*Proceedings of the 35th European Safety and Reliability & the 33rd Society for Risk Analysis Europe Conference*
*Edited by* Eirik Bjorheim Abrahamsen, Terje Aven, Frederic Bouder, Roger Flage, Marja Ylönen
 *Published by* Research Publishing, Singapore.
doi: 10.3850/978-981-94-3281-3_ESREL-SRA-E2025-P0871-cd

# Understanding and preventing fires close to the body

Ellen Synnøve Skilbred

*RISE Fire Research AS, Norway. E-mail: ellen.synnove.skilbred@risefr.no*

Edvard Aamodt

*RISE Fire Research AS, Norway. E-mail: edvard.aamodt@risefr.no*

Anne Steen-Hansen
*RISE Fire Research AS and Norwegian University of Science and Technology (NTNU), Norway.*

Several fatal fires start in the clothes worn by the deceased or in the furniture the deceased was lying or sitting in, and such fires are known to cause fatalities even in homes with automated mitigation systems installed. Studies of fatal fires have contributed to knowledge on how these fires happen, but there are fewer studies on near-misses and successful preventive measures. We have therefore interviewed people working with fire prevention in Norway to document what fire preventive measures they use and their thoughts on the effectiveness of the measures. They then shared what they see as key solutions to prevent fatal fires where someone is in immediate closeness to the object of first ignition. Their key message is that it is central to see the situation for each individual when assessing whether they need further fire safety measures. Understanding what hazardous situations may arise and how the person may react in case of a fire is central. Home visits are an important arena for giving information and advice, and for discovering that a person needs additional fire safety measures. Several mapping tools exist for assessing the fire safety in people's home but for successful mapping, it is important that the assessment is updated regularly and that the people conducting the assessment (often health employees with a busy schedule) have the time and training to conduct the assessments. Measures can be as simple as making sure that someone with reduced mobility who smokes indoors have a steady glass of water nearby, as both ashtray and extinguishing medium. The most expensive measure, which can also be tricky to implement, is personal protection water mist systems. Both financial, practical and organisational aspects are important for successful implementation of measures, as well as a good co-operation between the team implementing measures and the person receiving them.

*Keywords*: fire safety, fire prevention measures, vulnerable persons, smoking, fires starting close to the body

## 1. Introduction

Several fatal fires start in the clothes worn by the deceased or in the furniture the deceased was lying or sitting in, and such fires are known to cause fatalities even in homes with automated sprinkler systems installed (National Fire Chiefs Council and National Fire Sprinkler Network, 2019).

In a recent study, we analysed statistics related to fatal fires in Norwegian buildings in the 2015-2020 period (Aamodt and Skilbred 2024) and for some factors we distinguished fires close to the body from other fires.

Most of the fires close to the body were caused by open flame, either due to smoking materials (67.5%) or other sources of open flame (20.0%). To avoid the risk that individuals in the statistics could be identified, factors relating to less than five persons were anonymized.

35.0% of the fires close to the body started in the victim's hair or clothes, while 42.5% started in bedsheets or furniture the victim was sitting or lying in. In 50% of the incidents, the fire had not spread from the point of origin when the fire and rescue services arrived. 72.5 % of the fires started in the living room.

The median age of the victims of fires close to the body was 70 years, while the median age of victims in other fatal fires was 59 years.

In 57.5% of the police reports analysed for

fires close to the body, there was information suggesting that the victim had reduced mobility.

In studies of fire fatalities, fires starting close to the body are usually not described as a separate category, but there are studies focusing on fires caused by smoking materials and studies focusing on fires in clothes or furniture and these may include several fires close to the body.

Researchers in Sweden have performed a cluster analysis of fatal fires in Sweden, first for the period 1999-2007 (Jonsson 2017), later for the period 1999-2018 (Jonsson 2022). The first study identified six clusters, where two were related to smoking and appear to include fires starting close to the body. These were (1) fatalities that often involved older people, usually female, whose clothes were ignited (17% of the sample), and (2) middle-aged (45–64 years old), (often) intoxicated men, where the fire usually originated in furniture (30%).

The analysis of fires in the period 1999-2018 found similar clusters, but with somewhat different descriptions. The first cluster was fatalities caused by the ignition of clothes either by candles or cigarettes (13% of the sample). Victims were more likely to be older women who were not affected by alcohol, though had consumed anti-depressants. The cause of death was likely to be burns. The fires were small, occurred in care homes in smaller, rural communities during the day and during the winter months. The second cluster was fatalities due to furniture being ignited by cigarettes (28% of the sample). Victims were most often between 45 and 79 years old, lived alone and were affected by alcohol. Fires occurred most often in apartments in medium-sized municipalities where beds, armchairs, and sofas were ignited.

A study of fires caused by smoking materials in the U.S. (Hall 2013) found that most of the fatal fires caused by smoking materials started in upholstered furniture (37%) or mattresses and bedding (29%). However, one out of four victims of smoking-materials fires was not the smoker whose cigarette started the fire, and these fatalities were therefore probably not cases of fire close to the body.

The studies mentioned above show that fires close to the body are a significant part of fatal fires, but that it is difficult to know to what extent such fires happen unless it is specified in the fire statistics. Fires close to the body can cause great injury without causing much damage to property and information on the near misses and successful preventive measures has been difficult to find.

In this study, we sought to learn about who is at risk for dying and being severely injured in a fire close to the body, and how these fires can be prevented. We have interviewed people working with fire safety for people at risk to learn about how they work to prevent fires close to the body and to hear their experiences with these fires and measures used to prevent them.

## 2. Methods

### 2.1. *Literature review*

Literature on fires where a person is in immediate closeness to the object of first ignition has been studied, including online searches for different fire prevention and mitigation methods.

### 2.2. *Interviews*

14 interviews were held with 18 people working with fire prevention for people at risk. The interviewees included people working in fire and rescue services and other municipality units who inform about fire safety or have home visits, or coordination of home visits, as part of their job. The interviewees represented municipalities administering 45% of Norway's population. The interviewees were sent a list of questions before the interviews, but in the interviews, they were encouraged to speak openly about the topics that they found most fruitful to contribute with, as not all questions were equally relevant for all interviewees. The questions are listed in Appendix A.

## 3. Results and discussion

### 3.1. *Causes of fires close to the body*

All interviewees mentioned smoking as one of the most frequent causes of fires close to the body. Candles were also frequently mentioned, and some mentioned accidents related to starting a fire in the fireplace using lighter fluid, and a fire started by an electric device charged while lying on the bed.

There was also concern for the use of old space

heaters very close to the person's feet and sitting area. It was pointed out that these scenarios can start fires close to the body, but that there are usually additional risk factors involved when the fire causes severe injury or a fatality.

The interviewees were asked to also consider fires close to the body where there are no fatalities. Still, the causes mentioned were well aligned with findings in our recent fatal fire analysis (Aamodt and Skilbred 2024), which was not yet published at the time of the interviews.

In Fig. 1, we have used data from (Aamodt and Skilbred 2024) and shown graphically how the fatal fires caused by smoking materials, other sources of open flame and other causes were distributed on fires close to the body and other fires. The total number of fatal fires in the analysis was 152, where 40 fires were fires close to the body. The figure shows that most of the fires close to the body were caused by smoking, and that smoking is a less dominant cause among other fatal fires. Other sources of open flame are about equally represented in fires close to the body and other fires. However, it is important to note that fires close to the body more often have known causes, as the fire can cause fatal damage without spreading far. Among the other fatal fires, there are more fires with unknown causes, and this group may include fires caused by open flame.

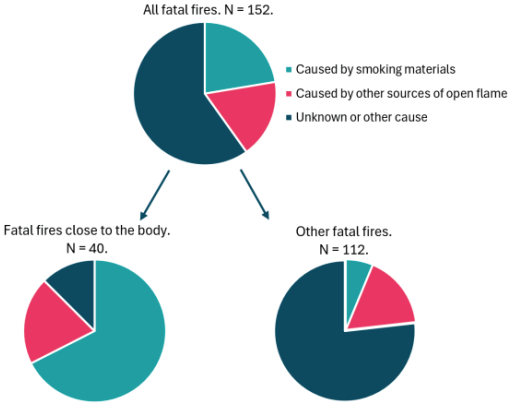


Fig. 1. Causes of fatal fires in Norwegian buildings in the 2015-2020 period, distributed on fires close to the body and other fires. Data from Aamodt and Skilbred (2024).

### 3.2. *Risk factors*

Risk is a function of the likelihood of an undesired event and the consequence of that event. Previously (Storesund, K. et al. 2015), people at risk in a fire situation have been defined as having a higher likelihood for starting a fire or limited ability to:

- Prevent a fire
- Discover the fire
- Alert and extinguish a fire
- Evacuate without assistance

When the interviewees were asked about risk factors making it more likely for a person to be injured or killed if they were exposed to a fire close to the body, they mentioned cognitive challenges, including challenges caused by drug use, reduced mobility and immobility, as the most significant categories.

Related to risk factors increasing the likelihood that a person will be exposed to a fire close to the body, they mentioned reduced coordination, reduced body control, and cognitive challenges, including challenges caused by drug use. The reduced coordination and reduced body control can increase the risk of contact with flames and also make fire extinguishing and cooling of burns more challenging.

Cognitive challenges that affect the person's perception of reality and consequence thinking can both increase the likelihood of a fire starting but also prevent the person from discovering the fire early and extinguishing it. Evacuation and calling for help can also be more challenging.

To live alone increases the risk for people to die in a fire, especially for people who already are associated with risk factors. The analysis of fatal fires in buildings in Norway in the 2015-2020 period found that 76% of the deceased were alone when the fire started and 74% were living alone (Aamodt and Skilbred 2024). For comparison, less than 20% of Norway's population were living alone in the same period (Statistics Norway 2025).

Many interviewees mentioned that older people more often become severely injured in a fire close to the body, but most of them elaborated that they did not consider high age as a risk factor in itself. However, some expressed awareness that burn recovery is slower for older

people, as also reported by Meenakshi and Schwacha (2012).

Hoarding was also mentioned as a concern, both for general fire safety when there are limited evacuation routes, but also considering that an open flame more easily can get in contact with flammable material. Having a hoarding disorder is therefore not a risk factor in itself but the act of hoarding can both increase the likelihood of a fire happening and increase the risk of fatalities, by making extinguishing and evacuation more difficult.

### 3.3. *Preventing fires close to the body*

#### 3.3.1. *Informing about fire safety*

The interviewees who had fire prevention as a core part of their job, emphasized that individual assessment of the persons' situation was essential in preventing fatal fires, including the fires close to the body. The assessment includes looking for potential hazards that can lead to a fire and assessing whether it is likely that the person will perceive that a fire has started, respond to the fire and evacuate if necessary.

General fire prevention work is often targeted towards building requirements and measures required by law, such as smoke detectors and manual extinguishment equipment. For the people who are most vulnerable to being injured in a fire close to the body, these measures are often not sufficient.

An important part of the work with preventing fires close to the body is informing people about the potential hazards and what measures can be taken. This can be simple measures such as using electric (flameless) candles instead of wax candles or suggest safer smoking habits. Many of the people at risk are mainly staying in their homes and home visits are an important arena for reaching them. The interviewees expressed positive experiences with home visits, but previous studies in Norway have pointed out that home visits can be experienced as invasive (Mikalsen et al. 2023).

Many municipalities in Norway offer to have conversations about health-related topics with people over a certain age. Such conversations typically include the risk of falling, diet, nutrition, and fire safety. These conversations are voluntary and can be performed over the phone or at home. When people say yes to these conversations, they will be better informed about how to improve their current situation, but also how to prepare for a future where they may have reduced mobility or cognitive challenges. They may also be inspired to inform friends, family and other close ones about what they have learned and to offer helping them with implementing measures.

Having a relative or other close ones present when information about fire safety is given is considered beneficial, as they can often help implementing measures. This can for example be help with changing batteries in smoke detectors, emptying ash trays, tidying away flammable materials from sources of open flame, purchasing technical measures and applying for measures in the welfare system. It is important to note that next of kin and other close ones do not have any legal responsibility to implement measures and should not feel accountable for ensuring the fire safety, but that having the help of close ones can be a benefit, especially for those who do not have home care services.

For the people who receive home care services in Norway, it is the health care services that have the responsibility to give adequate services, including fire safety. When the need for fire safety measures is discovered, it is often the health care services that implement measures. In these cases, it is easier to implement measures when the person receiving the measure has a good relationship with the home care services. Sometimes it was considered better that the fire department was directly involved in the implementation of measures and home visits, due to the respect many people have for them.

#### 3.3.2. *Tools for mapping fire safety*

Municipalities have different ways of mapping the fire safety for people who receive home care services. Some use digital tools which give suggestions to measures based on the input and others have a checklist.

For successful mapping, it is important that the assessment is updated regularly and conducted correctly. For example for buildings with several units, there have been misunderstandings that having a smoke detector in the common hallway was enough, when there should also be a smoke detector inside each unit. The people conducting

the assessment are often health employees with a busy schedule and it is therefore important that they are given enough time and training to conduct the assessments.

If the mapping shows that additional measures are needed, there are different routines for implementation. Some municipalities have interdisciplinary teams that can discuss suitable measures before a decision is made. Having the permission to share the information is important, unless the situation is so critical that the regulations require the municipal officers to act. People working in the health care services can also ask for advice from colleagues or fire and rescue services by describing the situation in a way that does not identify the individual they are concerned about.

### 3.3.3. *Technical measures for smokers*

Measures for making smoking safer with regards to fire safety was a main topic in the interviews. For other sources of open flame, such as candles or a fireplace, the interviewees had a low threshold for proposing to avoid the source of open flame, for example using electric candles or electric heaters. When it comes to smoking, some could inform about safer options, such as e-cigarettes, but most interviewees emphasized that it was important to not make the person feel that someone is trying to take smoking away from them. Building trust with the person at risk is important, and trying to convince someone to stop smoking, or smoke in another way, can be experienced as invasive. Therefore, the measures for smokers were mainly related to making smoking more fire safe.

A key element in making smoking safer is to have a safe way to dispose of the ash. The ash trays must be stable and put on a stable surface, such as a table rather than a bed. It must be easily accessible to the user and must contain the hot ashes without breaking or transferring heat to surrounding surfaces. It is also important to consider how the ashtray is emptied. Can the smokers do this safely on their own? If not, there should be a routine for them to have help with this, but even with a routine, it is important to be aware of that the person might try to do it themselves out of old habit.

An option to ashtrays was a steady glass of water. This measure could be implemented instantly when visiting someone who did not have safe smoking habits but could also be used more permanently. The glass of water could also be placed near the smoker as a means to extinguish embers that have landed on flammable material.

Smoker's aprons have been available through the Norwegian Labour and Welfare Administration, Nav, and have been in use, in particular at institutions. These have some shortcomings, as they only cover parts of the body of the user and some users may need help putting them on. For people not living in an institution, the interviewees considered other options as better for smokers, as it can be difficult to convince someone to start putting on the apron every time they smoke since most people have experienced that their smoking habits have been safe so far.

Using fire blankets was considered a more suitable measure for smokers. People are often more used to using blankets than aprons and the fire blankets could be adapted to cover parts of the floor near the person, or put on parts of the table, if the person tended to leave smoke ash there.

Flame-retardant bedding is a measure suitable for people smoking in bed, but a challenge is to make sure that the flame-retardant bedding is used, see Fig. 2. Some users did not use bedding in the first place, and interviewees mentioned that putting the bedding on for the user was especially important in these cases to make sure the measure was actually implemented. Bed sheets should be washed regularly, and in case a new bedding is put on before the flame-retardant one has been washed and dried, it is important to have several sets and that the person changing the sheets is aware of which sheets they should put on.

Different textiles have different flammability, and using less flammable materials in clothing has been considered a potential measure for preventing fires close to the body (Runefors et al. 2016). On the one hand, changing to less flammable materials in clothing can seem like a simple measure, as many already have such garments in their wardrobe and people can choose less flammable clothes when buying new garments. On the other hand, what you wear can be an important part of your identity and it can

Fig.2: Picture taken after a fire close to the body, where using a flame-retardant bedding possibly could have made a difference. (Photo: Vestfold Interkommunale Brannvesen, used with permission).

feel invasive when people have opinions on what you should wear. This topic was therefore mainly addressed generally in home visits, when giving general information about what people can do to improve their fire safety. For people who have close ones who buy their clothes, it can be particularly useful to inform about this to them, so they can avoid buying the most flammable options. There is a misconception that many people think synthetics are the worst option, when in fact studies show that some polymeric textiles melt before they burn and thus have a lower potential for spreading a fire compared to for example light weight cotton fabrics, which are very flammable. Information about the flammability of materials can help correct this misconception in the population.

Another measure that was discussed particularly for smokers was the smoker's robot, which is simply a device for transporting smoke from the cigarette to the user without the need for the user to hold the cigarette. This measure is very suitable for people who can easily drop the cigarette or fall asleep while holding a cigarette.

### 3.3.4. *Measures for improved fire extinguishing*

Fixed sprinkler and water mist systems are usually activated by heat, e.g., equipped with a glass bulb that breaks and releases the water when the temperature of the bulb has reached 68°C (for normal dwellings). This means that a fire close to the body can cause severe injury before the system is triggered (Department of Communities and Local Government: London, 2007).

Systems triggered by smoke detectors can react earlier than on heat and are therefore more suited for preventing fires close to the body. There are also systems which activate at 57°C. The fixed sprinkler and water mist systems are often installed in the building before people have moved in and the nozzle and detector positions have not been adapted to the people living there. For people associated with risk factors, a solution can be to adapt the system so that nozzles and detectors are near the areas where the person is typically sitting and sleeping.

Personal protection water mist systems are normally adapted to the user, so the nozzle and detector have the best chance of mitigating the fire hazard. These could also be triggered by smoke to react early enough. Some interviewees knew about incidents where water mist systems had been activated, and lives would possibly be lost if the systems had not reacted. These systems are not fixed to the building and can therefore be installed elsewhere if the need has changed. It has however happened that users have sabotaged such systems, as described in (Aamodt et al. 2022).

Apart from fixed automatic extinguishing systems, the personal protection water mist system is the most expensive measure suggested for preventing fires close to the body. The system has a high purchase cost but also demands resources for installation and regular service. It is important to clarify who should pay for the service costs and power cost for the system. For persons where the main concern is unsafe smoking habits, measures mentioned in 3.3.3 could be considered before investing in a personal protection water mist system. However, for some of the most vulnerable, the only other option may be being a full-time resident at an institution.

Extinguishing sprays are smaller and easier to use than regular handheld fire extinguishers and can be a good measure for people who cannot easily use the normal fire extinguisher. The sprays should, however, be used in addition to the manual extinguishing equipment, which is mandatory in Norwegian homes without

automatic extinguishing systems. Interviewees told that they could also offer a pistol grip extension to the extinguishing spray so that it was easier to trigger. Keeping the extinguishing spray close to the user is important for the measure to be effective.

#### 3.3.5. *Smoke detectors connected to an alarm centre*

Many municipalities have a system where people who have a personal security alarm can have their smoke detectors connected to the system. The same alarm centre that would be in contact with them in case of a fall or other incident will then also be able to contact the person in case of a triggered fire alarm. Although this system's activation may not be in time to prevent injury from all fires close to the body, they can prevent some damage, as the central can sometimes be faster than the fire and rescue service. Additional measures can therefore be useful, especially for those who have increased risk of starting a fire close to the body.

#### 3.3.6. *Availability of measures*

The interviewees represented several different municipalities. Some of the municipalities had received funding from "Det store brannløftet" (http://brannloftet.no/), which is a collaboration project between Gjensidigestiftelsen, fire and rescue services and other important actors in fire preparedness in Norway. Some municipalities had the possibility to install personal protection water mist systems, and some could hand out smoke detectors, smoker's aprons and flame-retardant bed sheets. Generally, the availability of measures depended on what the municipalities had in store and the financial situation of the municipality. Several interviewees mentioned that there is a need for more funding of measures, especially personal protection water mist systems which for some may be the only acceptable solution other than a full-time residence at an institution. However, the interviewees were generally expressing gratitude for the measures they had available and would use what they had available to make the best of the situation.

## 4. Conclusion

To reach the governmental vision of zero fatalities due to fires, the currently mandatory fire prevention measures in Norway are not sufficient.

A fire close to the body can occur for anyone, but the consequences are more severe for people who have a reduced ability to perceive that a fire has started, extinguishing the fire or evacuate without assistance. This can be people who have reduced mobility, sensory loss or reduced cognitive function, for example due to illness or use of drugs.

People who smoke or use other sources of open flame are more likely to experience a fire close to the body, but the incident may not lead to much damage if they extinguish the fire fast themselves.

There are many measures for preventing fires close to the body, and informing about this is important to help people make safer choices. Measures range from inexpensive and simple, like having a glass of water available while smoking, to expensive and advanced, like personal protection water mist systems.

For all the preventive work, a key message was to see the individuality of a person and their situations. Building trust and finding measures that will not be experienced as unnecessarily invasive is key for successful implementation of measures.

## 5. Outlook

There are significant differences between fatal fires close to the body and other fatal fires, and fire safety measures outside the general mandatory requirements are necessary to prevent them. Distinguishing between these two types of fires in the fire statistics is helpful for understanding how the fatal fires can be prevented. Additionally, more information on near misses and success stories is necessary to understand how fires can be prevented.

**Acknowledgement**

This work was conducted with financing from the Norwegian Directorate for Civil Protection and the Norwegian Building Authority.

## Appendix A. Questions for interviews

A series of questions were sent to the interviewees before the interviews, and also used as a basis during the interviews. The questions were written in Norwegian, but are given in English below:

- Briefly about the interviewee's background, organisational affiliation, work tasks and area of responsibility.
- Which municipalities are within your area?
- Do you work specifically with prevention of fires close to the body?
- If yes; What distinguishes this work from general fire prevention?
- What do you think are the most frequent reasons why fires close to the body occur?
- Are there any risk factors that make it more likely that a person will be injured or killed in a fire close to the body?
- Are there any risk factors that increase the likelihood of a fire close to the body occurring?
- What measures do you use to prevent/ limit fires close to the body?
- Which measures, in the list at the bottom, do you think:
    a. Is it practical to implement?
    b. Does it have a good effect?
    c. Does it cost too much for it to be used to a greater extent than is done today?

Feel free to comment on whether this is based on concrete experiences from your work.

- Do you have suggestions for other measures that are not on this list?
- What will make your work with the prevention of fires close to the body easier?
- Is there anything you would like to add?

List of measures:

- Personal protection water mist system
- Flame retardant textiles, e.g. smoker's apron or fire blanket
- Conscious choice of clothing, less flammable textiles
- Deep ashtrays for smokers
- Sprinkler systems
- Small fire extinguishers or extinguishing sprays adapted for users
- Glass of water
- Vibrating alarms

## References


Aamodt, E. and Skilbred, E.S. (2024) 'Analyse av dødsbranner i Norge i perioden 2015-2020', RISE Fire Research, Trondheim Norway, Report No. 2024:43.

Aamodt et al. (2022). 'Erfaringer med mobile vanntåkeanlegg installert i boliger', RISE Fire Research, Trondheim Norway, Report No. 2022:122.

Department of Communities and Local Government: London. (2007). 'Sprinkler Effectiveness in Care Homes', Report No. BD 2546.

Hall, J.R. Jr. (2013). 'The Smoking-Material Fire Problem', Quincy, MA, USA: National Fire Protection Association, Fire Analysis and Research Division. Report No. USS10

Jonsson, A. et al. (2017). 'The State of the Residential Fire Fatality Problem in Sweden: Epidemiology, Risk Factors, and Event Typologies', Journal of Safety Research 62: 89–100.

Jonsson, A. et al. (2022). 'Residential Fire Fatality Typologies in Sweden: Results after 20 Years of High-Quality Data', Journal of Safety Research 82, 68–84.

National Fire Chiefs Council and National Fire Sprinkler Network. (2019). 'Efficiency and Effectiveness of Sprinkler Systems in the United Kingdom: An Analysis from Fire Service Data - Incidence of Deaths and Injuries in Sprinklered Buildings.

Meenakshi, R. and Schwacha, M.G. (2012). 'Aging and the pathogenic response to burn', Aging and disease, bd. 3(2): 171–180.

Mikalsen et al. (2023) 'Kommunikasjon av brannsikkerhet', FRIC Fire Research Innovation Centre, Report No. 4.3-2023.08

Runefors, M. et al. (2016). 'How could the fire fatalities have been prevented? An analysis of 144 cases during 2011–2014 in Sweden: an analysis', Journal of fire sciences 34(6): 515-527.

Statistics Norway. (2025). 'Table 06079: Private households and persons in private households, by size of household (per cent) (M) (UD) 2005-2024.' Available at: https://www.ssb.no/en/statbank/table/06079/ Accessed: 12.01.2025.

Storesund, K. et al. (2015). 'Rett tiltak på rett sted', SP Fire Research, Trondheim, Norway. Report No. A15 20075:1.