

# Smart work clothing for sub-zero temperatures

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The human body is not adapted for cold. To work in extreme conditions, extreme clothing is needed. According to the researchers on this project, a new approach in design is needed to achieve this. Credit: Statoil

Working outside in a cold environment for any length of time is difficult with the protective clothing currently available. Innovative, warmer garments must be developed for those taking part in drilling operations under sub-zero conditions.

This is precisely what the researchers and industry players cooperating in the research project, ColdWear (“Textiles and clothing for improved safety, performance and comfort in the High North”) are seeking to do. The project has been granted funding under the Programme for User-driven Research-based Innovation (BIA) for the Research Council of Norway.

## Facing down the cold

One-fourth of Norway's remaining oil and natural gas reserves lie beneath the northernmost parts of the coast and in Arctic regions. Extracting oil and gas at such latitudes poses a number of challenges. One concern is whether it is physically possible at all for people to work under such severe conditions.

Under the ColdWear project, researchers have been studying how much [cold](#) humans can tolerate. It is clear that the textile industry needs to get involved if oil and gas exploration is to move even further north. Simply put, new types of clothing are needed to cope with the climate.

## Textile and petroleum industries working together

The project has led to a much clearer picture of what is required to design [garments](#) that will keep people warm in rough environments.

Researchers are now working together with the textile and the petroleum industries to learn more about work performance in cold environments and the integration of electronics into garments and advanced materials. One objective behind the project is to offer the Norwegian textile industry a unique position to develop products for applications in cold climates.

## Affects concentration and motor skills

Many of the vital bodily functions begin to fail if the body's core temperature falls even slightly below its normal 37° Celsius. At a temperature of just -5° Celsius, finger and hand dexterity become inhibited.

Even more detrimental is that the cold affects concentration, alertness and perception. The risk of human error rises as the temperature falls. “Transmission of nerve impulses slows and motor skills decline,” Hilde Færevik states.

Ms. Færevik is a physiologist and Research Manager at SINTEF, the independent research foundation. She has headed the interdisciplinary team of researchers from the fields of physiology, ICT and material science collaborating on the ColdWear project.

## **Field studies in Northern Norway**

Much is already known about the effects of cold on the body; however, no one has previously studied the effects of extreme cold in concrete work scenarios. Such studies are of great relevance to the petroleum industry.

This has spurred the researchers to carry out field studies involving people who work under some of the harshest climate conditions to be found – more precisely, employees of the state-owned petroleum company, Statoil, operating on the island of Melkoy outside Hammerfest in Finnmark, the northernmost county of Norway.

“We have recorded the body temperatures of petroleum workers and registered their heart rates. In addition, we have observed them while working and conducted interviews about their personal experience with the cold,” explains Ms Færevik.

## **What is the limit?**

The field studies have enabled the researchers to map the tasks where exposure to the cold cannot be avoided. Simulations were subsequently

carried out in SINTEF's cold laboratory.

It is a given that the body's reaction to cold entails some safety risk for anyone working on tightening or loosening a valve in an oil field far to the north. Thus, it is of the utmost importance to determine whether or not it is possible to undertake tasks requiring dexterity and depth of concentration under such conditions.

## **Must be ethically acceptable**

“Even those born here, so far north, are poorly adapted to such a cold climate. The human body automatically works to maintain a core temperature of 37° Celsius. If the temperature deviates much, problems will soon follow,” states Ms. Færevik.

The biggest challenge on Melkoy is the wind. The low pressure Polar front causes abrupt shifts in weather. If oil and gas are to be harvested from new oil fields (Havis and Skrugard) in the Barents Sea, workers will be facing even lower temperatures.

“When carrying out controlled laboratory experiments in a climate chamber it becomes clear that workers on Melkoy endure lower temperatures than can be considered ethically acceptable for work outside in the cold. The clothing worn today is not sufficient for optimal work performance. For oil exploration and drilling to be feasible further north, producing better clothing is, quite simply, a must,” the Research Manager asserts.

## **Innovation needed**

Certain situations give rise to particular challenges. Some workers are sent to a new site before a single building has even been erected. Some

will be scaling high masts, braving the elements. Some must build walls in storm winds. Is it really possible to develop garments for such conditions – that is, clothing that is warm enough yet not too thick or cumbersome to work in?

“Yes, it’s possible. But the textile industry needs to think along completely new lines,” says Ms. Færevik.

“We need to work from an integrated design concept. For example, ear and eye protection, shoes and gloves must all function together. Today, for instance, workers compromise protection when they wear a balaclava together with ear guards. The two are not designed to be worn together. Producers of work clothing must combine their efforts to find the optimal solutions.”

## **Clothing that registers temperature**

Occasionally, oil field operations must be put on hold due to extreme cold. This is very costly, so companies could reap great savings if they were able to monitor workers and summon them back in from the extreme cold when they approach the limit of what the body can handle.

Monitoring personnel in this way is possible using “intelligent” garments. Activities under the ColdWear project include efforts to integrate electronics into clothing in order to better gauge just how cold the workers are.

At present, no methods exist for measuring the temperature of a worker’s hands, for example. The researchers have therefore studied how to integrate sensors into jacket sleeves. The sensors can notify the control room when a worker is too cold and needs to return inside to warm up.

## **Large-scale investment – widespread interest**

“Intelligent clothing has attracted great interest in Europe in the past decade. High prices have prevented most items from ever leaving the laboratory, however. The cost of developing these types of textiles is a big obstacle to commercialization,” explains Ms. Færevik.

“But petroleum companies may actually have no choice,” she adds. “If they wish to conduct oil exploration so far to the north, work safety must be of the highest priority. In my experience, the petroleum companies are interested in investing in the development of the new clothing so that they can forge ahead.

Provided by The Research Council of Norway

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