraction industries over the past 10 years

The mining, quarrying and oil and gas extraction industry has one of the highest fatal work injury rates, which in 2015 was 11.4 fatal work injuries per 100,000 full-time equivalent workers. Only the agriculture, forestry, fishing and hunting industry and transportation and warehousing industry have higher fatal work injury rates, which were 22.8 and 13.8, respectively.

By comparison, the fatal work injury rate for the utilities industry in 2015 was 2.2 fatal work injuries per 100,000 full-time equivalent workers.

Fatalities caused by fires and explosions across all industries accounted for 121 occupational fatalities in 2015, which is 2.5% of the 4,836 total.

Fatal occupational injuries by major event, 2015



The latest study from Global Market Insights, Inc. underscores the importance of selecting a proper flame resistant clothing program, highlighting that the global industrial protective clothing market is expected to grow to more than \$14.4 billion by 2023. The growing number of flame resistant clothing options available in the market offer greater choice than ever before, but also complicate the evaluation process as managers search for flame resistant clothing that combines a high level of protection with both durability and comfort.

*Global industrial protective clothing market is expected to grow to more than \$14.4 billion by 2023.*

The purpose of this white paper is to help EHS managers navigate the plethora of choices that must be made in selecting and managing their FRC programs. This white

paper will also summarize research conducted by Mount Vernon FR in conjunction with the American Society of Safety Engineers (ASSE), with the purpose of ensuring that the voice of the customer – the EHS professional and the workers they serve – is heard throughout the industry to improve FRC programs and provide a greater number of workers with a greater level of safety.

## Selecting Proper FRC – Understanding Durability Factors

As the number of industries requiring flame resistant clothing continues to grow, EHS managers hold significant responsibility in selecting the proper flame resistant clothing that accommodates their employees' needs. The research conducted by Mount Vernon FR found that one of the greatest challenges professionals experience is the need for more durable flame resistant clothing to help their companies effectively manage program costs while ensuring worker safety. When considering this, it is important to understand that fabric and garment durability can have very different meanings, and they are evaluated by a range of methods.

Increasing your knowledge of these topics will help you in the selection of durable protective garments. It is important that environmental, health and safety professionals invest in flame resistant clothing programs that focus on durability in order to better protect their employees, take full advantage of the lifetime of a flame resistant garment, and reduce replacement costs.

There are a multitude of factors that can affect the durability of flame resistant fabrics and garments. Some of these may include:

- Fiber blend – Consider what fibers make up the fabric and garment. Fibers such as nylon, Tencel or Kevlar can give fabrics more resistance to abrasion, higher tear strength and increased durability. Absorbent fibers like cotton or Tencel promote comfort and moisture management.

- Fabric construction – Determine how the fabric is constructed. Single details of fabric construction will influence certain properties. For example, a twill weave may be more durable than a plain weave; higher threads per inch may have higher tensile strength, but lower threads per inch may have higher tear strength. The combination of weave, yarn count (or yarn size), threads per inch and fabric weight all play a role in determining a fabric’s ultimate durability.
- Garment construction – Examine how the garment is assembled. While no single attribute should be considered the one determining factor for durability, garment construction details like seam type, garment design, fit and features all can impact and contribute to durability.

To gain further insight into the durability of flame resistant fabrics and garments, multiple aspects and tests should be considered. They can be categorized into two primary groupings: appearance and functionality.

Functionality involves abrasion resistance, tear strength and flame resistance, while appearance includes colorfastness to laundering and light, among others.

- Abrasion resistance is the ability of a fabric to resist surface wear caused by rubbing contact with another material. There are several test methods used to measure abrasion resistance; among the most common are flexing and abrasion, Taber abrasion and Martindale abrasion. Each of these methods require different test equipment and can be useful for comparing fabric performance, but results can vary significantly between labs or even in the same lab over time. It is important that the fabrics be run on the same tester in the same test session to achieve an accurate and valid comparison.
- Tear strength is the resistance of a fabric against tearing or force required to propagate the tear once it is initiated. Fabrics with low tear strength will usually have a shortened service life. Garments made from fabrics with good

tear strength may outlast similar garments with higher tensile strength.

- The most important aspect of durability for a protective garment is the flame resistance. Industry standards like NFPA 2112 and ASTM F1506 include flammability durability requirements as determined by ASTM test method D6413. NFPA 2112 is the more strenuous standard requiring fabrics to have a char length of no more than 100 mm (4 inches) and after-flame of 2 seconds or less before and after 100 industrial wash and dry cycles. These requirements must be met.

Appearance can include pilling, edge abrasion, and colorfastness to laundering, crocking and light. While protection is always the number one priority, durability of the appearance of flame resistant garments can also be important. Certain companies may place greater emphasis on appearance; these are commonly organizations with employees that interact with the public, whose image may be more on display. Because employees are a representation of a company, it's important that their appearance is consistent with the organization's reputation; and when a garment becomes faded or shows signs of wear, it detracts from the appearance. Test methods have been developed to evaluate and standardize these properties as well.

## **Decoding Comfort of Flame Resistant Clothing**

Finding the right flame resistant garment that will satisfy your workforce requires working with fabric and garment manufacturers to find the best combination of fiber blend, fabric construction and weight for your application. Your goal should be to find flame resistant clothing that strikes your ideal balance of comfort, durability and protection without any tradeoffs.

In the past few years, we've seen an increased focus on comfort and its role in  
improving

overall satisfaction levels for FRC. According to Mount Vernon FR research respondents, weight (only 35.6 percent satisfied) and breathability (26.4 percent satisfied) have some of the lowest levels of satisfaction when it comes to flame resistant fabric, so we'll focus on these two aspects.

Lighter weight garments are often requested by people in the search for FRC because lighter weight may mean it is more comfortable, especially in hotter climates or conditions. This may not always be the case, however. A plastic bag is a helpful analogy to explain this key misnomer: a plastic bag is certainly lightweight, but probably not very comfortable to wear. So, fabric weight alone is not enough to deliver comfort to the wearer.

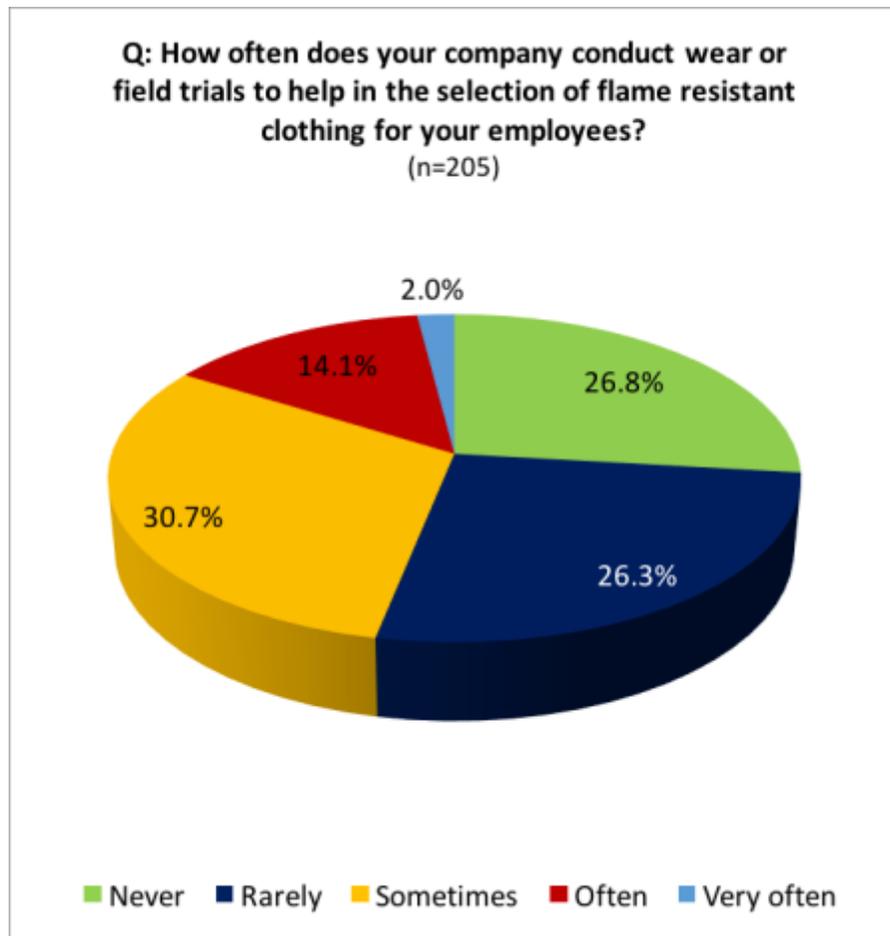
'Breathability' is another highly sought-after 'property', and it is a term that often shows up in promotional literature, but it is hard to define. Common usage seems to combine air permeability, moisture management and absorbency into a single word. Unfortunately, there is no real test or value that can accurately be called breathability. Air permeability is sometimes promoted as measuring breathability, but that is only part of the comfort equation. Let's go back to our plastic bag analogy, but this time, think of a plastic bag with holes punched out; it may have high air permeability, but it would never be considered comfortable. Just as with fabric weight, breathability alone does not necessarily equal comfort.

Safety managers want comfortable FR fabrics for their workforce, but as the two earlier examples demonstrate, quantitative measurements don't always tell the whole story. Garments are exposed to a combination of wear factors that may not be accurately replicated in a lab. The perception of comfort is likely determined by a combination of personal preference, environment, fit and aesthetics. This is where a wear trial fits into the picture; the best way to determine the optimal flame resistant fabric and garment is through a properly executed wear trial.

## The Important Role of Wear Trials

Laboratory tests can produce results for specific properties, but garments see a variety of wear factors that cannot be duplicated in the laboratory. New fabrics or garment designs need to be evaluated by end users on the job, through a properly executed wear trial. Wear trials can help guide you in selecting the right fabric by providing a more comprehensive evaluation of important factors such as performance, comfort and applicability.

Mount Vernon FR and ASSE's study found that just 16 percent of 243 EHS respondents said their company conducts wear trials often or very frequently.



Only 16% of responding companies say they conduct wear trials often or very often

With the total estimated expenditure for FRC by the responding companies reaching approximately \$215 million, a significant investment is being made without much data to support it. This fact emphasizes the need to test new fabrics or garment designs through a properly executed wear trial by end users on the job, prior to investing in an entire FRC program. When done correctly, wear trials offer guidance in selection of the right fabric and garment by providing a more comprehensive evaluation of important factors such as performance and comfort.

When it comes to a wear trial, the results are only as good as the methodology followed. Employers should adhere to a series of best practices in order to conduct a proper wear trial and to gain the most accurate and comprehensive results. This will help EHS professionals invest in flame resistant clothing programs that are an optimal fit for the needs of their employees. The following best practices should be considered when conducting a wear trial in order to ensure the best results:

- Keep it simple – limit the number of fabrics and/or garment styles to minimize confusion.
- Wear trials can be challenging to manage. Participants need to follow the guidelines and give all garments a fair evaluation. Be sure not to involve too many employees.
  - Do consider using some individuals from different shifts and areas to ensure feedback across the organization.
  - For authenticity and to keep the results relevant, garments should be evaluated by actual occupational professionals while performing their normal duties. No jogging on a treadmill or rock climbing unless it is part of the activities that will be required of employees during their everyday work.
- Use standard questions and ranking scales (e.g., 5-point Likert scales) to



*Following best practices for wear trials help ensure that you get the best FR garments for your employees*



obtain measurable feedback. Just 23% of survey respondents claimed to use ranking scales, and 47% said they use standard questions.

- Ask questions that address the utility of the garment – Does the garment fit? Does it restrict motion or interfere with normal job-related tasks? Are the features (pockets, snaps, etc.) useful or necessary?
- Allow for the evaluation of fabric and garment construction separately – did they like the fabric but not the garment, or vice versa? According to research by Mount Vernon FR and ASSE, just 39% of respondents allow separate evaluation of fabric and garment.
- Ask for written comments to add context to the data. Less than half of respondents said they ask for this.

A properly executed wear trial is beneficial in helping EHS professionals select the most appropriate garments for their workforce, receiving information directly from those that will be wearing them, and delivering a more comprehensive evaluation of important factors. Ultimately, this is likely to lead to a more satisfied and safer workforce.

## **Voice of the Customer – The Data Gathering Process**

As the focus on FRC continues to grow, Mount Vernon FR, a leading U.S. manufacturer of flame resistant fabrics, sponsored a Voice of the Customer study to gain insights into the challenges faced by EHS professionals. This Voice of the Customer research consisted of two phases:

- A focus group was held at the ASSE Safety Conference in Dallas. Participants included safety personnel from companies such as Piedmont Natural Gas, BP, Imperial Oil, Marathon Oil and Spectra Energy.

- A follow-up online survey was distributed to ASSE members, with 243 safety, health and environmental professionals in the oil/gas and utilities industries completing the survey. Results represent nearly 295,000 employees that wear FRC on the job, and the results have a margin of error of +/-6.3%.

*Nearly 295,000 workers that use FRC are represented in the 2016 survey results*



The research was conducted by Quixote Group Research, an independent research firm based in Greensboro, N.C., in conjunction with ASSE.

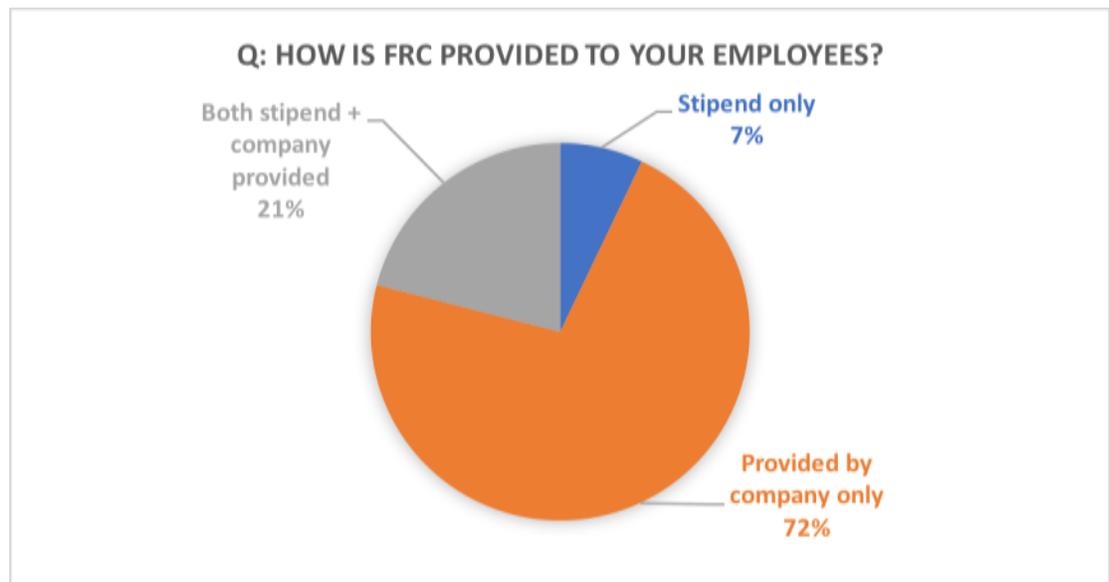
By gaining and sharing insights from the end users of FRC, Mount Vernon FR and ASSE will help drive meaningful and relevant developments throughout the supply chain that are focused on the key challenges – finding solutions that matter by keeping workers safer, regardless of industry, environment or gender.

## **Safety Professionals Generally Have a Moderate Level of Familiarity with FRC**

Based on the results from the survey, the typical oil/gas company provides six FR shirts and six FR pants to an employee, while the typical utility company provides seven FR shirts and six FR pants per employee.

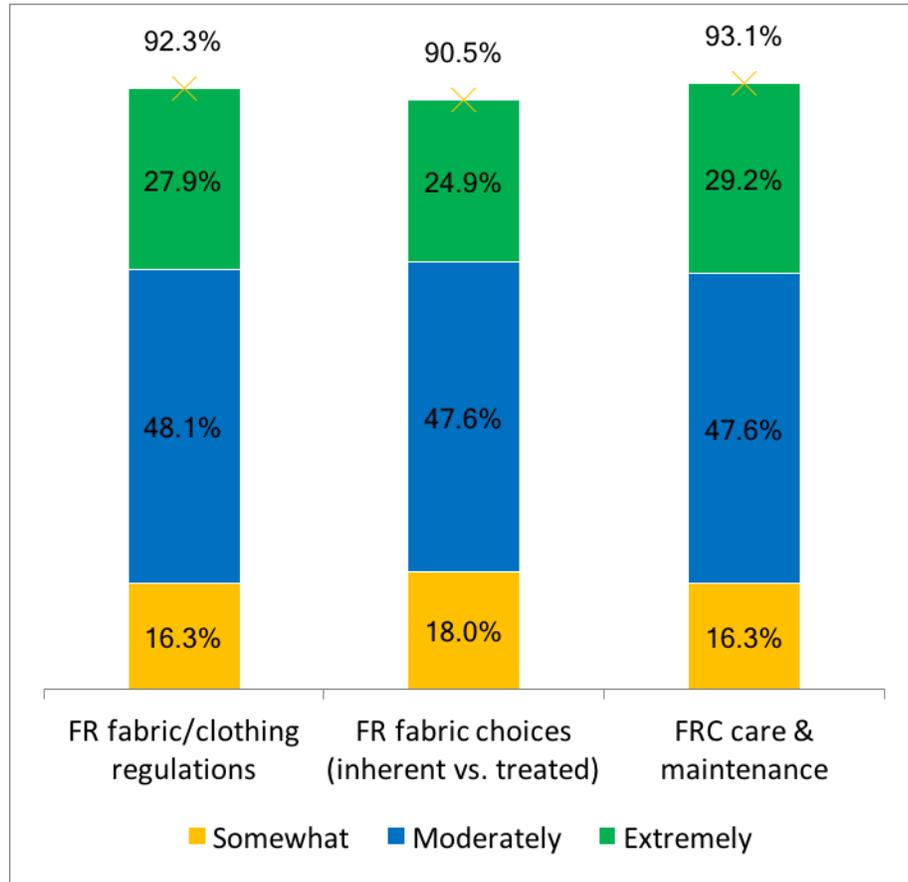
When asked how FRC is provided to employees, 72 percent of responding companies said that FRC is provided by the company only, while seven percent said that FRC was provided by stipend only. Twenty one percent of responding companies said that FRC was provided through a combination of stipend and company-provided garments.

When combined, 93 percent of responding companies say they are responsible for providing some or all of the FRC to their employees, making FRC a significant cost to their companies as well as an important responsibility to the safety of their workers.



However, only 25 percent of the survey respondents claim to be extremely familiar with the following: FR fabric or clothing regulations, FR fabric choices; and how to properly care for and maintain FRC garments.

Q: How familiar are you with each of the following?



The relatively low level of familiarity with FR fabric choices is a bit surprising when considering the following data points:

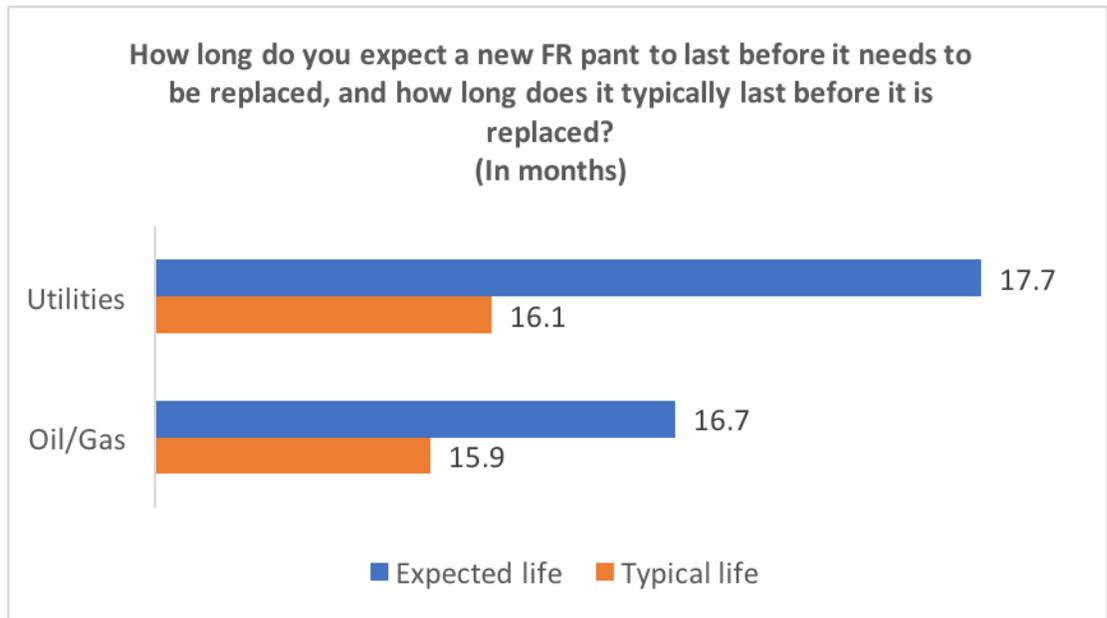
- 84% of the 2016 respondents disagreed with the following: “All FR fabrics are essentially the same.”
- 77% of the 2016 respondents agreed with the following: “It is important to specify the fabric used in FRC garments.”

## The Cost Implication of Expected Life Expectancy of FR Garments vs. Typical Life Expectancy

Flame resistant garments, for the most part, are living up to their expected life expectancy. According to the data collected from the more than 200 EHS respondents, a new FR shirt is expected to last 18 months in a utilities-based application and 17 months in an oil/gas-based application. Respondents perceive that the actual life expectancy of their FR shirts generally matches their expectations; however, even small differences in expected versus actual life expectancy can add significant costs to a large FRC program. For example, based on the data collected in the survey, the early replacement (typical life versus expected life expectancy) of FR shirts can add approximately 3.5 percent to the cost of an FR shirt program to utility companies and 5 percent to an oil and gas company.



The difference in typical life expectancy versus expected life expectancy is more dramatic when it comes to FR pants, which tend to take more wear and tear on the job. This means that the actual cost of an FR pant program could be five percent higher for oil/gas companies and ten percent higher for a utility company.

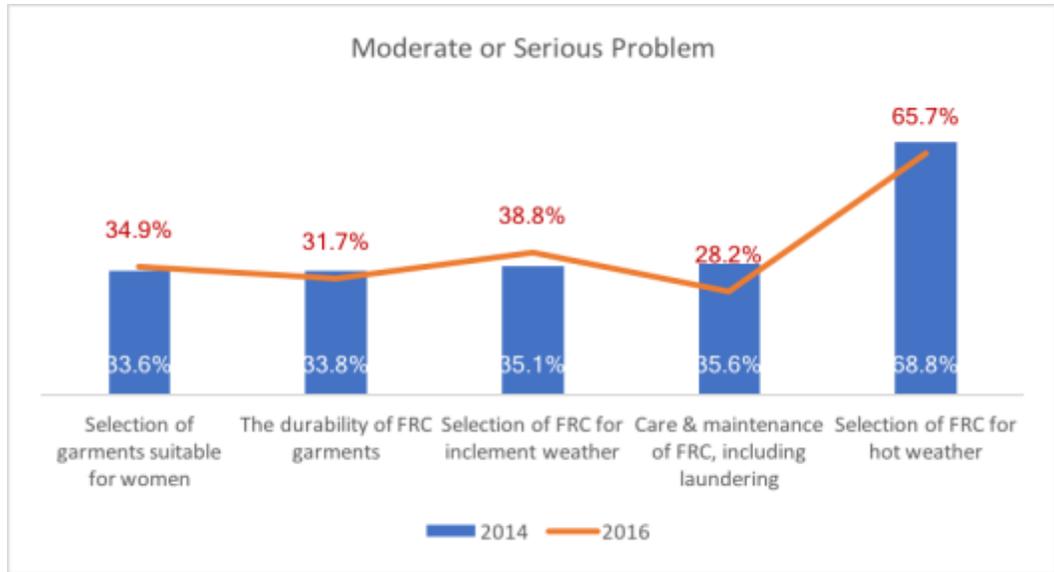


## The Top Challenges of an FRC Program

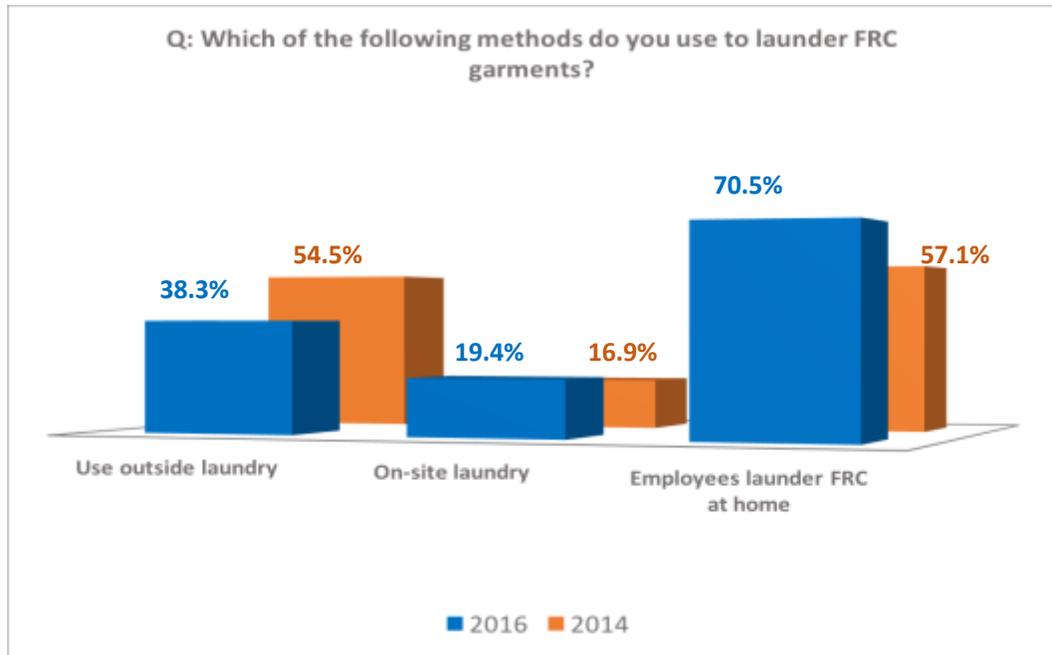
Another goal of the survey was to gain insights on trends in the industry, including what EHS professionals see as the challenges they face in managing an effective FRC program for their company.

The biggest challenge for safety managers is the selection of FRC for hot weather conditions, particularly given the concentration of oil and gas companies in the Southeast and Southwest portions of the U.S. and the concerns about heat exhaustion during the summer months. Approximately two-thirds of respondents rated the selection of FRC for hot weather a moderate or serious problem, and this level has not changed when compared to 2014 results.

When looking at the top five challenges from 2014, only one has had a statistically significant change: the care and maintenance of FRC, including laundering. This is less of a problem in 2016 than it was in 2014.



One notable factor in the care and maintenance of FRC is that there was a statistically significant increase in the number of companies saying that their employees launder FRC at home. It is important to note, however, that the figures below do not reflect share of total FRC garments being laundered via each method; rather, it is a share of companies.



As more companies shift some of the responsibility for laundering of FRC to company employees or the increasing number of contract employees, and given that only 29 percent of survey respondents said that they are extremely familiar with FRC care and maintenance (pg. 11), it is important to remind employees about proper ways to clean and launder FRC so that they don't compromise the flame resistant properties of a garment.

1. Washing at home can be accomplished using any typical home laundry detergent. Powdered detergents containing "color safe" bleaches such as sodium perborate may be used. Wash on the Cotton/Sturdy cycle with the wash temperature set to Hot.
2. Flame resistant clothing should be laundered separately from the family wash to prevent cross contamination. Turning the garments inside out before laundering will reduce abrasion on the exterior of the garment and help maintain a smoother appearance
3. If stain removal is required, any commercial stain removal product that does not contain hydrogen peroxide is acceptable. The detergent being used to launder the clothing can also be poured directly onto the stain to aid removal. It is possible that heavy stains may not be completely removed, but the presence of a visible stain doesn't necessarily compromise the flame resistant characteristics of a garment.
4. Dry on the Cottons setting, but do not over dry the garments as this may result in excessive shrinkage. If desired, garments may be ironed on the normal cotton setting.
5. Products to avoid: The objective in cleaning any flame resistant fabric is to remove soils and not to add anything that could serve to mask the action of the flame retardant or to serve as an ignition source. Liquid detergents or other products that contain hydrogen peroxide may not be used because of the risk of damaging the flame resistant finish. In addition, products such as



*Just 29% of respondents say they are extremely familiar with FRC care and maintenance*



starch, fabric softener or any other laundry additives, such as dryer sheets, must not be used. Any form of bleach must never be used on flame resistant treated fabrics.

Additional guidance for home laundering can be found in ASTM F2757 *Standard Guide for Home Laundering Care and Maintenance of Flame, Thermal and Arc Resistant Clothing*.

## Summary

The following are five key takeaways from this study:

1. The cost of an FRC program can be significant. The typical employee that is required to wear FRC has 6-7 FR shirts and six FR pants, and 70% of responding companies say they provide all the FRC to their employees.
2. The early replacement of FR garments can add up to 10% to the cost of a program. This is based on typical garment wear life compared to expected garment wear life.
3. Familiarity with FR fabric choices and FRC care and maintenance is fairly low, indicating the need for fabric and garment manufacturers to continue to educate EHS managers.
4. Suitable FRC options for hot weather remains a top challenge for EHS professionals.
5. The number of companies that are conducting wear trials on a frequent basis (often or very often) is very low (16%), and many companies are not using best practices such as ranking scales or allowing for the separate evaluation of the fabric and the garment construction.



As the number of FRC options in the market continues to grow, EHS professionals are challenged with analyzing all of the factors necessary to consider when choosing the right FRC program for their employees. Working in partnership with FR fabric and garment manufacturers, EHS professionals can better understand all of the elements that contribute to the durability, comfort and cost of a FRC program. In the end, this increased knowledge can help companies effectively manage the safety needs of their workforce.

## About Mount Vernon FR

Since 1845, Mount Vernon Mills has been producing durable workwear fabrics. Headquartered in South Carolina, the company has about 2,500 employees and operates 14 production facilities in the U.S.

Mount Vernon FR fabrics are made in the company's manufacturing facility located in Trion, Georgia, which is also one of the largest denim manufacturing facilities in the world. Every step of the production process – including cotton yarn sourcing and production, yarn spinning, weaving, dyeing and FR finishing – takes place in the company's Trion facility.

Mount Vernon FR offers several fabrics and finishes to help meet these challenges and help EHS professionals effectively manage their FRC programs, including:

- **AMTEX® TC:** Combines cotton and Tencel®, which is a cellulosic fiber similar to cotton, to create durable FR fabrics that feel lighter than their true weight, making them ideal for warm weather.
- **MY•FR:** A custom fabric program that allows customers to create FR fabrics that meet the exact needs of their workforce. Mount Vernon FR works directly with customers to optimize fabric construction, weight and color.



- **FlexTex:** FR fabrics that include an elastomeric fiber that allows fabric to flex up to 14% with 97% recovery. In addition to helping create more fitted and tailored garments, FlexTex fabrics increase range of motion, and the bilateral flex allows the fabric to elongate sideways and diagonally, which eliminates sagging or bagging.
- **Phoenix:** Mount Vernon FR offers a broad range of denim fabrics component certified to NFPA 2112, including flex denims and Tencel® blend denims.
- **Nanuq CWI:** Nanuq CWI (Cold Weather Insulated) is Mount Vernon FR's line of quilted FR composites. All Nanuq CWI quilted fabrics are NFPA 2112 component recognized, and can be used as part of an NFPA certified insulated coverall or outerwear garment.
- **amDRY:** A durable water repellent finish that can be applied to any Mount Vernon FR fabric.
- **amSOFT:** A mechanical finish that provides added softness to any Mount Vernon FR fabric without compromising durability.

For more information about Mount Vernon FR, please visit [MVMFR.com](http://MVMFR.com), or contact:

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