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Final report from the NKS NordThreat seminar in Asker, Norway 30 and 31 October 2008

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Norwegian Radiation Protection Authority, Norway

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Abstract

Changes in the international security environment have lead to an increased attention towards the need to revise various threat assessments in the Nordic countries. Together with recent events such as incidents at Nordic nuclear power plants, orphan sources and accidents involving nuclear powered vessels, this has given a good opportunity for an exchange of information and opinions.

The NKS-B NordThreat seminar took place at Sem gjestegård in Asker outside Oslo, Norway on 30 – 31 October 2008. Main topics in the seminar were:

- National threat assessments
- Potential hazards
- Experience from previous incidents
- Public perception of nuclear and radiological threats and information challenges
- Challenges for future preparedness

There were about 40 participants at the seminar. These were mainly members of the NKS organisations, invited speakers and representatives from various Norwegian emergency preparedness organisations.

Key words

Threat assessments, risk perception, potential hazards, incidents, communication, nuclear, radiation, risk mitigation, future challenges

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The seminar was organised by the Norwegian Radiation Protection Authority, the Swedish Radiation Protection Authority, the Finnish Radiation and Nuclear Safety Authority and the Icelandic Radiation Protection Institute, and was funded through the Nordic Nuclear Safety Research cooperation (NKS).

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1. Introduction

In October 2000, the Nordic nuclear safety research cooperation (NKS) funded through the NKS SBA-1 project a seminar addressing threat assessments in the Nordic countries. The aim of the seminar was to highlight the similarities and the differences between the different national threat assessments and to provide a basis for enhancing networks within the subject area.

Since then, changes in the international security environment have lead to an increased attention towards the need to revise various threat assessments in the Nordic countries. Together with recent events such as incidents at Nordic nuclear power plants, resurfacing orphan sources and accidents involving nuclear powered vessels, this gave an apparent need for a closer discussion and an exchange of information and opinions in the Nordic community.

Therefore, in May 2006, the mini seminar “Threat assessments reflecting emergency plans of the Nordic nuclear and radiation authorities” was arranged as part of the annually meeting of the Nordic Working Group on Emergency Preparedness (NEP). The mini seminar proved the need for a more thorough seminar with a wider range of participants.

The NKS NordThreat seminar was subsequently arranged as an answer to the NEP request. It was organised by the radiation protection authorities of Norway, Sweden, Finland and Iceland, and was funded through the Nordic Nuclear Safety Research cooperation (NKS). The seminar highlighted five distinct topics:

- Possible hazards
- Experience from previous incidents
- Public perception of nuclear and radiological threats and information challenges
- National threat assessments
- Challenges for future preparedness

The seminar was held at Sem Gjestegård in Asker outside Oslo, Norway, on 30 – 31 October 2008 and was joined by about 40 participants. These were mainly members of the NKS organisations, invited speakers and representatives from various Norwegian emergency preparedness organisations.

The seminar aimed to facilitate an exchange of information and opinions, and to provide a basis for enhancing networks within the subject area, especially between research communities and emergency preparedness communities. In a similar way, the seminar aimed to provide a skill upgrade in the emergency preparedness communities with regard to source terms and possible scenarios.

2. Abstracts

Session 1: Possible hazards

Sandström B: Radiation as a Weapon – A view from *open source* studies

Swedish Defence Research Agency (FOI), Sweden

The 13 cases that I am presenting here today all represent very serious crimes involving radioactive material or terrorist activities against nuclear installations or planned terrorist activities with radioactive material. They span a time period between the 1940s and today. With the exception of the poisoning of Alexander Litvinenko in 2006, most details in the other twelve cases seem to be fairly unknown in the wider community of radiation professionals.

The 13 cases represent several homicides and suicides, one case of intentional irradiation of a boy leading to his permanent sterility, several attacks on nuclear facilities, an attempted homicide and a possible contamination of tap water. Also included in this compilation is the first known case of an attempt to use radiation as a weapon that I have found; the plans of large-scale sterilization of Jews in Nazi Germany. Furthermore, the case of 'the radioactive boy scout', who fearless of any radiation effects on his own person, went on to build a prototype breeder reactor in his mother's garden shed and the large-scale planning of terror attacks in the UK, that included a plan to disperse Am-241 from 10,000 smoke detectors, will be discussed.

From this study, it can be concluded that:

- intentional radiation poisoning still is a rare event.
- particularly during the years 1975-1985, radiological terrorism existed as phenomenon, but the aim was primarily to stop further nuclear energy expansion and not to cause radioactive releases.
- reality shows that you have to be prepared for everything to happen!

Andersson K G: "Dirty bomb" explosion in a city area: What do we need to know for preparedness

Risø National Laboratory for Sustainable Energy, Denmark

Depending on the amounts and types of radionuclides, their pre-explosion physicochemical forms, and the construction of the explosive device, the radiological consequences of a 'dirty bomb' attack within a city could be anything from trivial to severe. In relation to such incidents it is highly valuable for preparedness organisations to have a prognostic decision support tool that in advance of an emergency enables identification of the possible consequences and likely requirements for mitigation in different types of conceivable malicious radionuclide dispersion scenarios. This will help to develop an effective operational preparedness. At the same time, this type of system would be valuable in the event of an emergency, to enable targeted response planning and to give an indication of which areas are likely to have been most severely affected, so that resources can be spent in the best possible way during the first critical period. It should in this context be noted that some of the radionuclides of primary concern in connection with a ‘dirty bomb’ are pure alpha or beta emitters, which could take exceedingly long to measure and map over a large city area. Also, to be able to optimise countermeasure strategies for the long term after an emergency, it is necessary to be able to adequately estimate the contributions to the total accumulated dose that would over decades be received from each type of surface. The ARGOS decision support system is being developed to address these issues. In the presentation, the crucial parameter requirements to estimate doses received through different pathways are discussed.

Bergan T D: Possible scenarios and challenges for CBRN preparedness

Norwegian Directorate for Civil Protection and Emergency Planning (DSB), Norway

The Norwegian Directorate for Civil Protection and Emergency Planning, (DSB), has among other tasks, a duty to keep overview over developing vulnerable situations and risks which threaten the Norwegian society – in peacetime and war. DSB shall take initiatives to prevent accidents, disasters and other undesired occurrences and ensure that preparedness measures are adequate.

In 1999 the Ministry of Justice and the Police decided there was a need for an overall national plan for preparedness against weapons of mass destruction. The plan was finished in 2003, and a subject/vocational group with participants from relevant professional bodies was established.

The aim of the National plan is to give an overview of management and coordinating mechanisms, conditions of responsibility and availability of resources. The plan proposes interventions to be implemented, based on already established agency preparedness and other principles of responsibility, and the group meets 2-4 times per year and serves as a contact forum and discussion group for further development within the different sectors. Today, the group consists of 15 different civilian and military bodies.

Means of mass destruction is a term applied to radiological, biological and chemical substances that can potentially cause injury to persons or loss of human life on a **large scale**, heavy material damage, and the destruction of infrastructure. In addition, the threat to use as well as the actual use of such means is because of their nature likely to create **great fear and concern** among the population.

In Norway, either the Police or the Fire and Rescue Brigades will be the first responders on a CBRN-scene, and act as on-scene coordinators. One of the biggest challenges is to detect and identify any hazardous substances present at the scene. The police do not have any CBRN identification equipment, where as a few of the fire trucks will be equipped with instruments. In most cases thorough expertise will be needed to correctly identify the challenges at scene. Furthermore, the Ambulance service requires clean patients, and the response time for setting up mobile decontamination units is between 1-2 hours.

The main challenge is how do we plan for CBRN-accidents or CBRN threats that are unlikely to occur? Regular threats, accidents that occur often, will lead to a society that learns how to respond. It is economical feasible to have emergency preparedness plans and equipment to respond to these types of events. Irregular threats are more challenging – they represent one of a kind events. It is practically impossible to provide standard responses, and experience based learning is less favourable.

Unexampled events – events that are virtually impossible to imagine will still occur. We have had several examples of terrorist acts during the last years, September 11th 2001 being perhaps the most visual act so far. Terrorist acts also include the Madrid bombing in 2004, and the London bombing in 2005.

As part of the CBRN preparedness in Norway, we use scenarios to prepare for practical cooperation and operations in the field. One type of scenario could be the spread of radioactive material in combination with biological harmful substances.

Part of the preparedness is to assess the capability and intentions in different groups. So far, traditional explosives have been efficient, easier to handle for terrorist groups, and planning attracts much less attention.

A more likely scenario is a road accident with hazardous material in for example densely populated areas.

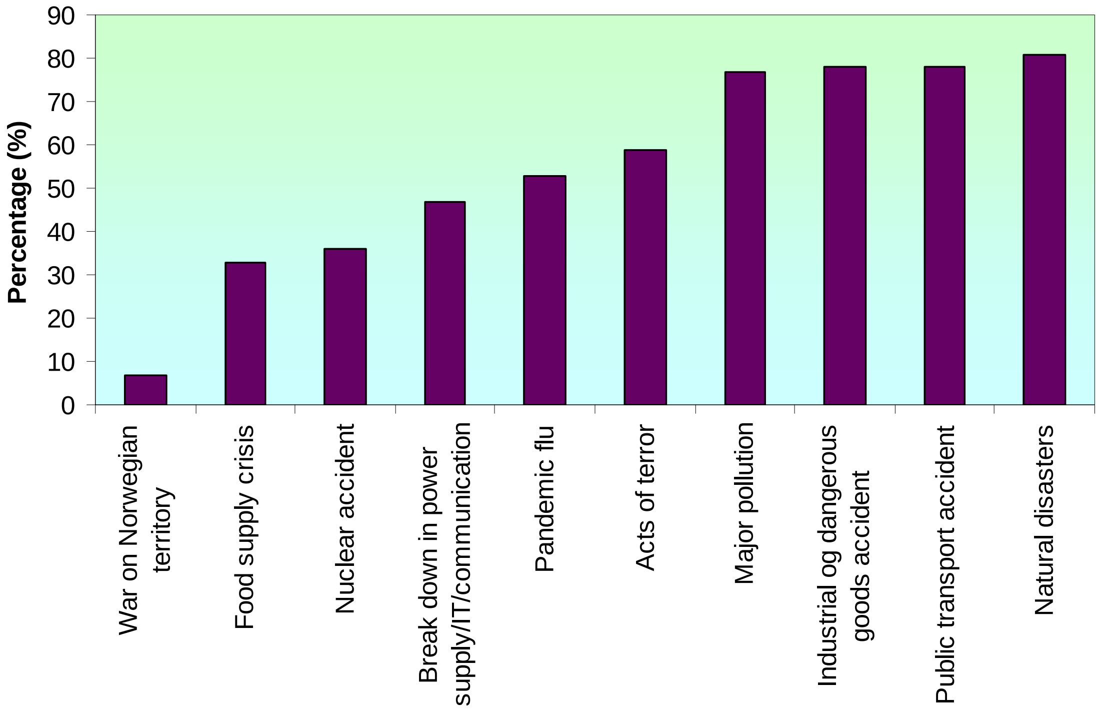

Figure 1: *On regular basis, we ask the population what they think is the likelihood of a catastrophe occurring within the next 5-10 years. As the graph show, acts of terror ranges fifth on the list, and 60% of the population believe it is likely or very likely that a terrorist act will occur in Norway within the next 5-10 years.*

These types of scenarios can be developed further and used actively in table-top exercises and other exercises. The scenarios must be developed in more detail, in order to facilitate discussions and identification of weak points. Furthermore we would like to evaluate the investments following September 11th 2001 and follow up on how they are implemented in emergency preparedness today.

Some of the questions we need to ask are:

- Are we succeeding in thinking the unthinkable?
- Are the systems robust and versatile enough to handle CBRN accidents and disasters?
- Should we in the Nordic countries rest assure that the US and UK will be much more attractive terrorist targets, also in the future?

Stenersen A: Terrorism, development and interest for RN

Norwegian Defence Research Establishment (FFI), Norway

Agenda

First of all, thank you for the invitation to come here and speak today. I was asked to hold a presentation on the topic of radionuclear terrorism. What I will do in this presentation is **first**, to briefly talk about the new trends within international terrorism, in order to explain why, over the last decade, there has been a growing concern that terrorist groups might seek to acquire and use CBRN materials. And **secondly**, which will be the main part of the presentation, I will discuss the question of "**why radiological and nuclear materials and weapons are attractive to terrorist groups?"** I will not try to provide a complete answer to this question, but will present a case-study of the group that's probably still regarded as one of the greatest threats to Western security, namely the al-Qaida network.

Just for the record, I define a "**terrorist group**" as a sub-state actor that uses the tactic of targeting civilians in order to spread general fear and to further a political message. And ”**al-Qaida**" is a network of militant islamists that's led by Osama bin Laden. And who follow al-Qaida's ideology which is sometimes referred to as "global jihadism". Just very briefly, if you believe in AQs ideology, you see the world as divided into two camps; the Muslim world and the West; and you also believe that the Muslim world is currently under attack by the leaders of the Western world; the US and Israel. This is both a direct military attack (occupation of Palestine, invasions of Afghanistan and Iraq), and an indirect attack (referring to the American economic, political and cultural dominance over the Middle East). Followers of AQ believe that since the Muslim world is under attack by the US, it is an individual duty of every Muslim to take part in the war, which includes carrying out terrorist attacks against the US and their allies all over the world.

The purpose of using AQ as a case-study when discussing radionuclear terrorism, is that I would like to not just focus on hypothetical, worst-case scenarios, but to put the phenomenon into some perspective by highlighting what terrorist groups have actually said and done in this field up until now. My impression is that the threat of CBRN terrorism from al-Qaida is often quite exaggerated, partly because of how this topic tends to be hyped up in the media. We tend to assume that the only goal of al-Qaida is to create as much destruction and kill as many people in the west as possible. But one might ask, if it really was true that bin Laden has been trying to obtain nuclear weapons since the early 1990s, why is it so that 15 years later, there is still no evidence the al-Qaida network has ever been close to detonating or even constructing a radiological or nuclear device? This can of course be explained by the fact that al-Qaida does not have sufficient technical expertise to do so, in addition to the difficulty it is to buy or steal the necessary materials. Still, this does not answer the question of why some terrorist groups might spend a lot of money and efforts to pursue a radionuclear capability, while other terrorist groups do not. And where is, really, the al-Qaida network on this scale? This is why the focus of this presentation will be to look at **why or why not AQ would be interested in using radionuclear weapons for terrorist purposes.**

New trends in international terrorism

"Terrorists want a lot of people watching, not a lot of people dead" (Brian Jenkins, 1985)
"Today's terrorists don't want a seat at the table, they want to destroy the table and everyone sitting at it" (Former CIA chief Woolsey, 1994)

As illustrated by these two quotes, the nature of the phenomenon of terrorism is changing. Traditionally, the main purpose of terrorism has been to get "a lot of people watching, not a lot of people dead". However, in the 1990s policy-makers and academics started talking about the emergence of a "new kind" of terrorism that was more violent, and that seemed to also hit more indiscriminate targets than previous terrorist incidents. It was within this context that the subject of CBRN (or non-conventional) terrorism also started to draw international attention, especially after a Japanese cult named Aum Shinrikyo carried out an attack with Sarin gas on the Tokyo subway in 1995, which killed 12 people and injured several thousand.

Statistically, the terrorist attacks of today have become fewer, but each attack has on an average become more deadly. This might in some sense justify the use of the term "new kind of terrorism". However, this should not lead us to think that terrorism has become more high-tech – rather it appears that the contrary is true. (An example of this is the increased use of suicide bombing as a tactic, both by religious and non-religious groups. The reason why I all suicide bombing a "low-tech" type of weapon is that the delivery method of the weapon is low-tech – it relies on a person to manually carry the bomb to its intended target.) And the terrorist attacks on 11. September where hijacked airplanes were crashed into buildings, showed that it is, unfortunately, a real possibility to cause mass casualties even without the use of CBRN weapons.

Why would terrorists want to use radionuclear weapons?

Now on to the second part of this presentation. As I mentioned in the beginning I'd like to focus on the question of "**why radiological and nuclear materials and weapons are attractive to terrorist groups".** What I have done here is to take three common assumptions regarding why terrorists would want to obtain and use RN-materials for terrorist purposes:

1. One is to achieve a balance of power with nuclear states in the West (for the purpose of deterrence)
2. Secondly, groups want to use RN-weapons as a revenge, punishing for the West killing millions of Muslims in the past (f. ex. during the Gulf War) – based on the principle of equal retaliation.
3. Third, and perhaps most realistically, some groups want to use RN-terrorism (or even just threaten with the use of RN-terrorism) to create fear and disruption, but not

necessarily to kill a lot of people. (Terrorists know of course, that this will give them a lot of attention because even the *threat* of a radiological or nuclear attack is something that will always create large newspaper headlines in the West.)
Now we will look at how these three assumptions apply to the al-Qaida network. This I believe will help to clarify AQs current intentions and capabilities in the field of radionuclear terrorism.

Balance of power
The first sentence you see here is probably one of the most often-quoted sentences of Osama bin Laden. He said in an interview in 1998 that **"Acquiring chemical and nuclear weapons for the defence of Muslims is a religious duty."** This sentence is often used as the ultimate proof that al-Qaida is determined to obtain a non-conventional weapons capability. What I find more interesting about this interview, is what bin Laden says afterwards, when he states *why* he wants Muslims to obtain nuclear weapons: "**It would be a sin for Muslims not to try to possess the weapons that would prevent the infidels from inflicting harm on Muslims."** In other words he has this idea that al-Qaida should possess chemical and nuclear weapons to function as a deterrent. This corresponds with an account published by an al-Qaida insider named Abu Walid al-Masri, who was present at meetings in al-Qaidas shura council in the end of the 1990s. He said that there was a discussion there of whether al-Qaida should obtain "weapons of mass destruction" or not. There were two wings within al-Qaida, one in favour of obtaining WMD and the other against. Those in favour of obtaining WMD expressed a concern that the US might attack AQ with WMD, and therefore, al-Qaida should also try to obtain them so that they're able to retaliate in case of an attack. There is another quote by bin Laden where he specifically states that **"we (al-Qaida) have these weapons as a deterrent"**. There has been no evidence later that bin Laden was speaking the truth, that he actually has possessed any kind of non-conventional capability at the time, but the *idea* he expressed in interviews in the late 1990s was, nevertheless, that the motivation for al-Qaida to obtain RN-weapons would be to achieve a "balance of power" with the West.

In light of this, it is interesting to look at what al-Qaida actually *did* in Afghanistan prior to 9/11, and specifically, how much resources they actually dedicated to developing what they called "weapons of mass destruction". Based on what was found in the training camps in Afghanistan after the invasion in 2001, we now with high level of certainty that al-Qaida members reviewed open-source information on CBRN weapons, conducted experiments with crude poisons, probably attempted to recruit scientists, including nuclear scientists, and possibly tried to, or were planning to, obtain chemical and biological warfare agents. According to documents found on one of al-Qaida's computers in Kabul, al-Qaida had a programme for developing a non-conventional capability, and that its initial budget was between 2-4,000 dollars. This is of course a ridiculously small amount if you're talking about making any kind of serious research into CBRN weapons. (Just as an illustration, it has been said that Aum Shinrikyo, the Japanese cult that attacked the Tokyo subway with sarin gas in 1995, invested 30 million dollars in its sarin gas programme alone). Documents on this computer also indicated that the efforts were mostly made in the chemical and biological fields. With regards to the nuclear weapons research efforts made by al-Qaida, there are very few indications that they went beyond theory, and beyond the stage of just reading about nuclear weapons in open sources. I think you will all agree that if al-Qaida set aside between 2-4,000 dollars to its CBRN programme, it does reflect a certain desire to look into the topic of CBRN-weapons, but this was certainly not a priority for al-Qaida at the time. According to one eyewitness account, bin Laden himself believed, at the time, that his war against the United States could be won by using conventional means.

The idea that al-Qaida need to obtain nuclear weapons in order to achieve a strategic balance with the West was also very clearly expressed by a Syrian militant named Abu Mus'ab al-Suri, who is al-Qaida's perhaps most well-known strategic thinker, and who wrote many books and articles discussing the strategy of the global jihadi movement and how al-Qaida should fight in order to win the war against the West. He lectured, for example, in Kabul in 1999 that "**In their countries (meaning the West) we have to use weapons of mass destruction in terrorism ... Because between us and these people there has to be a strategic balance."** In one of al-Suris more famous quotes he said that **if he had been in charge of the 9/11 attacks, he would have filled the hijacked airplanes with weapons of mass destruction**. This quote, of course, has to be seen in context with the rest of al-Suri's writings. He argues, of course, that in order for al-Qaida to have a strategic balance with the west, al-Qaida have to possess nuclear weapons. But he also realizes that this is impossible for the time being. Because the main strategy he argues that al-Qaida should follow is a strategy where autonomous cells all over the world carry out small-scale terrorist attacks against US interests; his ideas are very much inspired by theories of guerrilla warfare where a weak opponent is exhausting a strong opponent.

What we can conclude from this is that at least before 2001, certain al-Qaida members wanted to obtain nuclear weapons in order to use it as a deterrent, or to use it in self-defence, but when we look at what AQ actually *did* in this period, it is pretty safe to say, even when only basing it on open sources, that this was mostly talk and a bit of propaganda to scare the West, but it did not really translate into a lot of action. Part of the reason for that, I believe, is that the al-Qaida leadership was split in the question of whether it was really necessary to obtain CBRN weapons or not.

Revenge/punishment

Now on to the next assumption regarding why al-Qaida would want to obtain a radionuclear capability: The desire to punish the West, and the United States in particular, for the crimes that they have already committed against Muslims all over the world.

The principle of "equal retaliation" was clearly expressed by a spokesperson for the al-Qaida network in 2002, who wrote in an article that **"we have not reached parity with them. We have the right to kill four million Americans, two million of their children, and to exile twice as many and to wound and cripple hundreds of thousands."** These numbers he is listing is referring to his estimates of how many Muslims have died or been killed due to American and Israeli policies towards the Muslim world, and the Middle East in particular (the international boycott of Iraq in the 1990s is often used as an example because it is claimed that it indirectly led to the death of thousands of Iraqi children, and according to al-Qaida logic this is now something that al-Qaida has the right to take revenge for).

Such calls for retaliation and revenge are echoed in several other statements by al-Qaida members, but the most significant statement legitimizing "WMD" as it is referred to is a fatwa (or religious ruling) issued by a well-known radical cleric in 2003, which said **"The attack against [the United States] by Weapons of mass destruction is accepted, since Allah said: 'If you are attacked you should attack your aggressor by identical force.'" He goes on to argue, "Whoever looks at the American aggression against the Muslims and their lands in recent decades concludes that it is permissible... Some brothers have totalled the number of Muslims killed directly or indirectly by their weapons and come up with a figure of nearly 10 millions."** This fatwa by al-Fahd was based on the same argumentation that Abu Ghayth and others had used previously, but it carried considerably more weight since it came from a cleric with an authority to interpret religious texts and to issue fatwas.

As you an see from the dates of these quotes, these kinds of arguments started to appear especially after 2001. So what we can conclude from this is that there seems to have been a shift in al-Qaida's attitude towards the use of RN-weapons after the 9/11 attacks. It seems pretty clear that such weapons should no longer be obtained for the purpose of deterrence and self-defence, but they should actually be obtained and used immediately, in order to take revenge for something that has already happened in the past.

It is important to note that this reflects a shift in al-Qaida's attitude towards non-conventional weapons, but it is not necessarily an indication that al-Qaida are now more interested in obtaining and using radiological and nuclear weapons than before 9/11. My argument for saying this is that if we look at the terrorist plots connected to al-Qaida that have been revealed after 9/11, we see many plots that involve conventional explosives, suicide bombings, or hijacked airplanes, but we have no examples of al-Qaida making a serious attempt to carry out a true radiological or nuclear attack. In other words, the al-Qaida network today continues to rely on the same terrorist methods as they have used in the past, like the use of simultaneous explosions and suicide bombers. While there is certainly a desire to carry out a mass-casualty attack in the West, the dominant attitude is that **al-Qaida's goals of revenge and punishment can still be achieved by carrying out conventional terrorist attacks.**

<u>Fear/disruption</u>

The last assumption why al-Qaida would want to carry out a RN-attack is to create fear and disruption. And this is of course the most realistic way of using radiological or nuclear materials for terrorist purposes, because it is the least technically demanding. **To achieve a balance of power with the West (the first point I talked about) one would need to possess the nuclear arsenal of a state, which is practically impossible for a non-state actor. In order to achieve the second goal, which was retaliation or punishment for the West allegedly killing millions of Muslims, one would need a primitive nuclear weapon or a very powerful radiological device, both of which require technical skills and access to technology and materials that are beyond the reach of most terrorist groups. But to achieve this third goal is much more within reach for terrorist organizations.**

What I'd like to emphasize here, is that al-Qaida has been perfectly aware of this since the 1990s. For example, in the end of the 1990s, when al-Qaida disussed whether or not to try and obtain a non-conventional weapons capability, one of the arguments against trying to obtain them was that "al-Qaida being a non-state actor, would never be able to match the technically sophisticated weapons of the West". But the person who argued this, according to the source went on to suggest that **"al-Qaida should obtain a primitive non-conventional capability, but continue to call it 'weapons of mass destruction' to create fear."** It's interesting because it seems like this is exactly what al-Qaida did up until the invasion in late 2001, making experiments with crude chemicals and biological agents, and not dedicating a whole lot of money to making a *serious* effort at developing a CBRN programme.

Another case which illustrates this is the case of Dhiren Barot, an al-Qaida affiliate who was arrested in the UK in 2004, and who was in the process of planning several terrorist attacks. One of these plans involved collecting small amounts of radioactive material from a thousand smoke detectors, and use these to cause radiological contamination of a public area. The plan would probably not have worked, but it's nevertheless **the only attempt we know of by an al-Qaida affiliate, to actually build a so-called "dirty bomb".** What's interesting is that according to Barot's plans, is that he was aware that the radiological device would probably not kill anybody, the purpose was to set it off at the same time as a series of conventional explosions, hoping that the radiological contamination would create additional fear and disruption.

A **third example** of this that we see a lot, is of course internet propaganda and empty threats, that we se still manage to make the headlines – such as this video called "nuclear jihad" posted on the Internet in May this year. Al-Qaida's internet sympathizers are well aware that the topic of RN-terrorism is popular with western media, and do all they can to take advantage of this.

Concluding remarks

Why would al-Qaida want to use RN-weapons for terrorist purposes?

Shifting motivations for using RN: From "balance of power" to "retaliation/punishment" after 2001.

However, when we look at what al-Qaida has actually done in the field of RN-research, we see that there is a large gap in intention and capability.

In practice, there is an awareness among al-Qaida members that in the field of RN, "fear/disruption" is the only realistic option (this awareness both before and after 2001).
This may partly explain why AQ has not allocated more resources to development of a radionuclear capability.

The conclusion is that RN-attack from AQ is not very likely because AQs goals are such, that they can still be achieved through using conventional types of weapons. Whether or not they will carry out a RN-attack will depend on what resources are available at the moment, and of course on individual initiatives from AQ-inspired terrorists, but the strategy of "AQ central" is not to spend a lot of time and resources on developing RN-weapons.

It is also worth noting that I have used AQ as a case-study here, but there are studies that have looked at past cases of CBRN-terrorism conclude that militant Islamists are not the most likely actor to carry out CBRN terrorism. (It is more common, for example, among extreme right-wing or extreme left-wing organizations).

Eikelmann I M H: The wreck of the cruiser Murmansk

Norwegian Radiation Protection Authority (NRPA), Norway

In December 1993, the decommissioned cruiser Murmansk was torn from its towing towards India for dismantlement and ran aground just outside the fishing village Sørvær on the coast of Finnmark in Northern Norway.

The Norwegian Radiation Protection Authority (NRPA) received information about the wrecked vessel from the Norwegian Defence Command Headquarters. The coast guard carried out measurements and collected sea water samples.

The initial concern was the possibility that there might be nuclear materials onboard the vessel, either in form of nuclear weaponry or spent nuclear fuel. NRPA made initial assessments and concluded that it was very unlikely that the vessel would contain radioactive substances that could pollute the surrounding area

In June 2007 NRPA was notified by a private recycling firm that items taken from the wreck of the cruiser Murmansk showed sign of gamma radiation. The source was sent to a low level radioactive waste depository.

Friday 1 August 2008 major Norwegian newspapers have lead stories on public concerns regarding radioactive substances at the ship. NRPA realized the need for a more thorough follow-up and decided to visit the wreck for new investigations.

The investigations on the wreck were gamma dose rate measurements and collected samples of sea water and biota inside and outside the wreck.

All samples was analysed and compared to expected values based on the Norwegian marine monitoring programme. The analysis did not show any radioactive contamination from the wreck. Also further measurements of concentrated sea water samples, alpha spectrometry of biota and sediments samples have not shown any trace of radioactivity.

Handling of media was a main challenge thru this event and it proved to be the most publicised news bulletin concerning NRPA in 2008. NRPA received very good public, political acceptance for handling the case and lead to a good cooperation between responsible authorities.

Reponen H: Russian nuclear Power Reactors 2010 – 2020

Radiation and Nuclear Safety Authority (STUK), Finland

According to the official plans the vast majority of the 31 old nuclear power reactors in Russia will operate to the end of the next decade and at the same time a large number of new reactors will be commissioned. The indicators available demonstrate an encouraging safety level.

The continuous rearrangement of the involved Russian organisations aims at a smooth realisation of the nuclear programme, but at the same time it seems to threaten the position of the independent regulator.

Of the 31 nuclear power plant reactors presently operating in Russia, so far 12 units have exceeded the original 30 year design life time. By the end of 2010 another three units will reach that limit. Based on the permit of the national nuclear regulator the lifetimes have been extended by 15 years. For the seven oldest units this extended lifetime will expire between 2016 and 2019. The process of re-licensing the old units for extended operation includes thorough inspection and analysis efforts of the non-replaceable parts of the units and an extensive upgrading of the whole technology. The measures at units whose life-extension has been followed by the experts of neighbouring countries give a convincing impact and the low number of disturbances in operation supports the impression.

The low number of events and disturbances at the Russian nuclear power plants even raises suspicion among the Western experts as was discussed in the Fourth Review Meeting of the Convention on Nuclear Safety in April 2008. All over the world a typical number of INES 0 or INES 1 events per reactor year is 0.5. Russia, instead, has reported no INES 1 or higher events since 2004. A critical consideration of the known events at Russian plants suggests need to reclassify certain events to a higher class. Even after these changes the safety level of the Russian reactors, based on commonly used indicators, is not worse than at any reactor of the same vintage.

The official plan for new capacity by year 2020 includes completion of a couple reactors whose construction was started in earlier times, and the full construction of 18-35 totally new units. The final number will depend on the funding available. According to the latest news the quick start at the leading sites of Novovoronesh and Leningrad NPPs has lost the momentum due to the weakening economy. At Leningrad NPP site the funding for next year is unclear and Rosatom Corporation has recently dismissed altogether 89 project officials due to the slow progress of the project. (However, first concrete was poured at LNPP-II on October 25!) The new reactors will be of new type AES-2006 developed from the VVER-1000 reactors, with increased power and added new passive safety features. The design looks reliable and the safety of the nuclear power plants will eventually depend on the quality in the realisation of the projects and quality of the operation of the units. In assuring this the national regulatory organisation has an important role.

In May 2004 the Russian nuclear regulator Gosatomnadzor (GAN) was turned to Federal Service for Environmental, Technological, and Nuclear Oversight (Rostekhnadzor), where the technological and environmental oversight functions were combined with the nuclear one. In May 2008, in another administrative reorganization of the Russian government, Rostekhnadzor was placed under the supervision of the Ministry of Natural Resources and Ecology. It appears that Rostekhnadzor has suffered cuts in funding and personnel. The Ministry of Natural Resources and Ecology was endowed with functions on forming state policy and normative legal regulations in the nuclear sphere. It is unclear whether the restructuring permits effective independent government oversight of the nuclear sphere. The changes may fulfil the expectations on the industry side where many people wish more power to the Rosatom State Corporation.

In addition to the nuclear power reactors producing electricity into the national grid there are a number of smaller reactors in Russia serving other purposes. One group of them are the reactors in operation on nuclear submarines and civilian icebreakers. The same type of reactors are going to be furnished on the floating nuclear power plants for use in remote areas inaccessible for long periods of the year. Another big group are the research reactors. The main challenge for these is changing the fuel from High Enriched Uranium to low enriched one. The change is related to the proliferation risk. The scale of the threat from the small reactors is minor compared to the nuclear power reactors.

Smith-Briggs J L: Spent Nuclear Fuel at Andreeva Bay

Nuvia Ltd., UK

The storage facilities at Andreeva Bay (North West Russia) contain spent nuclear fuel (SNF) from nuclear-powered submarines and icebreakers. Approximately 22,000 fuel assemblies are kept in three storage units. The fuel assemblies were loaded into steel canisters following discharge from reactors; each canister contains between three and seven fuel assemblies. Within the storage units, each canister was placed into a cell consisting of a steel tube mounted vertically on the concrete base of the unit; the space between cell tubes is filled with concrete.

The current storage units were built as a temporary facility in the mid-1980s following failure of the original SNF storage facility at Andreeva Bay. The new storage units were intended to provide dry conditions in which to store the fuel. However, water has entered and many of the storage cells are flooded. Analyses of the water have shown that this contains high levels of radionuclides which indicate that there has been some corrosion of the canisters and of the SNF assemblies.

The UK Government's G8 Global Partnership Programme has been supporting a project concerned with SNF management at Andreeva Bay since 2002. The primary objective of this work is to improve the safe and secure management of the SNF at Andreeva Bay.

The strategy for SNF management at Andreeva Bay has now been developed in some detail. The technical strategy has been developed over several years and was presented to stakeholders in April 2007. This details the processes, facilities and equipment required to remove the spent nuclear fuel (SNF) safely from the site as soon as possible. The technical strategy has been endorsed by both Russian and international Donor stakeholders.

In summary, the strategy is to construct a building (B153) over the SNF storage tanks to provide containment and equipped to remove the spent fuel assemblies (SFA's) and to repack these into new canisters and thence into transport casks. Additional facilities are also required; B151 will be a storage pad for the casks prior to shipment off-site and B154 will provide general and active maintenance workshops, canister testing and decontamination facilities for the specialist equipment in B153. Supporting ground preparation, services and infrastructure and on-site cask transport equipment are also required. Operational radwaste arising from the SNF facilities has to be dealt with by the radwaste facilities that also deal with the site legacy waste.

The presentation will describe the key technical components of the SNF management strategy and how these are intended to be implemented at the site. The presentation will also discuss the potential hazards from the SNF at the site, in its current state and during recovery and transport of the SNF off-site.

Høibråten S: Nuclear Weapons

Norwegian Defence Research Establishment (FFI), Norway

Nuclear weapons are weapons which get their yield from processes in atomic nuclei, i.e., fission (chain reaction in uranium or plutonium) or fusion (of hydrogen isotopes). A "nuclear weapon" consists of one or more warheads plus a means of delivery, such as a missile or an airplane. So far only national states have possessed nuclear weapons.

For a while after the end of the cold war, nuclear weapons did not receive much attention. Today, they are back on the agenda, however, both because the nuclear weapons states still keep stressing their importance and because of the concern that more states and maybe even terrorist organizations may acquire nuclear weapons. The total number of nuclear warheads in the world today is estimated to be around 25000. Less that one thousand of these are outside the control of Russia or the United States.

The main obstacle for potential new nuclear weapons states, as well as for any non-governmental organization attempting to build such weapons, is to produce, or in other ways get hold of, weapons grade uranium or plutonium. The most important step to prevent the proliferation of nuclear weapons is therefore to closely guard all weapons grade nuclear materials.

Session 2: Experience from previous incidents

Reistad O, Hustveit S and Roudak S: Russian Nuclear Submarine Accident Survey 1959 – 2007

Norwegian Radiation Protection Authority (NRPA), Norway
Norwegian University of Science and Technology (NTNU), Norway

In this presentation, 166 safety-related events involving Russian nuclear submarines from 1959 to 2007 are discussed with respect to vessel generation, reactor type, various types of initiating event (loss-of-coolant accident (LOCA), transients, common cause initiators (CCI)), safety significance and the release of radioactivity. The survey of vessel operations shows that the accumulated number of vessel operating years (VOY)/ reactor operating years (ROY) from 1959 to 2007 is 4991/ 9335. With respect to the survey of safety-related events, out of the 166 events registered, there have been identified 17 accidents, 134 incidents and 15 deviations. As to event characteristics, 14 LOCA and 7 criticality events have been identified. The accident rates for each of the vessel generations exhibit the usual characteristics of a technological system under development, gradually going from a high accident rate to a stable lower level - however, with clear differences between reactor technologies (PWR vs. LMC) and vessel generations. The mean-time between failures (MTBF) for various types of safety-related events for the Russian nuclear submarines has been calculated for various events using the non-homogeneous Poisson process (NHPP) power-law model. When applied on the complete set of events, this model fails due to a cluster of safety-related events that occurred between 1984 and 1987. With respect to the release of radioactivity, the MTBF has been calculated to 893 ± 138 VOY.

Ulbak K: The Thule accident

The National Institute of Radiation Protection (SIS), Denmark

On 21 January 1968, a US Air Force B-52 bomber carrying four nuclear weapons crashed into the sea ice about 12 km west of Thule Air Base in north-western Greenland. The plane was on fire before the crash, and the collision with the ice triggered an explosion in the bomber's detonators of conventional explosives that exploded all four nuclear weapons and the bomber. The wreckage of the weapons and the bomber, including plutonium, americium, uranium and tritium, was dispersed over a large area of the sea ice. There was no sign of any nuclear explosion in the crash, but the explosion in the conventional explosives surrounding the nuclear material in the nuclear weapons resulted in radioactive contamination of the environment.

The presentation will describe the overall mitigation and follow-up activities and efforts in three distinct time periods after the accident.

1968 – 1971 the accident and the clean up

1986 – 1995 health status of Danish Thule workers and the local population

2003 - 20?? monitoring of the terrestrial environment and assessment of the radiological impact to the public.

Session 3: Public perception of nuclear and radiological threats and information challenges

Sjöberg B-M D: Public Perception of Radionuclear Threats and how it Affects Nuclear Emergency Preparedness

Center for Risk Psychology, Environment and Safety, RIPENSA, Norwegian University of Science and Technology (NTNU), Norway

The presentation outlined briefly four areas related to public perception of radionuclear threat and how it affects nuclear emergency preparedness, viz. perception of risk and threat, information, expectations and cultural influences. It was stated that uncertainty and non-voluntariness are effective contributors to perception of risk. Research has shown that there are a number of factors that can be used to predict perceived risk to a rather high extent ($R^2 \approx 0.55$), i.e. the new risk, disaster risk, and dread factors from the psychometric paradigm, the factors of interfering with nature, social and epistemic trust, as well as background factors such as gender, level of education and age. Epistemic trust relates to confidence that Science has or will provide an answer. Social trust refers to trust in others, e.g. authorities, experts, politicians, etc. Uncertainty in communication situations can be produced by the use of mathematical or statistical terminology, as well as by e.g. vague verbal probability expressions such as "sometimes" or "possibly". Distinctions were made between crisis communication in acute situations, the preparatory risk communication phase, and normal, everyday situations. It was underlined that hazards or accidents caused by human negligence, error or intended harm more easily produce strong, negative human reactions. Similarly, it can be shown that causes to hazards or harm that are perceived as "acts of God" or "natural" provoke such reactions to a lesser extent. If knowledge, information or other circumstances offer means or confidence that one can protect oneself and those concerned, the experience of risk is lessened. For example, there are usually stronger reactions to e.g. health hazards that are hard to detect by human senses or require mediated warnings, such as radiation. However, it has also been shown that radiation due to sun bathing or radon in the home provoke relatively less reaction that radiation caused by the Chernobyl accident or nuclear weapons testing, due to the perceived controllability of the former risks. Research in the area of risk communication has shown that effective information in a crisis situation must be quick (as soon as possible), goal oriented (to facilitate protective actions), as correct as the situation allows, and continuous over time. The ability to transmit relevant, reliable and action guiding information to people in a crisis or risk situation facilitates development of trust, expertise, and risk prevention or mitigation. Examples of newspaper content studies at selected times in Russia, Ukraine and Belarussia some years after the Chernobyl accident were shown, and illustrated differences across the countries regarding when information was presented to the public, which societal actors that produced texts, and the main emotional tone of the materials. Reactions and expectations in the public of the former Soviet Union countries were thereafter compared to the European situation. It was pointed out that individuals' resources related to e.g. socioeconomic standard, social and personal influence and ability to protect oneself steered expectations of e.g. warnings and information, help or rescue efforts and future well-being. It was also noted that expectations are related to earlier individual or historic/social experience and may trigger other associations than those intended. Non-optimal public information strategies or risk mitigation efforts may cause additional harm and fear instead of having empowering effects. Adaptation to local life conditions of information, dialogue attempts and risk mitigation efforts was suggested, based on the importance of knowledge of local circumstances, and cultural contexts.

Tønsberg K I: Information requirements in emergency situations, openness in crisis and risk communication

Norwegian Directorate for Health

The purpose of risk communication is to inform the people of the likelihood of some adverse event taking place, and how to deal with it. Choosing what aspects of such a crisis are communicated to them is of crucial importance. It is claimed that great deal of public attention will often be claimed by some aspect of an adverse event that was not included in the official information provided to the people. Whenever people are ambivalent, seeing merit on both sides of some issue, they tend to focus on the side others are ignoring. This is the "Seesaw-principle", www.psandman.com. "When addressing an ambivalent audience you can take the obvious seat, the worst strategy – and the most common one. It is to take the position you wish your audience would take, as if the game were follow-the-leader instead of seesaw. Companies and government agencies do this all the time. You want your stakeholders not to worry, so you tell them there's nothing to worry about. The unworried seat on the seesaw being thus occupied, your stakeholders reliably become all the more worried. Somebody needs to be worried, after all; if not you, then us. Take the counterintuitive seat. A far better strategy is to stress the side of the ambivalence that does you harm, leaving the other side – your preferred side – for your audience to stress instead. This is profoundly counterintuitive. But it works."

This view advocates risk communication to present a 'worst case scenario', appropriate contingency plans the people can carry out. "Tell people how scary the situation is, and watch them get calmer".

Success of crisis communication requires making available to the public and media all the relevant information before a crisis, or at its outbreak. To achieve this, it is necessary to ensure the communication preparedness of the authorities.

This should include information on the consequences rather than on the likelihood of a crisis, how to deal with them, and where to turn for further help. Moreover, this information must be presented to the public in a clear and coherent way, not avoiding the problematic issues, so that the public would come to rely on its source. The best way to deal with possible issues would be to make public the information on the sensational aspects of a crisis well before its outbreak, thus turning it into 'old news'.

Forsberg E M: Addressing uncertainty in risk assessments – What is the role of stakeholders?

Work Research Institute (AFI), Norway

In the case of contamination by ionising radiation, risk assessment of the effects of the contamination and of the countermeasure strategies will be carried out. This risk assessment will inherently contain uncertain elements, for instance with regard to concepts, models, data, interactions of contaminants with other environmental or physiological factors, interactions of countermeasures with other environmental factors, the implementation of the countermeasures, economic impacts, etc. Where scientific uncertainty is high it is important that these uncertainties are transparent, communicated to, and understood by, decision makers, that continuous research is performed in order to reduce uncertainty, and that broad scientific peer review is carried out. But in situations of high uncertainty and high stakes decisions/actions/solutions must be assessed not only be a scientific peer community, but by a larger public, so-called ’extended peer review’. The reason is that scientists do not have the privilege of determining what is acceptable uncertainty or what are acceptable stakes – this is a value issue and the public and those affected by the decisions should be heard.

There are many challenges determining what is the right action in such an uncertain situation: each action has many dimensions; different people will be affected in different ways, etc. Various “trade-offs” will be required when making choices; and there may be a lack of agreement within society on what is practical or acceptable, let alone on how one should “put a price on” such non-monetary side-effects. Because of these challenges decisions in situations of uncertainty should involve a broader scope of participants. In addition to these arguments, including stakeholders and the public in decision making may also lead to increased by public legitimacy of decisions, increased trust in decision makers, increased knowledge base for decisions, broader ownership to decisions (which may enhance the implementation of countermeasure strategies), democratisation and empowerment.

In addition to the involvement of stakeholders that is already routine in radiation protection one can also choose methods like consensus conference, citizen’s juries, value workshops, etc. Tools for value dialog, like the ethical matrix, may also be used. When stakeholders are to be involved it is important to start early, not when everything in reality is decided. It is also important to inform the stakeholders what status or impact their advice will have: there should be transparent procedures where it is made clear where the stakeholder input will come in, and what other input may influence the decision making process. Expectations to the stakeholders should also be made clear, for instance, if they have any responsibility for communication with their peers.

Stakeholder involvement in crisis management should be prepared for so that this is not novel when an accident occurs. Stakeholder involvement exercises could be carried out at emergency planning/preparedness exercises – generic stakeholders could be identified and contacted, and consultation methods could be tried out. Moreover, dialogue conferences with generic stakeholders should be carried out in order to develop broadly acceptable procedures for stakeholder involvement.

Session 4: National threat assessments

Nystrup P E: Danish Nuclear Emergency Preparedness

Danish Emergency Management Agency (DEMA), Denmark

A 24-hour emergency preparedness and response system is aimed at limiting damage if Denmark is exposed to an accident at a nuclear plant.

Emergency preparedness planning

A major release from a nuclear power plant may cause radioactive materials to spread across large areas and, in unfortunate weather situations, reach Denmark. The radiation may constitute both an instant threat and lead to long-term threats to life and health.

The Danish Emergency Management Agency (DEMA) is in charge of the national nuclear emergency preparedness planning and has prepared a national nuclear emergency preparedness and response plan. The purpose is to protect the population and reduce or mitigate any harmful effects.

Day-to-day emergency preparedness

The nuclear emergency preparedness includes a nation-wide automatic monitoring system with 11 permanent measuring stations, 2 vehicles with hyper-sensitive measuring equipment, 2 sets of similar measuring equipment for installation in aircraft or helicopters and more than 120 government or municipal monitoring teams. In addition, food and environmental monitoring can be established at short notice.

The duty emergency response officer has online access to the 11 measuring stations which report the radiation level at least every hour. In the case of an increased radiation level, the measuring stations will issue an alarm within 10 minutes. The automatic measuring systems are monitored by Risø National Laboratory and DEMA.

24-hour emergency preparedness

DEMA maintains a 24-hour emergency preparedness and response with an emergency response duty officer on call.

The emergency response duty officer will be alerted in case of an alarm from the monitoring system or one of the many international warning systems that Denmark participates in. The Danish National Police acts as the international contact centre for the Danish nuclear emergency preparedness. The Danish National Police has 24-hour staffing and the responsibility of immediately alerting the emergency duty officer in the event of reports of an accident at a nuclear installation abroad.

DEMA’s emergency response duty officer then decides whether – and to what extent – the nuclear emergency preparedness and response organisation should be activated.

Instruction to citizens

If Danish territory is threatened by radioactive contamination, it is vital that the nuclear emergency preparedness organisation can advice citizens about how to react. As a consequence, DEMA can quickly staff “question-and-answer centres”.

Information will also be posted on the Internet and close cooperation has been established with the media.

Olsson R: Swedish Assessments on Radionuclear Threats and the work conducted & in progress within KBM and the Swedish Co-ordination Area CBRN

Swedish Emergency Management Agency (KBM), Sweden

This presentation gives a brief description of:
Legal framework, national synthesis of capability assessments certain vs. selected scenarios, key methodological problems associated and one approach used in the assessment of RN threats and hazards in order to solve the methodological problems. On the latter, examples (dummies) are given to illustrate the method used and to give an impression on what conclusions can be drawn.

Strand P: Norwegian assessments of radionuclear threats

Norwegian Radiation Protection Authority (NRPA), Norway

Even though the Norwegian nuclear industry is limited, it has since the Chernobyl accident in 1986 been Norwegian policy to have a particular emergency preparedness towards nuclear or radiological events. In order to maintain an effective emergency preparedness with limited resources, it is necessary to have a good understanding of possible scenarios and related consequences. Norwegian authorities are therefore continuously assessing nuclear and radiological threats.

Due to their close vicinity to the Norwegian border and poor conditions at some of the sites, possible accidents at nuclear installations on the Kola Peninsula in Russia have been emphasised in Norwegian emergency preparedness. However, Norwegian and international efforts during the last few years have contributed to improve the conditions at several sites on the Kola Peninsula. Improved safety and physical protection at these sites have reduced the risk for cross-border contamination. Furthermore, extensive decommissioning and dismantlement of aged nuclear submarines have reduced the number of nuclear objects of particular concern.

Meanwhile, the latest changes in the international security environment have made one consider a new set of scenarios, involving e.g. massive attacks on nuclear installations. Aging nuclear installations, proliferation of nuclear weaponry and an international nuclear power renaissance have also contributed to change the Norwegian threat perception.

In addition, increased emphasis has been directed towards predominant ocean currents and wind directions and the perception of risk from facilities in Western Europe featuring large accumulations of radionuclear wastes such as those at the Sellafield site.

The consequences of the tsunami in East Asia in December 2004 has lead to an increased understanding of the authorities' responsibilities concerning Norwegian citizens and interests abroad, also with respect to nuclear and radiological events that will not bear any impact on Norwegian territory. In particular, the increasing attention towards the economic potential in the Russian High North implies new challenges regarding an increased Norwegian establishment in an area with still many problems concerning radioactivity.

Finally, awareness is also directed towards future climate changes and challenges related to nuclear safety and radioactive contamination.

3. Conclusions

Changes in the international security environment and new threats have lead to an increased attention towards the need to revise various threat assessments in the Nordic countries. The seminar presented important new topics, summarized experiences from previous incidents and new threat assessments from some of the Nordic countries. Each country has their special focus on the topics and such a seminar is a good arena for exchanging this information.

The seminar facilitated an exchange of information and opinions, fruitful discussions and building of new networks, especially between researchers and emergency preparedness communities. It was also an evident benefit that a wide number of different professions were represented at the seminar. The programme featured a diverse number of topics, ranging from technical aspects such as experience from pervious incidents and possible hazards to information strategies and management of the public and media.

It was argued by several of the participants during the seminar that it was an important and fruitful event and that similar seminars should be arranged at least every fifth year in the future.

Appendix: Seminar programme

Thursday, 30 October 2008

12:00 – 13:00 Lunch

13:00 Introduction

Session 1: Possible hazards

13:00 George M. Moore (International Atomic Energy Agency):
Illicit trafficking of nuclear and radiological materials and the IAEA ITDB

13:30 Björn Sandström (Swedish Defence Research Agency):
Radiation as a Weapon: A view from Open Source studies

14:00 Kasper G. Andersson (Risø DTU):
Dirty bomb explosion in a city area: What do we need to know for preparedness?

14:30 – 15:00 Coffee break

15:00 Tone D. Bergan (Directorate for Civil Protection and Emergency Planning, Norway):
Possible scenarios and challenges for CBRN preparedness

15:30 Anne Stenersen (Norwegian Defence Research Establishment):
Terrorism, development and interest for RN

16:00 Inger Margrethe H. Eikelmann (Norwegian Radiation Protection Authority):
The wreck of the cruiser Murmansk

Dinner 18:00

Friday, 31 October 2008

Session 1: Possible hazards conts.

08:30	Heikki Reponen (Radiation and Nuclear Safety Authority, Finland): Russian nuclear reactors 2010 – 2020
09:00	Jane L. Smith-Briggs (Nuvia Ltd.): Andreeva Bay
09:30	Steinar Høibråten (Norwegian Defence Research Establishment): Nuclear weapons
10:00 – 10:30	**Coffee break**

Session 2: Experience from previous incidents

10:30	Ole Reistad (Norwegian Radiation Protection Authority): Previous events with nuclear powered submarines
11:00	Kaare Ulbak (National Institute of Radiation Protection, Denmark): The Thule accident
11:30 – 12:30	**Lunch**

Session 3: Public perception of nuclear and radiological threats and information challenges

12:30	Britt-Marie Drottz Sjöberg (Norwegian University of Science and Technology): Public perception of radionuclear threats and how it affects nuclear emergency preparedness
13:00	Knut I. Tønsberg (Norwegian Directorate for Health): Information requirements in emergency situations, openness in crisis and risk communication
13:30	Ellen Marie Forsberg (Work Research Institute, Norway): Addressing uncertainty in risk assessments – what is the role of stakeholders?
14:00 – 14:20	**Coffee break**

Session 4: National threat assessments

14:20	Sigurður Emil Pálsson (Islandic Radiation Protection Institute): A low-key flexible approach to radiation emergency preparedness
14:40	Poul Erik Nystrup (Danish Emergency Management Agency): Short general introduction to the Danish Emergency Preparedness organisation and its participants
14:55	Richard Olsson (Swedish Emergency Management Agency): Swedish assessments of radionuclear threats
15:15	Per Strand (Norwegian Radiation Protection Authority): Norwegian assessments of radionuclear threats

Session 5: Challenges for future emergency preparedness

15:35	Panel discussion
16:30	Concluding remarks

Appendix: List of participants

Name	Affiliation	Country
Ajaz, Mahwash	Norwegian Radiation Protection Authority (NRPA)	Norway
Amundsen, Ingar	Norwegian Radiation Protection Authority (NRPA)	Norway
Andersson, Kasper G.	Risø DTU	Denmark
Ballangrud, Per	Institute of Microbiology, Armed Forces Medical Services (FML)	Norway
Bergan, Tone D.	Directorate for Civil Protection and Emergency Planning (DSB)	Norway
Bjørndal, Øystein	Directorate for Civil Protection and Emergency Planning (DSB)	Norway
Blom, Cécile	Norwegian Food Safety Authority	Norway
Bratvedt, Yngvar	Norwegian Radiation Protection Authority (NRPA)	Norway
Eikelmann, Inger Margrethe H.	Norwegian Radiation Protection Authority (NRPA)	Norway
Evensen, Pål	Norwegian Meteorological Institute (met.no)	Norway
Finnbråten, Guy	Norwegian Defence ABC School (FABCS)	Norway
Forsberg, Ellen Marie	Work Research Institute (AFI-WRI)	Norway
Granhaug, Jan	Norwegian Defence ABC School (FABCS)	Norway
Heldal, Hilde Elise	Institute of Marine Research	Norway
Holo, Eldri N.	Norwegian Radiation Protection Authority (NRPA)	Norway
Høibråten, Steinar	Norwegian Defence Research Establishment (FFI)	Norway
Jerstad, Ane N.	Norwegian Radiation Protection Authority (NRPA)	Norway
Lahtinen, Juhani	Radiation and Nuclear Safety Authority (STUK)	Finland
Moore, George M.	International Atomic Energy Agency (IAEA)	-
Nalbandyan, Anna	Norwegian Radiation Protection Authority (NRPA)	Norway

Name	Affiliation	Country
Nystup, Poul Erik	Danish Emergency Management Agency (DEMA)	Denmark
Ohrstrand, Per Inge	Norwegian Defence ABC School (FABCS)	Norway
Olsson, Richard	Swedish Emergency Management Agency (KBM-SEMA)	Sweden
Pálsson, Sigurður Emil	Islandic Radiation Protection Institute (GR)	Iceland
Pedersen, Stig Rune	Directorate for Civil Protection and Emergency Planning (DSB)	Norway
Reistad, Ole	Norwegian Radiation Protection Authority (NRPA)	Norway
Reponen, Heikki	Radiation and Nuclear Safety Authority (STUK)	Finland
Rønning, Jan Steinar	Geological Survey of Norway (NGU)	Norway
Saltbones, Jørgen	Norwegian Meteorological Institute (met.no)	Norway
Sandström, Björn	Swedish Defence Research Agency (FOI)	Sweden
Selnæs, Øyvind Gjølme	Norwegian Radiation Protection Authority (NRPA)	Norway
Sickel, Morten	Norwegian Radiation Protection Authority (NRPA)	Norway
Sjöberg, Britt-Marie Drottz	Norwegian University of Science and Technology (NTNU)	Norway
Smith-Briggs, Jane L.	Nuvia Ltd.	United Kingdom
Stenersen, Anne	Norwegian Defence Research Establishment (FFI)	Norway
Strand, Per	Norwegian Radiation Protection Authority (NRPA)	Norway
Tazmini, Kasra	Norwegian Radiation Protection Authority (NRPA)	Norway
Tønsberg, Knut I.	Norwegian Directorate for Health	Norway
Ulbak, Kaare	The National Institute of Radiation Protection (SIS)	Denmark
Vilkamo, Olli	Radiation and Nuclear Safety Authority (STUK)	Finland
Wethe, Per Ivar	Institute for Energy Technology (IFE)	Norway