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**Mika Kari**

# First of its Kind

**Eurajoki as a Nuclear Community and Site for the  
Final Disposal of Spent Nuclear Fuel**

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UNIVERSITY OF JYVÄSKYLÄ  
FACULTY OF HUMANITIES AND  
SOCIAL SCIENCES

JYU DISSERTATIONS 255

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**Mika Kari**

## **First of its Kind**

# **Eurajoki as a Nuclear Community and Site for the Final Disposal of Spent Nuclear Fuel**

Esitetään Jyväskylän yliopiston humanistis-yhteiskuntatieteellisen tiedekunnan suostumuksella  
julkisesti tarkastettavaksi Ruusuipuiston salissa RUU D104  
syyskuun 12. päivänä 2020 kello 12.

Academic dissertation to be publicly discussed, by permission of  
the Faculty of Humanities and Social Sciences of the University of Jyväskylä,  
in building Ruusuipuisto, lecture hall RUU D104 on September 12, 2020 at 12 o'clock noon.



JYVÄSKYLÄN YLIOPISTO  
UNIVERSITY OF JYVÄSKYLÄ

JYVÄSKYLÄ 2020

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Permanent link to this publication: <http://urn.fi/URN:978-951-39-8245-4>

ISBN 978-951-39-8245-4(PDF)

URN:ISBN:978-951-39-8245-4

ISSN 2489-9003

## ABSTRACT

Kari, Mika

First of its kind: Eurajoki as a nuclear community and site for the final disposal of spent nuclear fuel.

Jyväskylä: University of Jyväskylä, 2020, 114 p.

(JYU Dissertations

ISSN 2489-9003; 255)

ISBN 978-951-39-8245-4 (PDF)

The dissertation examines Eurajoki as a nuclear community pioneering in nuclear waste management. Eurajoki in Finland is the first municipality in the world where the siting of a final disposal facility for spent nuclear fuel (SNF) was concluded with the appropriate public and community acceptance. The subsequent granting of the construction licence has been characterized as "a milestone of global importance".

The interest in Eurajoki, stems from it being 'the first of its kind'. That said, Eurajoki is also a prime example of the tendency of nuclear communities to be more amenable to final disposal. While identifying a successful method for securing willing host communities has been a long-term mission of the international nuclear waste management community, understanding the dynamics of public and local acceptance also pose a challenge from the viewpoint of governance and social sciences.

The aim of the study is three-fold: 1) To form a picture of Eurajoki as a nuclear community and to examine the rationality of community acceptance in light of a resident survey. This is done by briefly recounting how Eurajoki became a nuclear community and the site for final disposal and exploring residents' opinions and their relation to certain theories. 2) To scrutinise the workings of the competing nuclear oasis and industry awareness frames by analysing how nuclear communities are interpreted and by applying the competing viewpoints to the results of the survey. 3) To draw conclusions on the viability of the frames based on the findings and reflect on the way forward given the evidence gathered in the course of the study.

The frames examined differ widely from each other. Where the nuclear oasis frame leans heavily on patterns of power related to economic and employment considerations, the industry awareness frame focuses heavily on the socio-cultural and symbolic dimensions of siting.

The results indicate that both concentrating strictly on economic necessities and dependency or, on other hand, on cultural integration and cultural capacity is clearly insufficient and that inhabitants' acceptance culminates in more encompassing considerations related to community well-being. Both the relationship between implementer and community and the perceived contribution of the project to the well-being of the community are highlighted.

Keywords: Nuclear waste, spent nuclear fuel, final disposal, nuclear community, framing, nuclear oasis, industry awareness, community well-being, siting, acceptance, opinions, survey, repository, Finland, Eurajoki

## TIIVISTELMÄ (FINNISH ABSTRACT)

Kari, Mika

Ensimmäinen laatuaan: Eurajoki ydinteollisuuspaikkakuntana ja käytetyn ydinpolttoaineen loppusijoituspaikkana.

Jyväskylä: Jyväskylän yliopisto, 2020, 114 s.

(JYU Dissertations

ISSN 2489-9003; 255)

ISBN 978-951-39-8245-4 (PDF)

Tässä väitöskirjassa tarkastellaan Eurajokea ydinteollisuuspaikkakuntana (nuclear community) ja käytetyn ydinpolttoaineen loppusijoituksen suunnannäyttäjänä. Eurajoki Suomessa on ensimmäinen kunta maailmassa, missä käytetyn ydinpolttoaineen loppusijoituslaitoksen sijoitus on saatu vietyä läpi asianmukaisen julkisen ja paikkakunnan paikanvalinnalle antaman hyväksynnän kera. Tätä myöhemmin seurannutta rakennusluvan myöntämistä on kuvattu "maailmanlaajuisesti merkittäväksi virstanpylvääksi".

Kiinnostus Eurajokea kohtaan nousee tilanteen ainutlaatuisuudesta - Eurajoen ollessa kirjaimellisesti "ensimmäinen laatuaan". Toisaalta Eurajoki on myös ensisijainen esimerkki ydinteollisuuspaikkakuntien taipumuksesta olla myötämielisempiä loppusijoitukselle. Vaikka menestyksekkään menetelmän löytäminen halukkaiden isäntäpaikkakuntien varmistamiseksi on ollut kansainvälisen ydinjätehuoltoyhteisön pitkäaikainen missio, julkisen ja paikallisen hyväksynnän dynamiikan ymmärtäminen on haaste myös sekä hallinnon että yhteiskuntatieteiden näkökulmasta.

Tutkimuksen tavoite on kolmiosainen: 1) Muodostaa kuva Eurajoesta ydinteollisuuspaikkakuntana ja tarkastella paikallisen hyväksynnän rationaliteettia asukaskyselyn valossa, esittelemällä kuinka Eurajoesta tuli ydinteollisuuspaikkakunta ja loppusijoituspaikka, sekä tutkimalla asukkaiden mielipiteitä ja niiden suhteutumista tiettyihin teorioihin. 2) Arvioida, teollisuustietoisuuskehysten (industry awareness frame) ja ydinkeidaskehysten (nuclear oasis frame) toimintaa analysoimalla kuinka ydinpaikkakuntia tulkitaan ja vertailemalla näitä kilpailevia näkökulmia tutkimuksen tuloksiin. 3) Tehdä johtopäätöksiä kehysten käyttökelpoisuudesta tulosten perusteella sekä pohtia jatkonäkymiä tutkimuksen aikana kerättyyn todistusaineistoon tukeutuen.

Tarkastelussa olleet kehukset eroavat suuresti toisistaan. Siinä missä ydinkeidaskehys nojaa vahvasti talous- ja työllisyysnäkökohtiin liittyviin valtasuhteisiin, teollisuustietoisuuskehys puolestaan keskittyy voimakkaasti loppusijoituksen sosiokulttuuriseen ja symboliseen ulottuvuuteen.

Tulokset osoittavat, että keskittyminen tiukasti ekonomisiin tarpeisiin ja riippuvaisuuteen tai toisaalta kulttuuriseen integraatioon ja kulttuuriseen kapasiteettiin ei riitä, ja että asukkaiden hyväksyntä kulminoituu laajemmin paikkakunnan hyvinvointiin liittyviin kysymyksiin. Sekä hankkeen toteuttajan ja paikkakunnan välinen suhde että projektin panos paikkakunnan hyvinvoinnille, paikkakunnan omasta näkökulmasta, korostuu.

Avainsanat: Ydinjäte, käytetty ydinpolttoaine, loppusijoitus, ydinpaikkakunta, kehystäminen, ydinkeidas, teollisuustietoisuus, hyvinvointi, paikanvalinta, hyväksyntä, mielipiteet, kysely, loppusijoituslaitos, Suomi, Eurajoki

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## ACKNOWLEDGEMENTS

It has been a long journey since my custos, supervisor and mentor, Prof. Tapio Litmanen, took me under his wing and introduced me to the world of nuclear waste management perceived "with the eyes of social scientists" over a decade ago. While my interests have definitely broadened to also include the front-end of the nuclear fuel cycle and other hazardous activities, I am nevertheless looking forward to seeing through at least one more decade with nuclear waste management research.

For now, it seems a great time to give my thanks to those who have contributed to my academic journey so far. First and foremost, I would like to express my gratitude to my mentors, Prof. Tapio Litmanen and Dr. Matti Kojo, with whom I have had the pleasure to work for some 14 years now and even to raise a few glasses every now and then. Thank you both for being there for me, and especially to Tapio for having faith in me and guiding me from the start.

I would moreover like to thank another supervisor of my dissertation Snr Lec. Pertti Jokivuori, who has always been ready to offer his help.

I would also like to thank Prof. Terhi-Anna Wilska, Prof. Ilkka Ruostetsaari and Dr. Marja Ylönen for promoting my career as a researcher and fellow STEER research group members Dr. Miikka Salo, Tuija Jartti and Anna Oksa, and everybody else I have had pleasure to work with, for collegial support. In particular I would like to mention Adj. Prof. Markku Lehtonen with whom I have been working a lot lately.

Finally, I would like to express my appreciation to my family. I am deeply grateful to my already departed mother and father for supporting my dream of becoming a social scientist and to my dear wife, Elina, and my daughter, Aurora, for enduring my eccentric behaviour and reclusive working habits.

I would like to dedicate this dissertation to "my brother from the other mother" Arto 'ATE' Nokela - you are missed, my friend.

The dissertation received funding from SOVAKO, Finnish Doctoral Program in Social Sciences, Graduate School for Cultural Research of Power and Governance, VTT Technical Research Centre of Finland Ltd and from the University of Jyväskylä, Department of Social Sciences and Philosophy. Additionally, the original research on which the dissertation is based was funded by the Finnish Research Programme on Nuclear Waste Management KYT. Without this funding this dissertation would not have been possible.

Jyväskylä 7.7.2020

Mika Kari

"But Gandalf has revealed to us that we cannot destroy it by any craft that we here possess,' said Elrond. 'And they who dwell beyond the Sea would not receive it: for good or ill it belongs to Middle-earth; it is for us who still dwell here to deal with it.' [...] And it is not our part here to take thought only for a season, or for a few lives of Men, or for a passing age of the world. We should seek a final end of this menace, even if we do not hope to make one.'" (Tolkien 2009, 266, see Blowers, Lowry & Solomon 1991, xvi)



## LIST OF ABBREVIATIONS

<b>BANANA</b>	..Build absolutely nothing anywhere near anyone
<b>CAVE</b> .....	Citizens against virtually everything
<b>CoRWM</b> .....	UK Committee on Radioactive Waste Management
<b>DiP</b> .....	Decision-in-Principle by the Government, decision that guides the state administration
<b>EIA</b> .....	Environmental impact assessment
<b>FSC</b> .....	Forum on Stakeholder Confidence, established by RWMC
<b>IAEA</b> .....	International Atomic Energy Agency
<b>IVO</b> .....	Finnish state-owned nuclear power company - Imatran Voima.
<b>JYT</b> .....	Finnish Public Sector's Research Programme on Nuclear Waste Management.
<b>KBS</b> .....	Swedish deep geological disposal concept
<b>KYT</b> .....	Finnish Research Programme on Nuclear Waste Management
<b>LULU</b> .....	Locally unwanted land use
<b>NEA</b> .....	Nuclear Energy Agency, specialised agency within OECD
<b>NIMBY</b> .....	Not-in-My-Backyard
<b>NPP</b> .....	Nuclear power plant
<b>OECD</b> .....	International Organisation for Economic Co-operation and Development
<b>RWMC</b> .....	Radioactive Waste Management Committee, NEA's standing committee
<b>SEURA</b> .....	Follow-up research regarding the socio-economic effects and communication of final disposal facility of spent nuclear fuel in Eurajoki and its neighbouring municipalities. Joint project of University of Jyväskylä and University of Tampere, funded by KYT.
<b>SKB</b> .....	Swedish Nuclear Fuel and Waste Management Company.
<b>SLO</b> .....	Social licence to operate
<b>SNF</b> .....	Spent nuclear fuel
<b>STUK</b> .....	Finnish Radiation and Nuclear Safety Authority
<b>TVO</b> .....	Finnish private nuclear power company - Teollisuuden Voima
<b>WIPP</b> .....	U.S. Department of Energy's Waste Isolation Pilot Plant

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ABSTRACT

TIIVISTELMÄ (FINNISH ABSTRACT)

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# 1 INTRODUCTION

## 1.1 Background

### 1.1.1 Public reaction to technological hazards

There has been long lasting interest in risk research, science and technology studies and environmental sociology in general to better understand how attitudes to hazardous facilities and other establishments referred to as locally unwanted land uses (LULUs), ever-present in modern societies, are formed.

The interest stems from around the turn of the 1970s. While modern research on technological hazards dates to the 1960s, it was the turn of the 1970s that saw the real increase in public and scientific concern regarding the newly created and recognised technological hazards, raising the question of risk acceptance or tolerance (Kates, Hohenemser & Kasperson 1985, 4,9, Kates 1976, 152-153, see also Kates & Kaspersson 1983). Notably, it was roughly at the same time that governments started to respond to these concerns and organisations like The Swedish Environmental Protection Agency (as early as in 1967), The United States Environmental Protection Agency (1970) and The Department of the Environment in the UK (1970) were established. In Finland Ministry of the Environment was proposed as early as in 1970, but was not established until 1983 (ME 2003, 5-7). The severity of the concern felt is also underlined by the fact that, after the United Nations Conference on the Human Environment in 1972, the United Nations issued a declaration stressing a need for caution regarding the consequences of our actions to the environment as our life and well-being depends on it - with an imperative to defend the human environment (UN 1973, 3).

As governments started to tackle technological hazards, such as pollution and waste issues, it soon became apparent that concern over these hazards had sensitized people to the potential negative effects of a whole range of different facilities, especially when risks are brought close to one's home, family and

community, creating what would be known as the "Not-in-My-Backyard" or (for short) the "NIMBY" phenomenon.

The NIMBY phenomenon depicts local public response to LULUs. It carries a somewhat negative connotation as it is also quite commonly referred to as the NIMBY *syndrome* and connected to such expressions as BANANA (build absolutely nothing anywhere near anyone) and CAVE (citizens against virtually everything) (Schively 2007, 255). While in several instances NIMBY, as a concept, is said to originate in the early 1980s (e.g. Schively 2007, 255, Wolf 1987, 216) it can be established to have already been a known phenomenon in the 1970s, as Jakimo and Bupp (1978, 66) refer to the NIMBY syndrome as the most obvious political issue connected to the SNF storage problem.

According to Popper (Popper 1981, 12.), by the turn of the 1980s, it was clear that there was huge selection of unpopular LULUs eliciting resistance, ranging from everyday usages like low-income housing, junkyards etc. to complex, large-scale land uses like mines and military installations. However, there was also consensus regarding the most unwanted land uses, namely nuclear installations and hazardous waste sites. The U.S Environmental Protection Agency's report of 1979 assessed public opposition to the siting of hazardous waste facilities as the most critical problem in developing new facilities and even threatening operational facilities. According to the report, opposition came from a wide range of people, united by their concern about and opposition to facilities in their communities, often amassing considerable resources. The report concluded that if problems with siting could not be solved, the consequences could be "enormous". (EPA 1979, III.)

### **1.1.2 Rejection of the final disposal of nuclear waste**

The subject of this study concerns community's readiness to consider a final disposal repository for a certain type of nuclear waste, i.e. spent nuclear fuel (SNF), fuel discharged from nuclear reactors.

According to the benchmark set above, at least as far as civilian facilities go, a final disposal facility for nuclear waste can be considered to be the ultimate LULU – as it is both a nuclear facility and a waste facility. According to Slovic et al. nuclear waste is so-called "dread risk", defined by a perceived lack of control, dread, catastrophic potential, fatality and threat to future generations and the imagery associated with a repository is overwhelmingly negative (Slovic 1987, 282-283, Slovic, Layman & Flynn 1990). In fact, in the study conducted by Kunreuther et al. the public assessed a nuclear waste repository as more risky than a nuclear power plant (NPP) or a nuclear weapons test site (Kunreuther, Desvousges & Slovic 1988, 20).

Since 1991, when Blowers et al. in their influential work "The International Politics of Nuclear Waste" established radioactive waste as the Achilles heel of the nuclear industry (Blowers, Lowry & Solomon 1991, 1), SNF management has proven to be an ever-growing international problem. Despite all efforts, no country so far has a permanent solution to final disposal and in the meantime waste continues to accumulate. According to the International Atomic Energy

Agency's (IAEA) 2018 (slightly outdated) estimate, at the end of 2013 stored SNF had amounted to 250,000 tonnes of heavy metal (IAEA 2018c, 1,36,47), and, according to the IAEA's calculations, at the end of 2017 there were 448 nuclear power reactors in operation (IAEA 2018b, 17).

While long-term SNF management can be seen as a big international or national issue, it requires a local solution in order for siting to proceed successfully and this solution has been elusive. After the 1960's, as the result of public controversies and risk management failures, welcoming attitudes towards nuclear facilities declined and the nuclear industry, regulators and licencing processes are now under strict public and political scrutiny (Sundqvist 2002, 14-15, NEA 1999a, 12). As it is, because of the public opposition, the siting of an SNF facility has proved almost impossible; in places deemed otherwise suitable, local communities have rejected repository plans time after time. Therefore, what had initially been considered a fairly easy technological task in the 1960s turned out to be a formidable socio-technical problem. While problems in handling even existing waste have prompted demands to completely discontinue the use of NPPs producing SNF, on other hand, there have also been arguments for the continued, and even expanded, use of nuclear power.

### 1.1.3 Revived interest in nuclear power

Despite the fact that the stalemate related to final disposal had not been resolved, it is clear that the turn of the millennium saw revived interest in nuclear power, described by scholars as a nuclear renaissance, nuclear revival, or nuclear renewal (Litmanen & Kojo 2011, 171-172). While this tendency was somewhat dampened by the 2011 Fukushima accident, the rationale behind it seems to be still worth examining as increased use of (or pressure to use) nuclear power would create even more pressure to break the deadlock.

There have been at least three clear reasons for the heightened interest. 1) The search for energy security and diversity. In addition, in a general increase in the need for energy, there have been recurrent fluctuations in oil and gas prices and speculation on the future depletion of these non-renewable resources. Additionally, it has become obvious that dependence on external energy sources can render country vulnerable. With nuclear power, dependence on carbon-based fossil energy sources, as well as continuous supply of them, would be reduced. 2) The search for a way to cut carbon emissions. To deal with global warming it has been deemed necessary to decarbonize the energy supply. To speed up this development carbon taxes and carbon emissions trading were introduced. Lowering carbon emissions has become politically correct and at the same time the cost-benefit ratio of low carbon footprint nuclear power has changed. 3) Ageing nuclear reactors. While existing reactors are upgraded all over the world their life span cannot be extended indefinitely and they are hard to replace with other energy sources, especially as increasing carbon intensive energy production is not welcomed. (cf. Greenhalgh & Azapagic 2009, Findlay 2010, Teräväinen, Lehtonen & Martiskainen 2011.)

Although some countries, notably Germany and Switzerland, opted for the 'nuclear exit' after the Fukushima accident (e.g. Ramana 2013, 67), for all the abovementioned reasons, nuclear power has managed to a certain extent to remain, or even become a more viable option for energy production. In particular, recent worrying reports on global warming (e.g. IPCC 2018) have enabled the industry, with pro-nuclear governments and organisations, to seize the opportunity to, once again, promote a nuclear renaissance, despite the deadlock in final disposal (cf. IAEA 2018a, foreword,1-5). Eliminating the industry's Achilles' heel would thus give nuclear power a whole new standing as an energy option and greatly increase its appeal as a solution to the abovementioned concerns.

### 1.1.4 Unique situation in Finland

At the turn of the millennium the State Council of Finland made a decision-in-principle (DiP) concerning a repository for SNF and this was ratified by the Parliament in 2001 (VN 2000, EK 2001). Soon Finland found itself in the middle of a nuclear renewal (see Litmanen & Kojo 2011, Kojo & Litmanen 2009). In 2010 there was a new NPP unit under construction, the first one in the Western countries since the Chernobyl accident (Teräväinen, Lehtonen & Martiskainen 2011, 3435), and DiPs were granted for two more NPP units. (For more information on the development of nuclear power policy in Finland, see Litmanen & Kojo 2011, Syrjämäki, Kojo & Litmanen 2015, Ylönen et al. 2017.) While one of the DiPs for an NPP unit was later left to expire, this was because of delays in the construction of the previous unit (WNN 2015) rather than changes in socio-political circumstances.

Decisions regarding the NPP units were made after Finland in 2001 became the first country in the world to successfully clear the socio-political obstacles to the siting of a final disposal repository for SNF<sup>1</sup>, and Eurajoki became the first municipality in the world to accept the siting of a repository in its area. The local residents have now lived the post site selection phase for almost two decades, during which time several expansions of the repository have been prepared to meet the needs of the construction of more nuclear power. (Kari, Kojo & Litmanen 2010, 6-14, Darst & Dawson 2010, 64.) The nuclear waste company Posiva submitted its construction licence application at the end of 2012 and the licence was issued in November 2015 (e.g. Litmanen, Kari et al. 2017, 20). Although local attitudes have showed some increase in reservations regarding the repository in recent surveys, there has been no major opposition to the final disposal project (Litmanen, Kojo & Kari 2010, 44-45).

In Sweden the waste management company SKB also submitted applications to build a repository, but the site for the repository was proposed much more recently, in 2009, and the Government has still to decide on the permissi-

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<sup>1</sup> U.S. Department of Energy's Waste Isolation Pilot Plant (WIPP) is limited to defence-generated transuranic wastes (see, [wipp.energy.gov](http://wipp.energy.gov)) and is thus not licenced to accept SNF.

bility of a repository – and, in this connection, the municipality still has a chance to use its power of veto and reject the repository (Municipality of Östhammar 2018, 4-7, SKB 2018). In Finland, however, this decision was already taken in 2000, when the municipality issued positive statement regarding the repository, thus choosing not to exercise its right of veto under the Nuclear Energy Act (e.g. Kari, Kojo & Litmanen 2010, 17).

In addition, while in Sweden permissibility is still an issue, and other countries have not been able to make notable progress with their final disposal plans, in Finland the possibility of a second repository is already under discussion.

In 2010 the Government took a DiP in favour of the NPP of the new nuclear power company Fennovoima stating in the preconditions that the company should either have an agreement with the existing nuclear waste company Posiva on SNF management or an environmental impact assessment (EIA) programme for its final disposal facility within six years after the ratification of the decision. The decision was ratified by Parliament later the same year. (Kari, Kojo & Litmanen 2010, 7-8, VN 2010, EK 2010.)

Posiva has so far rejected the idea of disposing of spent fuel produced by Fennovoima in its repository. In 2012 the Ministry of Employment and the Economy established a working party to address joint nuclear waste management in Finland. The working group recommended making use of the competence and experience of Posiva stating, however, that the number of final disposal facilities – one or two – did not play a key role. The group also urged the companies to negotiate further but concluded that its mandate did not extend to business negotiations. (Kojo & Oksa 2014b, MEE 10.01.2013.) In 2016 Fennovoima presented its EIA programme on its own SNF disposal facility, stating, however, that it had acquired a contract for services from Posiva and was continuing discussions on longer-term co-operation in the final disposal of SNF (Fennovoima 2016, 5).

### 1.1.5 Key to the deadlock?

While climate change and concerns regarding energy independence and security have opened the window of opportunity for a revival of nuclear power in Europe and elsewhere, it can be argued that nuclear renewal would be a very unlikely scenario (at least in western democracies) without some kind of promise for a solution to the nuclear waste *impasse*. Darst and Dawson (2010, 51) assert that:

"The "nuclear renaissance," if it succeeds, will have been made possible by Sweden and Finland's pioneering work in eliminating the industry's Achilles' heel: the permanent, safe, and locally acceptable disposal [...]. Were it not for the growing perception that this problem now has a solution, the prospects for a climate change-driven nuclear renaissance would be significantly reduced."

For a quite a long while it seemed that it would be impossible to organise the final disposal of SNF anywhere worldwide; because of public opposition it



simply could not be done. However it was considered that existing nuclear communities showed some promise, for, as a rule, the communities that had gone furthest in considering a final disposal facility were already 'nuclear communities' in the sense that there was already some kind of nuclear related activity within the community (NEA 2003b, 33, NEA 2004b, 49-50). And, indeed, it now seems that Eurajoki (with Swedish municipality Östhammar at its heels) has made that promise a reality, as it also fits the rule. As a result, from now on, and especially if the process in Sweden proceeds accordingly, it is fair to say that every existing nuclear community is becoming more than a potential final disposal site.

As a prime example of the marked tendency, Eurajoki is in a unique situation and serves as an interesting precedent. It is the very first municipality in the world in which the views of local residents on the final disposal of SNF have been elicited after the decision on the site selection, moving towards the 'unknown', i.e. to the construction phase. Thus, inevitably, the results necessitate close attention from different stakeholders, ranging from international authorities to local residents.

From a social scientific point of view there are several interesting aspects in SNF disposal, e.g. a technocratic system colliding with social realities and the effects of this collision, a change in framing from promising new technology to technological risk and the impact of the frame change to social environment, where different stakeholders operate, and the standing of the local community in relation to the industry and regulatory authority. Eurajoki, as a case, is especially intriguing because it seems that there collision has been largely, although not entirely, avoided, making it possible to move forward towards the construction of the repository without considerable opposition (see Kojo 2006a, 67-70, Suominen 1998, 40-58).

## **1.2 The spent nuclear fuel problem in social sciences**

### **1.2.1 SNF as a term**

Spent nuclear fuel is a label not everyone is comfortable with as it has been suggested that it is used to downplay the fact that it is radioactive waste that is at issue. As a term, it is, however, much more precise in the sense that it pinpoints the type of substance in question, "Spent (depleted or used) nuclear fuel" (U.S.NRC 2018), which is discharged from nuclear energy production. The terms radioactive waste and nuclear waste can essentially mean any material that is either radioactive itself or is contaminated by radioactivity and has ceased to be useful – including wastes from various civil and military uses and wastes with very low to very high levels of radioactivity. Additionally, SNF is not always considered waste as it can have further use. The terms 'used nuclear fuel' and 'depleted nuclear fuel' can be used to stress the fact that SNF is not

totally spent and could be enriched (recycled) for further use or used in reactors capable of utilizing the depleted fuel.

As usual, the terms we use are dependent on the society and the context in which they are used, for example, what is considered to be high-level nuclear waste can vary from country to country. In Finland the term used for nuclear waste *ydinjäte* is generally associated particularly with SNF. The Finnish Nuclear Energy Act (1987/990, §3, amendment 1420/1994), however, defines nuclear waste somewhat more broadly as "a) radioactive waste in the form of spent nuclear fuel or in some other form, generated in connection with or as a result of the use of nuclear energy; and b) materials, objects and structures which, having become radioactive in connection with or as a result of the use of nuclear energy and having been removed from use, require special measures because of the danger arising from their radioactivity", but still clearly connecting it to the production of nuclear energy. The term nuclear waste is also used in this study from time to time in a limited sense, as a more convenient way of expressing SNF or when referring to nuclear waste management in general rather than explicitly to SNF. The source literature of the study typically uses the term high-level nuclear waste as planned final disposal solutions usually could, at least in theory, accommodate these without being limited to SNF, or refers to nuclear waste management, or high-level nuclear waste management in general.

### 1.2.2 Final disposal as a concept

According to the IAEA (2011a, 3) in connection with radioactive waste "The term 'disposal' refers to the emplacement of radioactive waste [...] with no intention of retrieving the waste." However, that possibility is not ruled out (IAEA 2011b, 1). Use of the term 'final disposal', in turn, accentuates the finality of the solution. "Disposal of radioactive waste represents the final step in its management, and disposal facilities are designed, operated and closed with a view to providing the necessary degree of containment and isolation<sup>1</sup> to ensure safety." (IAEA 2012, 1). The term final disposal is commonly used both in Finland and Sweden where the terms in the respective local languages Finnish *lop-  
pusijoitus* and Swedish *slutförvar* translate roughly into final placement.

Radioactive waste has to be managed to reduce risks to people and the environment to acceptable levels (IAEA 2011a, 1). According to the assessment of the Swedish Nuclear Fuel and Waste Management Company, SKB, there are two ways of managing SNF, either as resource or as waste. Using SNF as a resource would be costly and lead to the end product ultimately requiring treatment similar to that for SNF, i.e. final disposal. Treating SNF as waste, three options can be envisaged. Of these, dilution and dispersion, i.e. dumping SNF for example in the sea, would violate international treaties and, as transmutation and similar treatments for reducing radioactivity of SNF will not be available in a reasonable time-frame, that would leave isolating the waste and separating it from humans and the environment as the only feasible option. (SKB 2010, 9-16.)

Several strategies could be adopted to achieve the separation of SNF from population and the environment, all the way from prolonging current interim storage practices indefinitely to launching SNF into space. The most recommended method to achieve this definitely appears to be deep geological disposal, which has been widely endorsed (e.g. NEA 2008, 7, OJ L 199 2011, 48, BRC 2012, 27, NEA et al. 2013). In the end, the chosen final disposal method must, of course, be both technically and socially acceptable.

Regarding the technical side of final disposal, in Finland, Posiva's final disposal plan is based on a deep geological disposal concept originating in Sweden. The Swedish KBS concept was first adopted as a reference model in Finland in 1977 due to similar geological conditions. After preferences changed from disposal of reprocessed waste towards the disposal of SNF the reference concept was changed to KBS-2 in 1982 and more focused collaboration was initiated. Non-commercial information exchange was followed by commercial consulting and gradually intensifying joint development of the KBS-3 concept, on which Posiva's DiP and, subsequently, the construction licence application for the final disposal repository were based. (e.g. Posiva 2012, app.7 p.8, Kojo & Oksa 2014a, Svenberg & Elam 2014.)

According to Posiva's construction licence application, the repository, comprising technical facilities and a tunnel network, will be located at a depth of 400-450 metres. In the reference concept, the waste will be placed in robust and corrosion resistant final disposal canisters made of copper and cast iron. The canisters, surrounded by bentonite clay to buffer them against external mechanical and chemical influences, will be placed in holes bored into the tunnel floors. Finally, the tunnels will be filled and sealed to stabilise conditions in the tunnels and to isolate them physically from the surface environment. The bedrock is to provide conditions where changes are slow and more predictable. After sealing, the repository is intended to be left alone; hence no measures are to be taken to improve retrievability. (Posiva 2012, app.5 p.3, app.8 pp.16-18, app.16 p.6, app.17 p.3.)

### **1.2.3 International academic research**

There is now (obviously) a plethora of social sciences research on the final disposal of high-level nuclear waste, including SNF, to which a wide range of disciplines have contributed over a lengthy period of time. Nonetheless, Solomon, Andrén and Stranberg's article *Three Decades of Social Science Research on High-Level Nuclear Waste*, from 2010, provides an excellent summary of the academic research on the issue. As the article limits its review to research on waste created by the civil nuclear power industry, and omits reprocessing (Solomon, Andrén & Strandberg 2010, 16), focus of the review essentially matches the focus of this study.

A typology with three distinctive but somewhat overlapping periods is presented. 1) The period starting from the mid-1970s, when the social dimension began to gain increasing recognition in research and ending in the early 1980s. In this time period the research concentrated on exploring the institu-

tional dimensions of nuclear waste. It was clear that there was a problem and a need to study what had gone wrong. Waste management had become a weak link to be studied and reviewed both nationally and internationally, including ethical considerations. 2) The period from the early 1980s to the mid-1990s, framed by optimism regarding siting. This time period had a problem-solving emphasis and produced studies, for example, on public trust, risk perception, social amplification, stigma, the role of the public and future generations, and equity. 3) The period from the mid-1990s onward, which has focused on what seems to be deadlock with the exception of progress in Finland and Sweden. In this time period research has started to reflect on lessons learned thus far and possible ways forward. The focus has been, for example, on the themes of transparency, democracy, participation and deliberation, the relationship of science, technology and society, in international comparisons and to some extent on the role of social sciences. As national efforts to resolve the final disposal issue have not been very successful, both nuclear waste management projects and research have started to gain in both international perspective and involvement. (Solomon, Andrén & Strandberg 2010.)

The last year included in the review by Solomon et al. was 2009. The following decade saw more research on the final disposal issue, and while interest in the relationship between science, technology and society and international comparisons has persisted, the focus of the research has apparently shifted to a certain extent from the need for transparency, democracy, participation, etc. to the need for governance solutions (e.g. Kuppler 2012, Parotte & Delvenne 2015, Kåberger & Swahn 2015, Turcanu et al. 2016), to how (e.g. Krütli et al. 2010, Bergmans et al. 2015, Whitton et al. 2016, Di Nucci, Brunnengräber & Isidoro Losada 2017), and to what end the general public and local residents are involved (e.g. Sundqvist & Elam 2010, Richardson, Rickwood & Rickwood 2013, Durant 2015, Schröder 2016). Moreover, trust (e.g. Gallardo, Matsuzaki & Aoki 2014, Di Nucci & Brunnengräber 2017, Kelleher 2017), fairness and justice (e.g. Krütli et al. 2012, Cotton 2018) and also other values (e.g. Seidl et al. 2013, Taebi 2017, Stefanelli, Seidl & Siegrist 2017), as well as compensation issues (e.g. Richardson 2010, Di Nucci & Brunnengräber 2017), have become recurring themes in relation to siting.

#### **1.2.4 Finnish research**

Finnish research on the issue was initially reviewed by Litmanen and Kaunismaa (1999) in their publication *Nuclear Waste from the Perspective of Social Scientist* (in Finnish). The review was updated and supplemented as part of Euratom's 7th framework programme research project regarding the socio-technical challenges for implementing geological disposal, in 2012 (Nurmi, Kojo & Litmanen 2012, 12-15,41-53).

A typology of four short periods largely congruent with the Finnish nuclear waste management procedure is introduced. 1) The period from 1990 to 1994 concentrating on the nuclear waste dispute. 2) The period of increasing research activity and research themes from 1995 to 1999, eliciting opinions, in-

formation needs and socio-economic factors in various municipalities in anticipation of the EIA process. 3) The period of research activity settling down after EIA from 2000 to 2004, the characteristic research being media research, decision-making studies and evaluation of EIA and the role of public participation. 4) The period from 2005 to 2010 in which the research concentrates on the chosen site, the municipality of Eurajoki, the research typically including image research and socio-economic research. In addition to the typology proposed, it is noted that recent research seems to be detaching somewhat from the needs of the waste management procedure and becoming oriented more towards international audiences and the bigger picture of things. (For more information on the changing role and contribution of social science to nuclear waste management in Finland, see Litmanen 2008.)

International research and Finnish research were compared in Matti Kojo's dissertation (2014, 57-61) concerning the deliberative turn in nuclear waste management politics. It is observed that: 1) While distinctly social sciences oriented nuclear waste research was lacking in Finland in the 1970s and 1980s, some research was indeed conducted as part of other research, e.g. energy policy research, which reflected the international tendency to emphasise the institutional dimension. 2) While internationally research moved towards problem solving emphasis and already began to scrutinise public perceptions and reactions in the early 1980s, in Finland this tendency became discernible in the mid-1990s, when the purely geological siting approach began to give way to a new emphasis on social criteria. 3) Since the 1990s research interests in Finland have been somewhat aligned with international research interests.

It should be pointed out here that public funding to the social sciences has been somewhat meagre. From research funding provided annually by the Finnish Research Programme on Nuclear Waste Management (altogether little less than 2 million euros per year) social sciences have received only a few percentage. It almost seems that the relatively smooth progression of the repository project has led to the impression that social sciences side of the repository project hardly needs attention and that it could instead even complicate things unnecessarily. Outside interest in the Finnish "success story", however, has grown stronger due to the prolonged deadlock elsewhere and the progress in Sweden and Finland. This show of interest from outside and a certain lack of it from within may explain observations regarding the current tendencies of Finnish research towards the international perspective and looking more widely beyond the process in Finland, which at least to some extent, seem to hold true. However, funding provided by the Finnish Research Programme on Nuclear Waste Management for social scientific research has recently increased moderately.

In recent years nuclear waste management has been studied by Finnish researchers, as a part of the nuclear fuel cycle (Litmanen, Solomon & Kari 2014), from the perspective of governance and risk dialogue (Litmanen et al. 2014, 2017, Auffermann et al. 2015), in relation to Sweden (Kojo & Oksa 2014a), and as a megaproject (Lehtonen 2014, 2015, Lehtonen, Kojo & Litmanen 2017).

Moreover, Finnish nuclear waste management policy has been examined in relation to the widespread participatory turn in nuclear waste management, as already mentioned above (Kojo 2014). Additionally, issues of building trust and positive relations with the community (Yli-Kauhaluoma & Hänninen 2014), stakeholder dynamics (Aaltonen et al. 2015), justice (Vilhunen et al. 2019) compensation and benefits (Kojo & Richardson 2014a, 2019, Lehtonen & Kojo 2019) and issues related to a possible second Finnish repository have also been examined (Kojo & Oksa 2014b, Kojo & Litmanen 2018). Much of this work has been done in connection with international research projects assessing different aspects of nuclear waste management from multinational perspectives (see Jons-son & Andersson 2010, InSOTEC 2014, Andersson 2014), and international book projects (see Brunnengräber, Achim et al. 2015, Brunnengräber, A. & Di Nucci 2019, Lehtonen, Joly & Aparicio 2017).

### 1.3 Roadmap to the study

#### 1.3.1 Starting point

This dissertation is mainly based on a survey conducted in 2008 as part of the research project SEURA, the abbreviation used for "Follow-up research regarding the socio-economic effects and communication of final disposal facility of spent nuclear fuel in Eurajoki and its neighbouring municipalities" in Finnish<sup>2</sup>. SEURA was a joint project by researchers at the Department of Social Sciences and Philosophy at the University of Jyväskylä and the Department of Political Science and International Relations at University of Tampere, 2008–2009, and part of the Finnish Research Programme on Nuclear Waste Management (KYT2010), 2006–2010.

This was the first time that social science research on nuclear waste was granted public funding in Finland since the Public Sector's Research Programme on Nuclear Waste Management (JYT2001), 1997–2001 and the ratification of the DiP on the repository in 2001. The target of KYT2010 was to support the overall competence needed for regulatory purposes, and to assess solutions for the long-term management of spent fuel. The aims of SEURA were, to update the knowledge regarding the perceived socio-economic and socio-political impacts of the repository and the information needs and ways and means to obtain information regarding the issues related to final disposal at the location. Notably, the municipality of Eurajoki was also the very first in the world where the views of local residents could be elicited at the post site selection phase i.e. after successful siting process<sup>3</sup>.

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<sup>2</sup> Full Finnish title: "Seurantahanke käytetyn ydinpolttoaineen loppusijoituslaitoksen sosio-ekonomisista vaikutuksista ja tiedonvälityksestä Eurajoen ja sen naapurikuntien asukkaiden näkökulmasta."

<sup>3</sup> The process was concluded, and the decision was largely accepted by the local community and the general public.

The target population of the 2008 postal survey consisted of 16 to 75-year-old residents of Eurajoki and neighbouring municipalities and limited to those with Finnish as their first language. Three thousand recipients were chosen by stratified sampling, for pragmatic reasons. The aim was to allocate resources efficiently to ensure an acceptable number of respondents. The main focus of the survey was the municipality of Eurajoki, but the neighbouring municipalities were also covered. The survey had a return rate of 21% and a response rate of 20%. The number of respondents from each municipality corresponded well with the stratified sample sizes. While the response rate was not very high, it satisfied pre-set minimum conditions and, according to the background questions, respondents represented the target population fairly well. (For more information on the survey, see Kari, Kojo & Litmanen 2010, 20-26.)

Unfortunately, the data on local opinions obtained from the survey was not normally distributed, which somewhat limited the choice of statistical methods described later (see Chapter 2.1.1). During the study process the use of the survey data also moved further and expanded considerably from the use for which it was originally intended and a considerable amount of other material was used in addition of the 2008 survey data, in an attempt to cope with the limitations of the source material. Additionally, the role of the survey data diminished, as the focus of the study shifted further as presented below (see Chapters 1.3.2-1.3.4).

Despite the fair share of challenges posed by the original material, on the other hand, it was obvious from the outset that the data itself and the insights it afforded would have been far too valuable and unique to pass by and reject without further inquiry. The next three chapters present the publications the study and describe how, after descriptive and explorative interest (Chapter 1.3.2), through gaining a new focus (Chapter 1.3.3), comparative and evaluative research interest rose to the fore - resulting in the need for preparing this dissertation (Chapter 1.3.4).

### **1.3.2 Descriptive and explorative interest**

I would like to view this study as a journey, starting from something quite basic but in itself interesting and valuable, progressing through different stages, opening interesting views, and ending, as I like to believe, in something more encompassing, insightful and meaningful. – And, what I consider important from an aspiring researcher's point of view, inspiring curiosity to learn even more about the subject at hand.

At the beginning of this particular journey, the starting point for this study was, essentially, to form a picture of local opinion on final disposal related issues in a phase where the site selection had already been concluded and approved by the municipality some time ago. This descriptive interest is apparent in the first publication of the dissertation.

Kojo, M., Kari, M. & Litmanen, T. (2010). The socio-economic and communication challenges of spent nuclear fuel management in Finland: The post site se-

lection phase of the repository project in Eurajoki. *Progress in Nuclear Energy*, 52(2), 168–176.

The publication sets the stage by presenting the 2008 survey and addressing local perceptions regarding issues connected to final disposal. An important aspect of the article is that it is concerned with the post site selection phase of the SNF repository, which is notable as earlier research had focused on the site selection phase, Finland being arguably the first country to enter the post site selection phase. Perceived impacts and perceived threats related to final disposal, as well as information issues were explored and it was concluded that local residents followed nuclear waste management issues actively and were especially concerned about well-being and the safety of future generations. This indicated that local acceptance was not necessarily guaranteed, but would have to be taken into account also in this new phase.

After acknowledging that acceptance, an issue that had dominated debate in the site selection phase, would also be a central theme in this phase, the next logical step was to try to discover what the data might reveal about the rationality of acceptance in this case. The second publication was built around this explorative interest.

Litmanen T., Kojo M. & Kari M. (2010). The rationality of acceptance in a nuclear community: analysing residents' opinions on the expansion of the SNF repository in the municipality of Eurajoki, Finland. *International Journal of Nuclear Governance, Economy and Ecology*, 3(1), 42–58.

The publication approaches acceptance of the final disposal through acceptance of repository expansion. The article analyses acceptance figures of possible repository expansion in relation to the assumptions of several common explanatory types as far as the data allows. While the results reinforced several of the explanation types considered, the study also ended up finding an intriguing correlation between what was then identified as respect for one's own community and acceptance of expanding the repository. The analysis indicated that the more the people valued the area where they lived, the more likely they were to accept an expansion. Additionally, it was evident that new actors were less readily tolerated than already established actors, connecting acceptance also to operators (i.e. implementers) instead of just operations.

After the data had been explored from various perspectives, it was obvious that the research had come to a crossroads. It would be necessary to decide whether to turn back, and approach the data from a new angle or angles, or focus on something and pursue some already identified path further.

### **1.3.3 Gaining focus**

As mentioned, the research had indicated an intriguing correlation between respect for one's own community and acceptance of expanding the repository. However, the right avenue to approach the issue was needed, and this was



provided by the OECD's Nuclear Energy Agency - by challenging the prevailing assumption linking acceptance with dependency. This contrasting view offered an excellent point of comparison for reflection on the basis of community acceptance.

Kojo M. & Kari M. (2010). Pride-effect in a nuclear community. Local perceptions regarding spent nuclear fuel repository in the municipality of Eurajoki, Finland. In *WM2010 Improving the Future by Dealing with the Past, Final Proceedings*, paper no 10192.

The third publication introduces the concepts of nuclear oasis and industry awareness, pursuing further the issue of community respect observed in an earlier publication. According to the prevailing nuclear oasis hypothesis, less opposed attitudes towards final disposal in those communities already hosting facilities related to the nuclear industry, derive mainly from dependency from the industry - while according to the industry awareness hypothesis this disposition derives from the existing cultural basis for facility development. The article examines how certain perceived benefits and impacts correlate with acceptance, the analysis indicating that acceptance is more closely related to industry awareness factors than to nuclear oasis factors.

At this stage it was obvious that this path would require further exploration as the results obtained clearly warranted thorough examination and comparison of these two approaches - especially as the dominant approach had been, to a certain extent, called into question.

### **1.3.4 Comparative and evaluative interest**

The comparative and evaluative interest is pursued in both remaining publications of the dissertation, in the fourth as part of the overall report of the findings of the survey and SEURA project, and in the fifth as the central issue of the article.

Kari, M., Kojo, M. & Litmanen, T. (2010). *Community Divided. Adaptation and Aversion towards the Spent Nuclear Fuel Repository in Eurajoki and its Neighbouring Municipalities*. Jyväskylä: University of Jyväskylä; University of Tampere.

The fourth publication is an extensive research report that goes through the range of variables related to final disposal, in relation to certain socio-demographic variables. The question of acceptance and the concepts of nuclear oasis and industry awareness are also explored further. The analysis moreover indicated that there were reasons to take a critical stance towards the predominant approach and the results implied that we should consider the competing theory as an explanatory model when examining local acceptance in nuclear communities.

Kojo, M., Kari, M. & Litmanen, T. (2012). Nuclear community considering threats and benefits of final disposal. Local opinions regarding the spent nuclear fuel repository in Finland. *International Journal of Environmental Technology and Management*, 15(2), 124-145.

The fifth publication concentrates on the nuclear oasis and industry awareness approaches and applies them as the conceptual frameworks to interpret the survey results and evaluates their claims. The analysis concludes that concentrating on strictly economic necessities and dependency was clearly insufficient in scope and that it would be more fruitful to pay attention to the general well-being of the community. At the same time, the claim made by industry awareness, that acceptance does not primarily depend on economic considerations, was far from proven as community well-being was (quite obviously) closely related to economic factors.

As a result, the need for a more holistic approach and a more comprehensive analysis of the workings of the nuclear oasis and industry awareness frames was identified; The dissertation therefore explores, for its own part, these themes further in order to meet this need.

### **1.3.5 The dissertation**

According to the requirements for postgraduate degrees at the Faculty of Humanities and Social Sciences at the University of Jyväskylä; "The dissertation can be an article dissertation or a monograph or a combination of these two." An article dissertation includes, in addition to scientific publications, a summary written by the doctoral student, which assembles and evaluates the results of the articles. While this dissertation is based on publications examined in preceding chapters (Chapters 1.3.2–1.3.4), here it deviates somewhat from the traditional path of an article dissertation. Instead of just assembling the results of the publications, the summary also introduces some new analysis, complementing and adding to the research reported in the publications. In this respect it thus resembles a monograph presenting independent scientific research, making this dissertation a combination of these two types.

The subject of the dissertation concerns the readiness of communities, and more precisely nuclear communities, to consider the final disposal of SNF in their area (cf. Chapter 1.1.2). This is approached through the case of Eurajoki, because it can be considered a prime example of the nuclear communities' tendency to be less opposed towards the final disposal, and because of its unique situation, thereby serving as an interesting precedent (see Chapters 1.1.4 and 1.1.5). The analysis is mainly based on the publications introduced earlier in this chapter (Chapter 1.3) and the survey conducted on the SEURA project in 2008 as part of the Finnish Research Programme on Nuclear Waste Management (see Chapter 1.3.1), while other data (see Chapter 2.1) is used, and even some additional analysis introduced (see Chapter 3). As mentioned earlier (Chapter 1.3.1), the use of the 2008 survey data has moved further and expanded considerably from the use for which it was originally intended; The existing survey respons-

es are re-examined with research questions differing significantly from the aims of the original research, i.e. they are subjected to a secondary analysis, and additional material is used in order overcome some limitations of the original data.

The aims of the dissertation are:

1. To form a picture of Eurajoki as a nuclear community and to examine the rationality of community acceptance in the case of Eurajoki. This is done by briefly recounting how Eurajoki became a nuclear community and the site for the final disposal of SNF (Chapter 4.1), and exploring residents' opinions regarding the final disposal, including acceptance levels and their relation to certain preconceived considerations (Chapter 4.2).
2. To scrutinise the workings of the competing nuclear oasis and industry awareness frames. This is done by analysing them as the conceptual frameworks to interpret nuclear communities (Chapter 3, see also Chapter 2.3) and by applying the competing viewpoints to the results from the survey (Chapter 4.3).
3. To draw conclusions on the viability of the frames based on the findings and reflect on the way forward given the evidence gathered in the course of the study (Chapter 5).

The summary of the dissertation will proceed as follows: After this introduction in Chapter 1, consisting of the background, course and aims of the study, next, in Chapter 2, the different methods and approaches used to examine Eurajoki in the different stages of the study are described. This is followed, in Chapter 3, by the abovementioned new analysis, which scrutinises the premises and the backgrounds of the two framings decisive for the aims of the study, i.e. the industry awareness and nuclear oasis frames. After these three preparatory chapters, the next three chapters address first of all the results of the study, in Chapter 4, the results are discussed and reflected upon in light of existing knowledge, in Chapter 5, and finally, in Chapter 6, the conclusions are drawn, i.e. the main results, their relevance and possible implications are considered.

The account of questions in the 2008 SEURA questionnaire and the original publications are appended to the end of the dissertation, after brief summaries in English and Finnish and the references.

## 2 APPROACHES USED IN THE STUDY

### 2.1 Descriptive and explorative interest

As noted in Chapter 1.3.2, the starting point of this study was initially descriptive. The main aim, of the original SEURA project, was to form a picture of local opinion on final disposal related issues in Eurajoki based on a resident survey, and thus update the existing picture based on previous surveys. However, right from the outset of the study, survey data was also thoroughly scrutinised with a keen eye for 'the usual suspects', i.e. certain explanation types frequently used in the literature in connection to local acceptance – although the study was not designed with this in mind.

For this purpose, because of the two distinctive reasons: 1) the descriptive and explorative nature of the study, i.e. the intention to form a picture of Eurajoki as a community from a certain viewpoint and analyse how the data relate to a certain set of approaches and 2) nature of the data, i.e. not normally distributed, the analysis methods were kept straightforward and robust or non-parametric methods were used.

It should be noted, however, that while these interests formed the starting point of the study, they are in no way limited only to the first part of the study, as the latter publications and even this summary of the dissertation (see Chapter 4.1) demonstrate. In fact, the most thorough and systematic presentation describing the different considerations related to the final disposal project in Eurajoki is offered in the fourth publication (Kari, Kojo & Litmanen 2010), examining in detail opinions on obtaining information about the final disposal, the quantity of information provided by different actors, confidence in the information provided by different actors, information needs, perceived impacts and threats connected to the repository, and acceptance of the final disposal, and of expanding the repository.

During the study, in addition to the main data from the survey (see Chapter 1.3.1), e.g. Energy Attitudes of the Finns annual survey series data from 1983

to 2008<sup>4</sup>, Power Wielding in Finnish Energy Policy: Citizens' Views survey data from 2007<sup>5</sup>, and the results of three former resident surveys (Kurki 1995, Harmaajärvi, Litmanen & Kaunismaa 1998, Aho 2008), and relevant Eurobarometer surveys, were used in the different stages in order to obtain a more comprehensive picture of the situation.

### 2.1.1 Statistical methods

While the Community Divided report (Kari, Kojo & Litmanen 2010) offers the most thorough account of opinions in Eurajoki and the neighbouring municipalities among the publications of the dissertation, it also provides an account of the tools used in the analysis in the report, and in fact throughout the whole study, to form a picture of Eurajoki as a nuclear community and explore the situation in the area. As described in the report (Ibid., 27-28), the following methods were used for this purpose:

**Frequency analysis** and **frequency tables**, and graphs based on these were used to illustrate the distribution of opinion among the respondents and also to examine the general opinion climate in the area. Also, in addition to this kind of general illustrative purpose, they were also used to identify and assess differences in opinions between those living in Eurajoki and those living in the neighbouring municipalities (Eura, Kiukainen, Lappi, Luvia, Nakkila, Rauma)<sup>6</sup>, and in some cases other selected groups - in the same way as in case of cross-tabulations (see below).

**Crosstabulations** were used to produce figures and charts on the attitudes of different respondent groups and to examine differences between those groups. The groups were usually formed on the basis of background questions but were also based on theory and scientific curiosity. Statistical significances of the differences between the groups were tested and, depending on the context, usually only the most significant were reported.

**Chi-square tests** (Pearson's chi-square,  $\chi^2$ ) were used to test the statistical significance of observed group differences in crosstabulations. The chi-square test is a widely used nonparametric test to test differences between two samples or groups.

**Kendall's correlation tests** (Kendall's tau-b,  $\tau_{\text{Ken,b}}$ ) were used to chart relationships between different variables in the data and especially to explore relationships between different variables presumably related to the acceptance of final disposal, like attitude towards the construction of more nuclear power and variables actually measuring acceptance of final disposal, like acceptance of repository expansion to accommodate new operators. Kendall's tau-b is a non-

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<sup>4</sup> Acquired from Finnish Social Science Data Archive <http://fsd.uta.fi>

<sup>5</sup> By courtesy of Governance of Finnish Energy Policy-Making project which was led by prof. Ilkka Ruostetsaari.

<sup>6</sup> These were the neighbouring municipalities at the time of the survey 2008. Subsequently the municipality of Kiukainen merged with the municipality of Eura and the municipality of Lappi with the municipality of Rauma in 2009. Additionally, the municipality of Luvia merged with the municipality of Eurajoki in 2017.

parametric measure of association which measures rank correlation and takes ties into account. Again, as in the case of crosstabulations and the associated chi-square tests, for the most part only the highest correlation coefficients were reported.

### 2.1.2 Exploring the rationality of acceptance

From the initial analysis of the survey data it was clear that local residents followed issues actively and were concerned about well-being and safety, indicating that acceptance was not guaranteed in the post site selection phase either, and that examining the rationality of acceptance would be as important as ever (Chapter 1.3.2).

That established, the local acceptance figures for Eurajoki were examined, in order to ascertain how well the data corresponded with certain assumptions from the related literature. As described in the second publication of the dissertation (Litmanen, Kojo & Kari 2010, 46-48), the six assumptions used, and corresponding aspects examined for this purpose based on both the literature and questions used in the survey were:

**Information deficit** (e.g. Slovic 1987, Wynne 1995, Desvousges et al. 1993). According to this assumption, opposition of lay people is due to lack of information. It is presumed that acceptance could be achieved through better communication and further that efficient communication of scientific facts and the consequent 'enlightenment' would resolve misconceptions resulting in approval of the solution proposed by the 'experts' or 'scientific community'. On the other hand, even if one does not share such a belief in "enlightenment" via one-way communication, it seems clear that information gained also affects the ability to take part in any meaningful dialogue regarding the project. Interestingly, it has also been assumed elsewhere that if people had more information regarding relevant issues, they would be more likely to participate in environmental movements and turn to environmental activism (Agyeman & Angus 2003, 346,351, Bulkeley & Mol 2003, 148) – and traditionally environmental movements have been rallying opposition against nuclear facilities, including waste repositories.

**Social trust** (e.g. Desvousges et al. 1993, Mushkatel, Nigg & Pijawka 1993). According to this assumption, to gain acceptance for a repository, both the organisations responsible for the final disposal and regulators as well as the process itself must be trusted to handle the job in a safe and competent way, and with integrity and sensitivity to local concerns. It has also been pointed out that trust is easily lost and hard to gain - and even harder to regain. The main actors responsible for Finnish SNF management are the Radiation and Nuclear Safety Authority (STUK) and the developer Posiva, which play the key roles with regard to safety issues, and the Ministry of Employment and the Economy, which oversees the process and makes recommendations to the Council of State. On the other hand, the role of social trust has also been called into question as it has been proposed that there are other facets of trust (epistemic trust and antagonism) which also play a pivotal role (e.g. Sjöberg & Wester-Herber 2008, Sjöberg

2008). In addition, it has been shown (see Drottz-Sjöberg 1996, 15, Drottz-Sjöberg 1998, 18-19,23) that social trust does not necessarily translate into acceptance.

**Benefit versus cost** (e.g. Fischhoff et al. 2009). According to this assumption acceptance depends on personal benefit-cost calculation. The so-called expected utility model employed particularly by economists stipulates (in its basic form) that "an individual who expects to be affected by a proposed facility will compute his or her expected utility with and without the facility, and then express a preference depending on which of these two values is greater" (Kunreuther & Easterling 1996, 603). This, together with the literature (e.g. Jenkins-Smith & Kunreuther 2001, Chung, Kim & Rho 2008, Kojo 2009, Kojo & Richardson 2014a), suggests that additional compensation can play an important role in the siting process. In such a case, in order to gain acceptance by the community, "compensation has to [...] offset the net disutility imposed by the facility" (Frey, Oberholzer-Gee & Eichenberger 1996, 1299). However, how far the cost-benefit analysis can be extended has been questioned (van der Pligt 1992, 164), likewise whether the benefits could compromise the evaluation of risks locally (see Kojo & Richardson 2013, 14-15). Also, in a number of cases, compensation proposals have in fact had a negative effect as they were perceived as attempts at bribery (Frey, Oberholzer-Gee & Eichenberger 1996, 1299-1300,1307).

**Sense of moral obligation.** The moral and ethical questions regarding SNF issues have been investigated from many perspectives (e.g. Krannich, Little & Cramer 1993, Easterling & Kunreuther 1995, Frostenson 2008). Here it is assumed that members of the nuclear community might feel responsible for the SNF produced, and consider that there exists moral obligation to manage nuclear waste because an NPP is located in the municipality. According to this assumption, personal ethics direct the behaviour and responsibility may take precedence over the promotion of self-interest (Easterling 1992, 449). Moral values have been recognized as a major factor and important predictor regarding risk acceptability in empirical research (Sjöberg & Drottz-Sjöberg 1993, 1).

**Perceived risks and threats.** Studies on the perception of risks have shown that the public perception of the risks connected to the disposal of nuclear wastes differs widely from the views of experts. In addition, it has been shown that the risks associated with radiation are perceived qualitatively differently from those of other health risks and markedly negative cognitive images are linked to nuclear waste in the eyes of the public (e.g. Desvousges et al. 1993, Easterling & Kunreuther 1995, 131-132, Slovic 1987, Slovic, Layman & Flynn 1993). According to this assumption, acceptance is related to perception of risk and not to risk calculations or scientific assessments. In this kind of intuitive understanding, assessment is "enriched by the perceived presence of situational and risk specific characteristics" and incorporates various connotations, semantic images, values, social contexts and cultural affiliations. This type of multidimensional risk assessment, in turn, defies calculation as it cannot be reduced to the probabilities of a certain clear set of consequences. (Renn 1998, 60,64.)

**Attitude to nuclear power.** One factor used to explain people's attitudes to repository issues has been their overall view of nuclear energy (e.g. Dunlap et al. 1993, 147, Desvousges et al. 1993, 206). According to this assumption, acceptance of final disposal is related to acceptance of nuclear energy. It is natural to assume that relatively similar risk issues should analogously produce relatively similar attitudes to risks, especially if they are intertwined as in the case of nuclear power and nuclear waste. In addition, the claim "that opinions concerning nuclear waste management must be seen in the wider context of more general attitudes toward nuclear energy" has also gained credibility from survey studies (van der Pligt 1989, 238). Attitude to nuclear power has been considered to be one of the major factors behind acceptance of the repository, also in Sweden (Sjöberg 2004, 743-744, Sjöberg & Drottz-Sjöberg 2009, 283-288,290).

– And, obviously, efforts were also made to identify other factors deserving further attention in the light of the data, like the intriguing correlation between respect for one's own community and acceptance already mentioned (see Chapter 1.3.2).

## 2.2 Gaining focus

As outlined in Chapter 1.3.3, the third publication of the dissertation (Kojo & Kari 2010) represents bringing focus to the study by pursuing further the issue of community respect observed in an earlier publication (Litmanen, Kojo & Kari 2010). Issue of nuclear communities and the way they are viewed, central to the study, were brought to the fore in this stage and continued in later publications, including this summing up of the dissertation. At this time, the use made of the data elicited by the 2008 SEURA questionnaire deviates significantly from the original purpose as the items of the questionnaire were not designed for gauging issues related to the nature or framing of nuclear communities (see Chapter 1.3).

### 2.2.1 Nuclear communities

While willing host communities for SNF have been sought for a quite a while, community itself has remained somewhat elusive concept. Given that the repository requires a site for the facility, the place, or the area where it is located is essential. However, community also refers to collective identity, the feeling of unity, recognition of common interests, connectedness and the engagement of actors, in which community is something an individual identifies as belonging to or being part of. Also, it has to be noted that community relations and sense of community change with time, for example, according to Bauman (see Bauman 2001) people seek safety from community in insecure circumstances.

In this study the residents of the municipality are considered to represent the local community. According to the Finnish Local Government Inhabitants' survey (FSD 2007, 15-16) around half (48%) of inhabitants identified fairly or



quite much with their municipality (or city) of residence and only under a fifth (18%) fairly or very little, whereas in the case of sub-region and region identification was clearly lower, with under a fifth (17%) identifying fairly or quite much with their sub-region and under a third (29%) with their region. In addition, our own survey data also indicated differences in acceptance levels between residents of Eurajoki and residents of neighbouring municipalities (Kari, Kojo & Litmanen 2010, 76-77). It should be born in mind, however, that such is not necessarily the case everywhere. In addition to cultural differences, the size, composition, political weight, etc. of municipalities vary greatly.

Communities which have nuclear activities in their areas are often referred to as 'nuclear communities'. Thus the presence of the nuclear industry in the community is considered to somehow define the whole community. "It is assumed that nuclear activity is not just something that is going on in the area, but instead being 'nuclear' becomes part of the community's identity." (Kari 2009, 3, Kari, Kojo & Litmanen 2010, 92.) In line with this, nuclear communities have been characterized by the United Kingdom's Nuclear Decommissioning Authority (NDA 2007, 89) summing up lessons drawn from the independent multinational CARL project as "communities who host nuclear activities and are conscious of their nuclear identity".

This means that the nuclear industry has a presence and is a fixture in the community and the inhabitants have developed a familiarity with nuclear activities. While nuclear activity in the community is often seen as a mixed blessing with economic advantages and disadvantages on other fronts, it seems that there is an interest in continued co-operation with the industry in these communities. (Kari 2009, 3, Kari, Kojo & Litmanen 2010, 92, Kojo, Kari & Litmanen 2012, 126-129.) The Nuclear Energy Agency (NEA) has actually observed that, "experience worldwide shows [...] it is with nuclear host communities that progress in facility siting has been made quickest" (NEA 2003a, 25).

While numerous researchers have concluded that the inhabitants of a nuclear community tend to be more positively disposed towards nuclear activities than the general public (Easterling & Kunreuther 1995, 162, Eiser, van der Pligt & Spears 1995, Kiljunen 2010, ch. 2.3, van der Pligt 1992, 75-89), it has been also noted (e.g. Bergmans et al. 2008, 62) that nuclear communities tend to develop a pragmatic acceptance or 'tolerability', rather than embracing the prospect of hosting nuclear facilities. In addition, various researchers have established how attempts to site nuclear facilities are affected by economic and power relations (e.g. Blowers 1999, Jacob 1990, Darst & Dawson 2010, 53-54,74, Elam & Sundqvist 2009, 980-982, Gunderson & Rabe 1999, 196-197, Chung & Kim 2009, 8,10,13-14, McCutcheon 2002, 194-195, Kojo & Richardson 2014a, 35-37), indicating that nuclear communities are more susceptible to the industry's advances due to their vulnerability, dependency or economic needs.

## **2.2.2 Challenge to how nuclear communities are viewed**

In 2007 the NEA introduced, in connection with acceptance of final disposal, the concept of 'industry awareness'. The concept showcased the standpoint of the

NEA, according to which a more favourable stance towards final disposal in communities already hosting nuclear facilities should not be attributed to economic dependency, but rather be credited mainly to cultural integration. This, in turn, should not be seen as a question of simple familiarity with (or knowledge of) nuclear activities, or the industry, as the reasoning runs deeper. According to this view, as final disposal is tied to existing ongoing nuclear activity, it builds on and renews the existing cultural basis for facility development as "communities have already integrated the industrial activity and cognitive understanding into their local culture". (NEA 2007b, 41-42.)

This view on the part of NEA in 2007 is intriguing in the sense that it clearly challenges the well-established 'Nuclear oasis' view. This view, popularized by Andrew Blowers and his associates at the beginning of the 1990s, brought to the fore the essential role of uneven power relations and dependency mentioned above. According to this view dependent workforce, economic leverage and support from governments trying to resolve nuclear facility siting issues leads to situations in which the nuclear industry operates from a position of advantage and this, in turn, produces nuclear oases. Blowers also asserts that nuclear oases are often peripheral, remote and economically and politically marginal from the outset. (Blowers 2002, 72-74, Blowers, Lowry & Solomon 1991, Marshall 2005, 3.)

As discussed above in connection with "being 'nuclear'", it is in practice impossible to talk about nuclear communities without assuming that nuclear activity is somehow an essential part of the local community. Thus the nuclear oasis and industry awareness approaches frame the manner in which a community and its identity are connected to and affected by the nuclear industry, i.e. the relationship between industry and community, very differently. In so doing, they also paint very different pictures of nuclear communities and the prevailing reality in those communities – what it means to be a nuclear community. (Kari 2009, 3-4, Kari, Kojo & Litmanen 2010, 92-93.) Yet, ultimately, this is the reality on which the actors related to siting should base their actions, and on the ground of which those actions should be evaluated when community aspects of siting are considered.

Where the nuclear oasis frame concentrates on dependency, oppression, and control by external influences, labelling nuclear communities as oppressed or disadvantaged communities, the industry awareness frame concentrates on added value, sustained relationships, shared understanding and local development, labelling nuclear communities as communities with an industry culture and insight.

This quite radical discrepancy in viewing these communities, combined with the aforementioned results warranting thorough examination of the approaches, as the dominant approach had to a certain extent been called into question (see Chapter 1.3.3), led to an interest to compare and evaluate the approaches and the way they frame the situation in communities.

## 2.3 Comparative and evaluative interest

While the concept of frame and its derivatives framing and reframing are not used in the original publications, with the exception of 'Community Divided' (Kari, Kojo & Litmanen 2010), as a multitude of related terms like interpretations, approaches, interpretive approaches and conceptual frameworks were used as working definitions as part of the process of finding the relevant concepts for approaching the issue at hand, they are employed in the summing-up of the dissertation as they seem to offer valuable insights into the matter of disparate views on the nature of nuclear communities and their relationship to the nuclear industry. Essentially, nuclear oasis and industry awareness seem to give different answers to the basic question which, according to (Goffman 1986, 8), frames are supposed to answer - "What is it that's going on here?"

### 2.3.1 Frame

The basic idea of the frame stems from the Kantian notion that humans do not just passively receive knowledge in perception, but instead our minds play an active part in the process (see Kant 2009, Kant 2001, O'Shea 2011, 116-157). While for Kant 'categories of reason' were constant and unchanging, it has become evident that concepts and categories can be seen as historically changing and varying. In the 1960's Kuhn in his influential "The Structure of Scientific Revolutions" asserted that this type of structuring concerns all knowledge including scientific knowledge, stating that knowledge cannot be pursued without depending on prior assumptions and perspectives, thus essentially arguing that there is no knowledge outside a frame of reference. In order for us to see things differently the frame of reference has to change. (See Kuhn 1996.)

In the field of sociology Mannheim introduced 'relationism' recognising that knowledge is always knowledge from a certain position (Berger, P. L. & Luckmann 1991, 22, see Mannheim 1954, 253-256), this including social scientists' knowledge as early as in the 1920's. The theme of social context affecting our view of reality, however, remained outside the mainstream of sociology until it surfaced in the late 1960's - early 1970's with Berger and Luckmann's prominent work on the social construction of reality (Berger & Luckmann 1967) and Goffman's seminal work on the organization of experience (Goffman 1974).

The concept of 'frame' as a schema for interpreting reality was established in social sciences by Erving Goffman. In his book "Frame Analysis" Goffman refers to frames as "terms of the organization of experience" (Goffman 1986, 11). A frame, by defining the situation, shapes the meanings generated within it (Berger, B. M. 1986, xiii). According to Goffman, in any given situation we face the question: "What is it that's going on here?" (Goffman 1986, 8). The frame or frames (as it is likely that several are applied) we employ provide a way of describing the event to which they are applied (Goffman 1986, 24-25). We do not even have to participate in the situation. As Goffman puts it "observers actively project their frames of reference into the world immediately around them"

(Goffman 1986, 38-39). Thus, frames are the tools we use to make sense of 'raw' information regarding the situation, giving them meaning and coherence (Kendall 2015, 5). Although our interpretations of the situation may differ, according to Goffman, we as individuals do not usually create a definition of the situation, instead we only assess correctly what the situation ought to be for us and act accordingly. Usually a mere glance is enough to convince us that anticipated perspectives apply, giving us an indication of what has happened before and expectations of what will happen next. (Goffman 1986, 1-2,9,38.)

While Goffman (1986, 302-339) discusses ambiguities and frame disputes, as being in doubt or disagreement regarding what it is that is going on, he argues that "correct reading is usually soon established" and the frame cleared. As he sees it, facts are not a matter of opinion, our framings are usually adequate and framing errors are not likely to be long-lasting (Goffman 1986, 440,444). According to Goffman (1986, 22,328,337) social frameworks provide background to events that are not 'purely physical' and institutionalised means of social control serve to keep frames clear and easy to apply. In Goffman's account frames remain a very static concept as he does not portray mechanism(s) that would lead to the 'correct' frame changing or evolving due to individual or social action. However, social processes can also be given a much more active part in defining and constructing relevant frames, as comes obvious when examining concepts of framing and reframing.

### **2.3.2 Framing and reframing**

'Framing' as a concept stresses agency as it refers to the active construction and articulation of frames. In media research the focus is on the articulation of frames. For example, according to Entman, framing entails selecting some aspects of a reality and making them more salient in communication, in effect, promoting some interpretation, problem definition, moral evaluation, and/or treatment recommendation (Entman 1993, 52). Different actors will understand the situation differently, prioritize or exclude different aspects and different solutions (Dewulf, Craps & Dercon 2004, 178). When several parties are involved and in disagreement regarding the relevant frame to apply to the situation, influential actor(s) may, by directing discussion and promoting certain frames seek to affect general perception of the issue at hand. The framing of environmental and other public policy problems, social movements and collective action has recently become a significant area of study in the social sciences (Bickerstaff et al. 2008, 146, Benford & Snow 2000, 612). Benford & Snow (2000, 614) describe how social movement scholars use framing to denote "an active, processual phenomenon that implies agency and contention at the level of reality construction" and how there is dynamic evolving process that "involves the generation of interpretive frames that not only differ from existing ones but that may also challenge them." Thus, frames can be seen as co-constructions, where frames can be challenged and renewed, while they are not reduced to temporal frame alignments negotiated on the spot (cf. Dewulf et al. 2009, 159-160, Fiss & Hirsch 2005, 30-31). In practice, influential actors can try to change general per-

ception, i.e. dominant framing, regarding the certain situation and thus reframe the issue, although the task of challenging the established way of seeing things cannot be described as an easy one.

It can, however, be argued that reframing and the way that the frames are backgrounded could have received, and should receive, more attention. After all, dynamic processes of reframing, frame changes, influence how we understand different issues and situations and what we view to be appropriate policy responses, making new lines of thinking open and readily accessible. (Bickerstaff et al. 2008, 146.)

In this case there is a situation where the already well-established nuclear oasis frame is challenged by more recent industry awareness frame, in what is rather obviously an attempt on the part of the international nuclear (or radioactive) waste management community to reframe nuclear communities and their relationship to the nuclear industry by claiming that the new frame provides a more accurate definition of the situation prevailing in these communities. While the success of reframing attempts obviously also depends on aspects other than merely the validity of the claim presented (like the aforementioned influential potential of the actor(s) presenting the claim), here my interest lies in comparing the frames in question by examining the grounds of both the established and the challenging frame, evaluating how well they seem to portray the situation in Eurajoki and then assessing validity of their claims in light of the case.

Next the frames are examined in greater detail.

## 3 FRAMES SCRUTINISED

### 3.1 Frames under examination

This study concentrates on two contrasting approaches, i.e. analytical frames, concerning the reason for heightened readiness to consider hosting a final disposal repository for SNF in the nuclear communities, namely the industry awareness and nuclear oasis frames, already mentioned on several occasions earlier.

While the frames in question are analytical frames, as they tell us where to look (and where not to) while seeking a reason for less opposed attitude towards final disposal in nuclear communities, they are also frames in the wider sense mentioned in the preceding chapter (Chapter 2.3) because they guide our interpretation of 'what is it that's going on here', that is, what it means to be 'nuclear', what kind of places nuclear communities are and how they differ from other communities. And the answers they offer are remarkably far from one another as these two frames present a very different picture of nuclear communities. According to the nuclear oasis frame, these are disadvantaged, probably hard-pressed or even oppressed communities, whereas, according to the industry awareness frame, these are communities with an industry culture and insight, as noted (see Chapter 2.2).

This raises the question of how these interpretations regarding the fundamental nature of nuclear communities can be so far apart from each other. What lies in the background of these frames, and how accurately do they portray the situation in the communities?

Regarding the backgrounds of the frames, in the case of the industry awareness frame, the material which best accounts for the nature of the frame consists of Forum on Stakeholder Confidence (FSC) studies and reports, workshop proceedings and summaries, the proceedings of topical sessions, FSC background documents and Nuclear Energy Agency (NEA) documents regarding FSC. These, with a few exceptions, are obtainable from the NEA and FSC

websites<sup>7</sup> and freely available to the public. In case of the nuclear oasis frame the material consists of the works of Andrew Blowers alone and co-authored. These are integral source materials concerning the frame. Blowers is the central figure in the nuclear oasis approach, as he was involved in the 1991 publication "The International Politics of Nuclear Waste" (Blowers, Lowry & Solomon 1991) which established the idea of nuclear communities as oases for the nuclear industry, and has ever since addressed the issue and related processes.

The material was subjected to textual analysis, combining close reading and the hermeneutic approach in order to examine the content of the texts and interpret how the respective frames are constructed in them. The texts were subjected to several reading rounds, where material considered superfluous to understanding the frames was cut and parts considered important for interpretation highlighted, thus forming a series of consecutively revised interpretations. This type of analysis relies heavily on the interpreter; therefore, in the following chapters concerning the backgrounds of the frames (Chapters 3.2 and 3.3), several quotations are used as textual evidence to support the interpretations and strengthen the arguments.

Frames are supposed to guide the interpretation of complex reality by providing the perspective most accurately capturing the essential characteristics of the situation or the issue at hand. Frames distil reality as a sort of 'ideal types' into which we try to fit our experiences. Frames reduce the high complexity of rationalities and by so doing ignore some of the multifacetedness and inherent complexity of real-life situations. Here (in Chapters 3.2, 3.3 and 3.4) the above-mentioned frames are examined in order to ascertain the essential aspects characterizing nuclear communities and local acceptance of final disposal according to them.

As regards how accurately the frames really portray the situation, and capture the essential aspects and issues, that is scrutinised and discussed later in connection with the results of the study (see Chapters 4.3 and 5).

## 3.2 Background to the industry awareness frame

Behind the industry awareness frame there is long line of acronyms; FSC, RWMC, NEA and OECD. According to more recent NEA/FSC documents "The OECD is a unique forum where the governments of 34 democracies work together to address the economic, social and environmental challenges of globalisation." (e.g. NEA 2015c, 2, NEA 2015a, 2). However, older NEA documents (e.g. NEA 1995a, 2, NEA 2004c, 2) are more frank; they state that the Organisation for Economic Co-operation and Development promotes economic growth and economic expansion, although allegedly in responsible, sustainable way. Transparency regarding the mission of OECD's Nuclear Energy Agency – NEA, however, has always been a feature as it is defined as assisting in maintaining and devel-

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<sup>7</sup> <http://www.oecd-nea.org/> and <http://www.oecd-nea.org/rwm/fsc/>

oping the use of nuclear energy (e.g. NEA 2015c, 2). The NEA's Radioactive Waste Management Committee - RWMC "is a forum of senior operators, regulators, policy makers, and senior representatives of R&D institutions in the field of radioactive waste management" that provides "guidance on the solution of radioactive waste problems" including identifying challenges to waste management and the best ways to further disposal programmes (NEA 1999c, 3,8); the Forum on Stakeholder Confidence - FSC was conceived as the answer to RWMC's "need to identify audiences, perspectives, and expectations and [...] to share experience in building public confidence and, in particular, in how to obtain the trust of local communities" (NEA 1999c, 19). According to its mandate, the FSC was created at the 33<sup>rd</sup> RWMC in 2000 to review outreach programmes and to identify and examine issues of public perception and stakeholder confidence regarding radioactive waste management (NEA 2010c, 2-3).

As early as in 1995 the RWMC had taken the stance that, there was broad consensus on the technical side of final disposal, and that geological disposal as the preferred method was also compatible with fundamental ethical and environmental considerations. The RWMC, however, also noted that it was essential that long-term safety should be convincingly presented and accepted prior to waste disposal and on the grounds that ethical values are influenced by socio-cultural background, it would be important to involve diverse publics in order to detect the relevant ethical aspects. (NEA 1995b, 5-7,12.) Nevertheless, social considerations did not really stand out in the RWMC reports until 1999, a year before the founding of the FSC. At this stage it was becoming apparent that while some kind of consensus about the feasibility of final disposal could be identified among the majority of scientists in the field, non-expert groups did not share this favourable opinion - and this was causing problems (NEA 1999c, 7, NEA 1999b, 3,8-10,18-19). As a result, public perception and confidence were identified as critical areas (NEA 1999c, 18-19).

"Waste management institutions have become acutely aware that technical expertise and technical confidence in the geologic disposal concept are insufficient, on their own, to justify to a wider audience geologic disposal as a waste management solution, or to see it through to successful implementation. [...] Overall confidence must be developed in a much wider audience if a decision to implement disposal is to be acceptable." (NEA 1999b, 21.)

"In order to ensure that progress is being made, it is imperative that the technical community also tries to understand stakeholders' interests, answer technical questions that the stakeholders feel need to be answered, and participate in a two-way communication." (NEA 1999c, 17, see also NEA 1999b, 24).

It was understood that the radioactive waste management community would have to argue its case to a wider audience and from a wider viewpoint than expected. Non-technical stakeholders would have to be assured, or 'given sufficient confidence', that the benefits would outweigh the risks and consequences and further that these stakeholders should also be assured about the technical feasibility and long-term safety of final disposal - using less technical, more qualitative arguments. In addition, as the RWMC noted, a wide audience would



also need "confidence in non-technical aspects of repository development in order for implementation to be acceptable". (NEA 1999b, 8, NEA 1999a, 3,11-12,61.) Essentially this meant that the RWMC needed to extend the scope of its activities.

"It is accepted that the RWMC, building upon the technical areas in which it has demonstrated strength, extend its endeavours to the interfaces between technical advances, regulatory developments, societal concerns and their input to the decision making process." (NEA 1999c, 8, see also 23.)

The inauguration and first workshop of the FSC took place in Paris in August 2000. The meeting acknowledged that the environment had been changing and it was suggested that nuclear waste management would have to change with it as it would have to meet the criteria specified by the surrounding society. (NEA 2000, 7,14.)

"[...] environment but also the world at large is seen to be changing. Publics no longer have faith in the infallibility of authority and science. Technology is no longer perceived as the bright future. Those who contested the old order are now in decision-making positions. Centralised decision has ceded to a stronger involvement of local authority. Top-down decision styles are rejected. Development projects in general are rejected when stakeholders have not been actively involved [...]" (NEA 2000, 14.)

The FSC was to serve as a platform for exchanging opinions and experiences regarding stakeholder interaction and confidence issues of nuclear waste management and would be expected to identify issues of interest and "distil" the lessons learned (NEA 2002, 2-3).<sup>8</sup>

Looking at the strategic directions of the FSC for Phase I (on the phasing see NEA 2005b, Brown & Pescatore 2006) up to 2004, the questions posed are very down to earth and pragmatic, addressing issues such as how to adapt processes and structures to the new reality, how to achieve and maintain trust and what is role of science and the role of stakeholders in decision-making and implementation (NEA 2002, 6-7). Acceptance seemed to be a matter of convincing, communicating and perhaps consulting.

"What information on waste management do local decision-makers need? Can a "Tool Kit" of materials be developed in support of dialogue on radioactive waste management? E.g., by addressing issues of public concern and interest (communicating the results of safety analyses, the issue of time scales, etc.)." (NEA 2002, 7.)

"[...] are there ways of consulting and involving a broader segment of stakeholders [...]? How can people be convinced to co-operate in a long-term solution to the waste-management issue, independently of their view on the future of nuclear energy?" (NEA 2002, 6.)

Posing such questions was bound to affect the results presented in FSC publications. The limitations of this early focus on informing and consultation has later

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<sup>8</sup> According to NEA (2017a) FSC members are "[g]overnment policy and regulatory officials, research and development specialists, implementers and industry representatives". Other stakeholders, non-governmental organisations, local community and the general public, are represented via national workshops and community visits.

been duly noted also within the FSC, the view being that a participatory outlook in the early stages of the FSC remained essentially at the level of tokenism (see NEA 2010e, 13-14, also NEA 2010b).

However, at the end of Phase I the focus was already shifting. FSC site visits and workshops had evidenced the benefits of community-based methodology and local partnerships (NEA 2004a, 24-27). The change is evident from the FSC report of 2004 regarding learning and adapting to societal requirements. The report, which sums up the experiences of the FSC, refers, for example, to the meaningful involvement of the public, co-operation between stakeholders and interactive processes where different interests and options are weighed, recognizing "that radioactive waste management involves both technical and societal dimensions which cannot be dissociated" (NEA 2004b, 24,26,29). The report also refers to such issues as interest in continued partnership, integrating nuclear waste management into local development, building long-term relationships and promoting constructive communication (NEA 2004b, 49,51,53,56). This shift towards a more collaborative focus also implied a need to reform and both improving relations between nuclear waste management actors and the local communities and the strategic document for FSC Phase II from 2005 to 2010 reflected this new course by raising relationship building to one of the main agenda (NEA 2005b, 5).

Essentially the starting point for FSC Phase II was articulated in the summary regarding the FSC Phase I community visit and workshop in Germany 2004, stating that:

"[...] defining a robust policy is much more than ensuring that, for each stakeholder, economic benefits are higher than costs, since for several stakeholders economic benefits cannot balance environmental, health, social, etc. risks. Negotiations should, therefore, cover all dimensions (e.g., safety, cost-benefit, fairness), which are of importance for any of the key stakeholders, rather than focusing only on certain (e.g., economic) aspects." (NEA 2005a, 29.)

Conclusions from the first FSC Phase II visit and workshop in Spain 2005 highlighted the idea (concurring with earlier FSC findings) of finding a licensable site that the local actors consider safe and acceptable, instead of a technically optimal one, bringing into focus the themes of local development and sustainable development. (NEA 2006b, 23-25). These themes were further developed at the 2006 workshop in Hungary (NEA 2009a), in the FSC report for 2006 regarding added value and sustainability (NEA 2006a), and the 2007 report on fostering a durable relationship (NEA 2007b) and bundled under the concept of quality of life as "A state of physical, psychological, and social well-being" and cultural and amenity values were stressed over economic opportunities, incentives and compensation (NEA 2006a, 33). This meant, in effect, putting social considerations before economic issues and underscoring importance of societal aspects and making the facility part of the community.

"The societal durability of an agreed solution, i.e., its sustainability over the long term is essential to success." (NEA 2007b, 7).

"A long-term relationship may be facilitated by designing and implementing facilities in ways that provide added cultural and amenity value to the local community and beyond. By cultural and amenity value we mean: agreeable additions to quality of life [...]." (NEA 2007b, 9.)

"Making a facility into an important, positive part of its community may be vital for making sure that the facility is understood and remembered over time by residents and not only by the technical people." (NEA 2007b, 10).

What the notion of communities with industry awareness (see Chapter 2.2.2) brought up by the NEA/FSC in 2007 does, is that it distils and accentuates the idea of making final disposal a part of the community through socio-cultural integration, while at the same time being able to make the idea lot more concrete and tangible. To back up this framing, the NEA could show that there really were such nuclear communities which as default were more willing to consider a repository. It could be convincingly argued that developing new facilities, in fact, means "developing joint solutions" and "building on an adding to [...] existing cultural basis" in these communities, because they had already integrated nuclear related activities into their local culture. Additionally, claiming that readiness to consider a facility "should not be seen primarily as a sign of economic dependency", of course, issues a challenge to prevalent framing. (NEA 2007b, 41-42.)

Subsequently the FSC produced reports like 'The symbolic dimension of radioactive waste management' (NEA 2009b) and an expanded version, 'More than just concrete realities' (NEA 2010d), further examining symbolic dimension of radioactive waste management and framing as a means to ground siting in social and cultural foundations. One reason for the interest in the cultural and symbolic dimensions of siting was presumably the realisation of a major cultural change among NFC members. The 2007 report concerning cultural and structural changes in radioactive waste management organisations pointed out that attitudes and ways of thinking were changing with the circumstances, raised the issue of an adaptive learning process and touched on the idea of "learning from and with stakeholders" (NEA 2007a, 7,37-38). What both 2009 and 2010 FSC reports (NEA 2009b, 2, NEA 2010d, 3) highlight is that interpretations, seated in values, norms, identifications, traditions, etc., play a crucial role, and that issues and concepts are interpreted differently depending on which social group is in question. The reports delve into issues of the symbolism and connotations connected to "the conventions, or the culture, of the social group within which a person lives" (NEA 2009b, 4,6, NEA 2010d, 9,19). It is stated that there is a contest between interpretations and that, "the facility may earn meanings from those who live with it" and thus it would be beneficial to integrate facilities into the "fabric" of the local community and encourage positive connotations by improving well-being and fulfilling ideals (NEA 2009b, 7-8,12, NEA 2010d, 16,25).

Since then, the FSC has further named the symbolic dimension as "transversal" theme when outlining the main investigation themes for 2010 and on-

wards (NEA 2010a, 6,20-21), and stressed the importance of getting the facility to fit in.

"The objective is to better integrate the facility within the local community by providing added value beyond economic benefits and land use compensations." (NEA 2013, 17-18)

"The desired cultural and amenity *added value* when designing and negotiating the construction of a radioactive waste management facility is a key aspect." (NEA 2015a, 10)

"Co-operating on co-framing is of particular importance to achieve quality and legitimacy, especially in contentious situations." (NEA 2015c, 12, see also NEA 2015b)

### 3.3 Background to the nuclear oasis frame

As noted (see Chapter 3.1) it was the 1991 book by Blowers and associates 'The international politics of nuclear waste' (Blowers, Lowry & Solomon 1991) which established the idea of nuclear communities as oases for the nuclear industry. This extensive study concerning political conflicts over nuclear waste management in several countries pointed out how all endeavours to achieve high-level nuclear waste repositories had been thwarted (with the exception of military waste) and how nuclear oases, i.e. the places with already existing nuclear industry activity, could be the only places to which governments and the industry could have a chance to "retreat"; there, at least part of the community should be welcoming. This tendency of the nuclear industry to target existing nuclear communities when siting nuclear facilities has been observed and analysed in several publications starting from the early 1990s (see e.g. Jacob 1990, Eiser, van der Pligt & Spears 1995, see also Kojo, Kari & Litmanen 2012). Already then, Blowers et al. (Blowers, Lowry & Solomon 1991, 1,xvii,xxii) concluded that the waste problem would have to be solved, as they continued to accumulate, but at the same time the authors also recognised that this could be a political problem that might prove impossible to solve satisfactorily and would raise profound moral questions.

In 1994, Blowers and LeRoy published an article, 'Power, Politics and Environmental Inequality', (re-published in 2006) in which they explored the theme further from the broader perspective of the processes of locating environmentally hazardous activities and looking into several different locally unwanted land uses (LULUs) including radioactive waste (Blowers & LeRoy 1994, Blowers & LeRoy 2006). The authors enumerated siting problems as inevitable and tied them to the nature of modernisation.

"As both political awareness and environmental concern have risen, very few communities are prepared to accept the location of such activities on their territory. [...] Since many of the examples of LULUs seem to be inherent in modern societies while others are essential to an effective environmental policy, they have to be located

somewhere. The location of LULUs is, therefore, an 'inevitable' problem." (Blowers & LeRoy 1994, 198, Blowers & LeRoy 2006, 203).

The question posed by Blowers & LeRoy concerned how society could deal with the inevitable locational problem. And, as they saw it In their view, LULUs tended to be sited in peripheral areas, reproducing and reinforcing what they called 'peripheralisation'. However, according to these authors, the situation was not static. Instead, they emphasised the interplay between the processes of peripheralisation, and the combination of push and pull factors. (Blowers & LeRoy 1994, 198,202,206, Blowers & LeRoy 2006, 204,207,210.) Yet the final result nevertheless seemed to be fixed, as for some, there seemed to be no other option.

"[...] the process of peripheralisation reflects material self interest both on the part of those communities anxious to avoid the blight created by hazardous activities and those who have little option but to accept risks in return for economic benefits." (Blowers & LeRoy 1994, 206, Blowers & LeRoy 2006, 210).

"[...] the power of mobilised coalitions to prevent the location of LULUs in some communities, combined with the powerlessness of peripheral communities to resist them, narrows the locational options, making the location of LULUs in peripheral communities politically almost inevitable." (Blowers & LeRoy 1994, 208, Blowers & LeRoy 2006, 212).

"The pull factors are present in the characteristics of the communities [...]. Given little choice, peripheral communities will opt for enterprises that provide a palpable benefit in terms of income whatever the longer term risks may be. The acceptance seems to be the greater as the new activities to be located are, technically or economically, linked with or similar to the industries they know. But, this situation is reinforced by the push factor, the refusal of other communities to accept risk-creating and polluting activities." (Blowers & LeRoy 1994, 206, Blowers & LeRoy 2006, 210.)

The 1994 article outlined the characteristics of peripheral communities and the way in which siting problems are connected to modernisation using radioactive waste as only one example of a LULU. In his articles 'Nuclear waste and landscapes of risk' (1999), 'Inequality and community and the challenge to modernization: evidence from the nuclear oases' (2002), and 'Why dump on us? Power, pragmatism and the periphery in the siting of new nuclear reactors in the UK' (2010) Blowers, however, concentrated specifically on nuclear communities, elaborating a more refined picture of nuclear oases against the backdrop of peripheralisation and modernisation.

Blowers portrays the relationship between environmental and social change as problematic. There is tension between development and the environment and while policy decisions are usually made on the assumption that development (which is usually equated with economic growth) is compatible with, or able to adapt to, environmental concerns through ecological modernisation, such is not necessarily the case (Blowers 1999, 255-256, Blowers 2002, 65-71, see also Blowers 1997.) In fact, according to Blowers, the nuclear industry is incapable of achieving sustainable development as it ultimately poses a high

consequence risk that cannot be entirely eliminated (Blowers 1999, 255-256,261, Blowers 2002, 67,73).

"While it is possible to introduce pollution controls, resource efficiency and conservation in a wide array of processes, certain industries cannot be modernized to the extent of removing threats to the environment. This is especially so with industries [...] which pose high consequence, long term risks [...]." (Blowers 2002, 67.)

"While ecological considerations have led to tighter controls, thus minimizing the statistical risk, ultimately the risks can never be eliminated. [...] Moreover, the risks are long term and therefore quite beyond the short-term horizons of the capitalist market." (Blowers 1999, 255-256.)

"Above all, ecological modernization tends to focus on the technological and economic dimensions of environmental change, thereby neglecting the important social, cultural and political dimensions [...]." (Blowers 1999, 256.)

Blowers observes that the risk society theory (see Beck 1992) describes the relationship between modernisation and the environment in a way that resonates better with the case of nuclear industry than ecological modernisation. At the heart of the theory is the idea of the high-technology, high-risk society, where technologies are created, supervised and controlled by experts or expert systems. According to the theory, fundamental changes are needed to alleviate anxieties and to avoid impending disaster relating to and deriving from individualisation and inherent complexity of the risk society.

"Given the complexity of the systems and the uncertainty and disagreement among experts, they are technologies that, in the ultimate, may be beyond control." (Blowers 1999, 256.)

"The anxieties engendered by the awesome potential hazards of technology are compounded by a process of 'individualization', the insecurity [...], withdrawal of the support structures [...] and dislocation in our personal lives [...]. This results in a fatalistic acceptance of risks for which all are responsible but which individually we are unable to control." (Blowers 1999, 256-257.)

"Risk Society argues that the risks of continuation are too great, the controls over risky technology too feeble and that fundamental changes at a societal level [...] will be necessary to avert catastrophe." (Blowers 1999, 257)

While, according to Blowers, risk society theory seems to portray the situation somewhat better, as it draws attention to high-risk technologies neglected by ecological modernisation, it is still limited in its explanatory power what comes to nuclear communities, as it fails to grasp some highly significant points which become apparent when moving from the abstract societal level to the local level. Like ecological modernisation, risk society theory sees modernisation and its consequences as a universal condition, pervasive and all-encompassing, and as such democratic, while they clearly are not. (Blowers 1999, 256-257, Blowers 2002, 69-71.)

"Although the risks to which we are exposed may ultimately engulf us all, the impacts of risky technologies are present here and now and are experienced more by

some than others. Nor is the condition of individualization universal – some individuals and groups are more vulnerable than others [...]" (Blowers 2002, 69).

These theories claim that traditional and local integrating institutions have increasingly been overwhelmed or broken down and fragmented as a result of modernisation but Blowers observes that traditional integrating institutions make a difference (Blowers 1999, 254,258, Blowers 2002, 73, Blowers 2010, 162). According to Blowers, nuclear oases are victims of power relations which put other considerations before the safety of the community and future generations. In greenfield sites (i.e. sites without previous nuclear related activity), the notion of unified community with available resources and connections enables resistance against the industry – But in nuclear oases, by contrast, industry and community are brought together because the traditional values and institutions intertwined with capital and labour work with peripheral nature of nuclear communities to make them more amenable to industry's aspirations. (Blowers 1999, 254, Blowers 2002, 72,76, Blowers 2010, 162,169.)

Blowers describes these modern 'company towns' as peripheral communities disadvantaged on five different dimensions; geographic, economic, social, cultural and environmental, and correspondingly identifying five characteristics typical of nuclear oases: 1) Remoteness – the communities are geographically remote, relatively inaccessible or isolated. 2) Economic marginality – the communities are dependent on the dominant employer and therefore monocultural. 3) Relative powerlessness – the communities are company towns or divided, controlled by external influences. 4) Acquiescent culture – Because of economic conditions and powerlessness the communities exhibit ambiguous, defensive and fatalistic attitudes, forming an overall acquiescent culture. 5) Environmental degradation – the communities are in or near polluted areas or places where risk is present. (Blowers 1999, 247-253, Blowers 2002, 72-73,76, Blowers 2010, 162.)

While Blowers argues that nuclear oases are a product of power relations and peripheral conditions are reproduced and reinforced in the peripheralisation process, in his 2010 article he, however, also noted that peripheralisation processes are not inevitable. Blowers mentions several issues which could affect the situation; some oases may have only some of the characteristics described, some greenfield sites may also be vulnerable, political cultures and opportunities may vary and changes in public opinion may influence the overall power relations. He maintains, however, that while exceptions are possible, the process is, in fact, predictable, as peripheral communities are least able to resist. Therefore, he asserts that, it is fair to assume that the reception of new nuclear facilities varies according to the degree of peripheralisation, and economic circumstances. (Blowers 2010, 162-163,169, Blowers 2002, 72.)

"Economic conditions appear to be the crucial determinant" (Blowers 2010, 163).

"[...] in order to understand the conditions most likely to result in the actual deployment [...] we need to look at power relations" (Blowers 2010, 163).

In his recent book 'The Legacy of Nuclear Power' Blowers (2017) re-visited and analysed developments related to nuclear communities familiar from 'The international politics of nuclear waste' (Blowers, Lowry & Solomon 1991), which established the idea of nuclear oases. While he still stresses the key characteristics (or dimensions) of peripheral communities, here, Blowers draws further attention to the fact that power relations evolve and are socially shaped, pointing out how changing discourses have influenced the balance of power and communities' ability to deploy resources to promote their interests.

"[...] I tried to show how discourses have tended to shape and change the individual fortunes of particular nuclear communities. [...] In all the cases studied prevailing discourses shifting over time have left their imprint on the nature of the legacy and the communities which manage it" (Blowers 2017, 239).

Nonetheless, Blowers made it very clear from the outset that discourses merely set the stage for the opponents.

"While discourses [...] changing and sometimes competing over time establish the context and boundaries within which conflicts occur, outcomes will relate to the resources [...] that can be mobilised and deployed [...]" (Blowers 2017, xv).

### **3.4 Summing up the assumptions behind the frames**

The framings above would appear to have relatively similar starting points, that is, change caused by modernisation. Whether we talk about the 'modern condition' as late modern, second modern, liquid modern, risk society (connected to reflexive modernity), or postmodern (assuming that modernisation reached the end of its road), there is a wealth of theories describing how traditions, traditional institutions and traditional authority have eroded and become contested due to the high dynamism and complexity of contemporary society leading to fragmentation, increasing uncertainty and adverse effects. This family of theories essentially argues that a more open and more problematic operating environment makes relevant a wider variety of values and evaluations of 'what is important' while views evinced by those traditionally considered to be authorities, such as various kinds of experts and officials, appear more questionable.

That these framings are based on very different takes on modernisation is clear. Where Blowers sought to put the phenomenon of peripheralisation, which he connected to nuclear oasis, straight "into broader explanations of the process of modernization" and observed that the concept of Risk Society resonated with the nuclear industry, but had its limitations (Blowers 1999, 255,257). NEA's entry point was "modern societal demands" and the "new dynamics of dialogue and decision making", as it had become obvious that the industry would have to argue its case, since the 'expert opinion' was no longer enough to convince wide range of stakeholders (NEA 2000, 20, NEA 2003c, 7).

After this shared starting point on common ground, there is, however, a highly significant turn in different directions among the assumptions behind



the framings. The nuclear oasis frame, in effect, turns its back on modernisation as the defining factor of nuclear communities, leaning instead towards patterns of power and location and traditional integrating institutions activated in local communities. Blowers' (1997, 858, Blowers 1999, 257, Blowers 2002, 69) claim is that the modern condition is not pervasive and universal, but instead, traditional integrating institutions persist in nuclear communities and the support of these institutions combined with the communities' vulnerable condition is what defines the setting for the nuclear oases. What the nuclear oasis frame does is to point out that the risks are uneven. Following the logic of framing, in the nuclear oases, nuclear waste management is treated differently because the power relationships intertwined with economy and livelihood issues and amplified by the peripheral nature of the communities, are different compared from those in other communities.

On the other hand, the industry awareness frame embraces the modern condition as it shifts attention towards relationships and the symbolic dimension of siting, i.e. culture, symbols and connotations. It is evident that the radioactive waste management community has become acutely aware of the importance of how things are perceived, what values are attached to them and what connotations they give rise to. The NEA lists, for example, values, beliefs, identifications and cultural bases as factors shaping perceptions and interpretations (NEA 2010d, 3), conveying the view that the situation, in fact, is not shaped by concrete realities and traditional institutions alone. The industry's need to involve a broader segment of stakeholders arises directly from the differentiation of stakeholders arising from the fragmentation of contemporary society. Following the logic of this framing, in communities with industry awareness nuclear waste management is received differently because the relationship of nuclear community residents to nuclear issues and the nuclear industry is essentially different from that of those residing in non-nuclear communities as it builds on already existing cultural basis.

As a result of the division outlined above, the nuclear oasis frame brings into focus the peripheral nature of nuclear communities and especially how they depend on the nuclear industry economically, whereas the industry awareness frame accentuates the special nature of nuclear communities, characterised by the special relationship they have to what is considered nuclear in nature and stresses that nuclear activity becomes integrated into the local cultural base.

From the nuclear oases' point of view economic considerations are essential; economic vulnerability combined with a large dominant employer creates a situation in which the community and a great part of its workforce are largely dependent on that employer. This economic marginality, in turn, can be seen as leading to both the relative powerlessness and acquiescent culture described by Blowers. Moreover, traditional institutions supporting the industry in the community are, according to Blowers' description, tied to economy and employment. (Blowers 1999, 245-254, Blowers 2010, 157,162,169.) From the perspective of industry awareness, the key is to develop an integrated project em-

bedded in the local area, community and culture by providing cultural and amenity value and establishing constructive and integrative relationships; the NEA even refers to the community's "ownership of a societal project" as opposed to mere acceptance (NEA 2013, 15,18-19,24-27).

According to Blowers and his associates, the nuclear industry is inherently unsustainable and new wastes should not be created. However, the nuclear legacy, i.e. nuclear wastes, contaminated materials, pollution etc. created because of past decisions, should be taken care of in an ethically sustainable way<sup>9</sup>; Communities should not be exploited and leverage should not be used. Nuclear communities, especially those managing the nuclear legacy, "have a moral claim on society for bearing a burden that others are happy not to carry. This moral claim is expressed in terms of equity both spatial and temporal", i.e. the communities should not be, or become, disadvantaged (Blowers 2017, 229,246). Such thinking clearly has its roots in the critical theory tradition of morally inspired research focusing and reflecting on antagonisms in society and is also associated with environmental justice, which advocates fair treatment of all people as regards environmental issues and, according to Blowers (2002, 71), provides a compelling "theoretical counter-perspective".

As a part of the OECD, the NEA's goal to assist in maintaining and developing the use of nuclear energy can be seen as a part of the OECD's mission to promote sustainable economic growth, i.e. the nuclear industry is viewed as capable of sustainable development when waste management is appropriately taken care of. According to the NEA (2015a, 13-14) the management of radioactive waste should avoid disrupting and seek to contribute to improving sustainability, i.e. the societal durability. Adding economic, social and/or ethical value is mentioned. However, relating to industry awareness, the NEA concentrates heavily on cultural and amenity value, and on fitting and adapting projects into the sphere of those hosting them. Raising positive connotations and making a facility presentable and pleasing seem to be the major considerations in this context. (cf. NEA 2010d, 2015a.) Relating to this, for example, Lupton (1999, 106) has considered how, from the perspective of the cultural/symbolic approach, risk is used to define self, reproduce concepts and connected to modernisation "creating new forms of relating to the self and others, including experts and institutions". However, drawing a line between cultural implications, as cultural products, and situational attitudes, as more dynamic situation bound traits, may prove a hard distinction to make (cf. Karimi 2017, 43).

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<sup>9</sup> Blowers himself exemplifies this conviction, as he has been a member of the Committee on Radioactive Waste Management (CoRWM) making recommendations regarding nuclear waste management for the UK and, on other hand, has also set up a citizens' action group against nuclear new build (see Blowers 2017, xvi).

## 4 EURAJOKI AS A NUCLEAR COMMUNITY AND SITE FOR THE FINAL DISPOSAL

### 4.1 Becoming first of its kind

#### 4.1.1 The arrival of nuclear power

At the beginning of the 1970s the state-owned power company Imatran Voima (IVO) ordered Finland's first commercial NPP units<sup>10</sup> from the then Soviet Union to be built at the municipality of Loviisa on the south coast of Finland. According to the agreement the fuel needed to run the units would be purchased from the Soviet Union and also that spent fuel produced by the units would be returned to the Soviet Union. Loviisa 1 was connected to the power grid in 1977 and Loviisa 2 in 1980. However, the private sector had its own nuclear aspirations and as a result the power company Teollisuuden Voima (TVO) purchased two NPP units of its own from Sweden. TVO was able to secure a uranium enrichment contract with the Soviet Union even though the NPP units were from a third country and plans for reprocessing spent fuel were less than complete. These TVO units would be built on the west coast of Finland, in an area called Olkiluoto located in south-western Finland in the municipality of Eurajoki. Thus Eurajoki began its career as a nuclear community. The construction of Olkiluoto 1 began in 1974 and of Olkiluoto 2 in 1975. Consequently, Olkiluoto 1 was connected to the electricity grid in 1978 and Olkiluoto 2 in 1980. (Lehtinen & Sandberg 2004, 14-19.)

At the time as the NPP units were ordered, the decision to obtain nuclear power and build NPPs did not really create public debate or give rise to opposition in Finland since at that time nuclear power was not generally considered problematic. Even among Finnish environmental organisations, opposition to nuclear power only really began to increase in the mid-1970s, as it first ap-

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<sup>10</sup> There had been a research reactor in Finland since 1962 (Lehtinen & Sandberg 2004, 14).

peared that it could be a good alternative to harnessing more hydropower and the accompanying environmental hazards. It was not until 1977 that a nationwide anti-nuclear power organisation was established in Finland<sup>11</sup>. Nor was SNF initially considered problematic as, according to the plans, it would be either transported out of Finland, as IVO intended, or used as resources, as TVO intended. In fact, the Ministry of Trade and Industry and the Technical Research Centre of Finland started to take a real interest in investigating nuclear waste management issues around the same time, in the mid-1970s, that opposition towards nuclear power began to emerge. (Suominen 1999, 24-25,32-33, see also Nikula et al. 2012, 13-16). While nuclear waste was not an issue of common concern at the time, the question of SNF was still raised by the representatives of the municipality before Eurajoki approved the TVO NPP plan in 1973 – and the municipality was informed by TVO that SNF would not be disposed of in Eurajoki (Kojo 2009, 174, see also Nikula et al. 2012, 212,216). An undertaking confirming this was later requested and given (see Chapter 4.1.3).

#### 4.1.2 Road towards final disposal

Nuclear waste management was included in the Finnish Atomic Energy Act of 1957 when this was amended in 1978. According to the amendments the licence holders of NPP units were responsible for all measures and costs related to nuclear waste management and this was incorporated into the operating licences issued to NPP units. (Posiva 1999a, 3.) According to Suominen (Suominen 1999, 25-27,29) the licensees were also obliged to seek final disposal arrangements whereby waste would not end up in Finland or, if no such arrangements could be made, to find a domestic option. While IVO already had its arrangement with the Soviet Union<sup>12</sup>, TVO had a problem as international reprocessing or final disposal options were not readily and cost effectively available. Thus in 1980, a work group set by the Ministry of Trade and Industry concluded that if TVO had not secured an agreement which included final disposal, i.e. disposal 'in an irreversible manner', abroad (for wastes related to reprocessing or SNF as such) by 1983, investigations regarding the domestic option should be initiated.

In 1983 the Council of State made a DiP on the aims of nuclear waste management. While the DiP stated that aim should still be final disposal abroad (again, for wastes related to reprocessing or SNF as such) it also set the timetable for the management of SNF in the absence of a final disposal option outside Finland. TVO had already been studying the issue as it had been obligated to do so when operating licences for the NPP units were granted and the timetable set by the DiP was in fact in line with the schedule proposed by the TVO report of 1982. (VN 1983, Kojo, Kari & Litmanen 2010, 170.) Thus TVO started the

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<sup>11</sup> The first demonstration against nuclear power in Finland was held in 1978 (Lehtinen & Sandberg 2004, 20).

<sup>12</sup> Technically the contracting parties were companies, but the disposal arrangement, within the framework of bilateral agreement between the countries, was authorised beforehand by the respective governments (Nikula et al. 2012, 15).

search for the final disposal site more or less at its own pace. However IVO joined in this search slightly later.

After the collapse of the Soviet Union at the start of the 1990s, IVO's final disposal agreement no longer appeared adequate in the new situation for both political and environmental reasons. The former Soviet Union was politically unstable and it had become apparent that environmental considerations had been neglected in the case of nuclear waste management. Finland also started negotiations for EU membership in the early 1990s and – as pointed out in Posiva's account of Finnish nuclear waste management – it was deemed important to make it clear that nuclear waste management would remain under domestic control. (Nikula et al. 2012, 37-38,71.) Hence, before Finland joined the EU in 1995, the Finnish Nuclear Energy Act of 1987 (990/1987) was amended in 1994 to ban both the export and import of SNF (1420/1994). Thus IVO was left without a nuclear waste management solution of its own and, after briefly considering its options, sought to intensify its co-operation with TVO. In 1995, TVO and IVO established Posiva, a mutual expert organisation, which would be responsible for the final disposal of their SNF. (Nikula et al. 2012, 38, Anttila 1995.)

#### **4.1.3 The site selection phase**

After the timetable for the nuclear waste management was set officially in the DiP of 1983, TVO immediately launched area screening for repository sites and in 1985 produced a list of 102 locations considered suitable for further study. Of these locations, 101 were selected by a systematic geological elimination process but Eurajoki was added to the list as a special case. According to TVO this was due to the short transport distance and under-representation of coastal locations because the identification method used in the screening was not really suitable for coastal areas. (Kojo, Kari & Litmanen 2010, 171, also Kari, Kojo & Litmanen 2010, 16) In 1987 five sites were selected for preliminary investigations and in 1992 three sites, including that in Eurajoki, were selected for detailed site investigations. As IVO joined TVO in the hunt for a final disposal site and they formed Posiva together in 1995, Loviisa was brought into the siting process as a special case, for same reasons as Eurajoki earlier. After it had gone through its own preliminary site investigations, detailed site investigations started in Loviisa in 1997. (Posiva 1999a, 6.) In 1999 Posiva concluded that all the sites which had undergone detailed site investigations were geologically suitable, stating that, "no surveyed area can be regarded as clearly safer than the others, neither does the safety analysis give any reason to discard any of the alternatives" thus moving the focus from the 'best possible site' to the 'suitability of site', in line with international expert recommendations. (Kojo, Kari & Litmanen 2010, 171, also Kari, Kojo & Litmanen 2010, 15-16, Posiva 1999a, 8, Posiva 1999b, app.5 p.40). (For more information on the siting strategy, see Kojo 2009, 168-174.)

According to the Finnish legislation (Nuclear Energy Act 990/1987, Nuclear Energy Decree 161/1988), as a prerequisite for a DiP, an applicant has to produce assessments regarding the environmental impacts and the safety of the

facility and, furthermore, when decision is made particular attention has to be paid to the suitability of the site and its effects on the environment. The EIA was at the time governed by the Act on Environmental Impact Assessment Procedure of 1994 (468/1994). As in the case of Finland environmental impacts are understood broadly, the social impacts were also considered as a part of the assessment process, and in fact, according to Posiva, the main differences between the potential sites arose from social considerations (Kojo, Kari & Litmanen 2010, 171, Posiva 1999a, 195). Posiva's EIA indicated that Eurajoki and Loviisa as nuclear communities would be more sustainable options than other two candidates as they appeared more ready to accommodate the final disposal facility. In these communities final disposal would cause less fear and anxiety, there would be fewer image problems and the majority of the residents would be willing to accept the facility. Additionally, the residents of these communities were more positively disposed towards final disposal on the whole and the facility would generate less commotion as nuclear operations were already an important factor in the lives of those communities. (Posiva 1999a, 195.)

In May 1999, in its application to the Council of State for a DiP, Posiva proposed that the Olkiluoto site in Eurajoki should be considered as the site for the final disposal facility for SNF (Posiva 1999b, 5-6). The local council of Eurajoki issued a positive statement regarding Posiva's application in January 2000, thus choosing not to use the right of veto guaranteed by the Nuclear Energy Act (990/1987) (eg. Kari 2009, 1, Kojo, Kari & Litmanen 2010, 169). However, much had to happen before this point was reached. In a relatively short period the municipality changed its stance on final disposal.

In 1980, when TVO wanted to extend its power plant in Olkiluoto, the municipality of Eurajoki demanded and obtained a written undertaking from TVO that the final disposal of its SNF would not take place in the municipality. Those wary of final disposal also succeeded in getting the statement against final disposal recorded in the municipality report. This stance was further accentuated in 1993, when TVO had nevertheless chosen Olkiluoto for detailed site investigation. However, the very next year, 1994, the local council adopted a neutral stance towards a possible siting, and in 1995 a co-operation agreement was already signed between the municipality and TVO. This development of intensifying co-operation between TVO (and subsequently Posiva) and the municipality coincided both with a taxation reform greatly affecting the municipality's income (see Kojo 2009, 178,181), and also with the amendment to the Nuclear Energy Act (1420/1994), which once and for all confirmed the need for a domestic final disposal site. In 1998, in its new municipal strategy, Eurajoki presented the Olkiluoto vision, which took a positive stance towards both additional nuclear energy and the final disposal of SNF, and, after successful compensation negotiations, the municipality was ready to accept the siting in 2000. (Kojo, Kari & Litmanen 2010, 171-172, Kari, Kojo & Litmanen 2010, 16-17, Municipality of Eurajoki 2000, for more detail see Kojo 2009, 174-184.) After the positive statement was given by the municipality, the Council of State was free

to issue the DiP in December 2000 (VN 2000). The DiP was ratified by the Parliament in 2001 (EK 2001).

#### **4.1.4 The post site selection phase**

The Parliament's decision to ratify the DiP marked the end of the site selection phase and the transition to the unknown territory of the post site selection phase, thereby making Finland the first country in the world to successfully complete the siting of an SNF repository, i.e. the process was concluded and the decision was accepted by the local community and by the general public. This post site selection phase itself can be divided into different phases e.g. Posiva's EIA report from 2008 defines four phases: 1) Construction of the ONKALO rock characterization facility and complementary characterization and planning, 2) Construction and commissioning of the repository, 3) Encapsulation and final disposal and 4) Decommissioning and sealing of the final disposal facility. (Posiva 2008, 28.) The transition from the siting phase has also been described as moving from the site selection to the site investigation phase, also referred to as the research, development and design stage aiming at a construction licence (Kurki 2000, 75, Posiva 2008, 28).

In addition, much more was being done than just the site investigations. After the ratification of the DiP in 2001, Posiva applied for a DiP for a repository extension, and this was approved in 2002 together with a DiP to build a new NPP unit, Olkiluoto 3, the construction of which commenced in 2005. Posiva also moved its headquarters to Eurajoki in 2002. In 2003, Posiva successfully applied for a licence for the ONKALO rock characterization facility to be part of the future repository. Construction of the ONKALO started in 2004. In connection with its owners' applications for DiPs for new NPP units Posiva applied for DiPs for extensions to the repository in 2008 and 2009, of which the first was granted, along with the DiP for TVO to build a new NPP unit, Olkiluoto 4. The DiP for the second extension was not granted, as Fortum did not get a DiP to build a new NPP unit at Loviisa. Significantly, the local council of Eurajoki had the right of veto on all decisions concerning Olkiluoto and decided not to use it, issuing positive statements instead. (Kari, Kojo & Litmanen 2010, 7-8,14,17-18.)

In 2010, at the same time as TVO was granted the DiP for Olkiluoto 4, a new nuclear power company, Fennovoima, was granted a DiP for its first NPP unit, Hanhikivi 1. Fennovoima had planned to dispose of the company's SNF in the same repository as TVO and Fortum considering the repository to be a national solution, but met with an unexpected and unwelcome response as the municipality of Eurajoki expressed its displeasure at not having been consulted early on, and Posiva stated bluntly that the repository would be for the SNF of its owners only, and thus Fennovoima would have to take care of its own waste independently. (Kari, Kojo & Litmanen 2010, 7-8,18, YLE 2009, Municipality of Eurajoki 2010.) After the working group on co-operation in nuclear waste management set by the Ministry of Employment and the Economy concluded in 2013 that the number of repositories did not play a key role and the business negotiations were beyond its mandate (MEE 2013) it seems improbable that that

Eurajoki would have had to make decisions regarding Fennovoima's SNF. However, Fortum, a part owner of Posiva, subsequently acquired an interest in Fennovoima (MEE 2015a), which could in principle open the backdoor for Fennovoima to Posiva's repository. In addition, Olkiluoto 4 was cancelled 2015 due to the long delay of Olkiluoto 3 (TVO 2015).

In the middle of all this commotion related to Fennovoima's waste management Posiva also managed to submit in 2012 a construction licence application for its final disposal facility (consisting of an underground final repository and above ground an encapsulation plant). After a positive statement from the Finnish Radiation and Nuclear Safety Authority (STUK) in 2015, the licence was granted by the Finnish Government later the same year. (MEE 2015b, Posiva 2015.)

## 4.2 The picture provided by the study

### 4.2.1 Opinions regarding the safety of final disposal and threats posed by the repository

Overall, the Finns have become more confident in the safety of final disposal. For a part of the study a secondary analysis was conducted on the data gathered for the annual Energy Attitudes of the Finns survey, by the Finnish Energy Industries, showing that in 1983, when TVO launched area screening for final disposal, 14% of respondents deemed final disposal in the Finnish bedrock safe and 57% unsafe, whereas in 2008 (when the survey on which this study is based was conducted) the number of those considering final disposal safe had increased to 31% and those considering it unsafe had decreased to 44% (Kari, Kojo & Litmanen 2010, 10-11).

In the case of Eurajoki, change had been even greater. The first results from Eurajoki, from 1984, indicated that 60% considered final disposal in the Finnish bedrock unsafe and 17% safe. After that, as Olkiluoto was selected as a site for preliminary site characterization in 1987, the decision seemed to inspire confidence instead of doubts regarding final disposal at the local level. When, contrary to expectations, the Chernobyl accident of 1986 did little to undermine confidence in final disposal, in 1993, when the additional siting studies started, the numbers of those reportedly confident (39%) and in doubt (39%) regarding the safety of final disposal were already equal among the residents. However, a change to the trend of growing confidence occurred in 1997, as during the EIA procedure confidence started erode, until the DiP granted in 2000 and ratified 2001 again re-established the earlier trend. And in 2003 over half (53%) of the residents of Eurajoki considered final disposal safe and the number of those doubting its safety reached an all-time low, under one out of four (23%). However, after 2003, when the excavations for ONKALO (see Chapter 4.1.4) in Olkiluoto started, local opinions became considerably more critical settling at a different level. According to the Energy Attitudes of the Finns survey, in 2008, at



the time the survey on which this study is based was conducted, 41% of the residents of Eurajoki considered final disposal in the Finnish bedrock safe and 34% doubted the safety of final disposal. (Kari, Kojo & Litmanen 2010, 18-19.)<sup>13</sup>

In our survey, however, confidence among the residents did not eventually rise quite so high with 42% of those living in Eurajoki considering final disposal in the Finnish bedrock *unsafe*, and 32% safe, effectively reversing the situation reported in the Finnish Energy Industries survey. The residents of the neighbouring municipalities were slightly more sceptical compared to those living in Eurajoki. The share of those believing that final disposal was safe was almost the same in the neighbouring municipalities (30%) as in Eurajoki, but the share of those doubting the safety of final disposal (49%) was actually somewhat greater. (Kari, Kojo & Litmanen 2010, 67-68.)

Yet the confidence in the safety of final disposal can still be considered to be surprisingly high given the magnitude of perceived threats the survey revealed. According to the survey, over half of the residents of Eurajoki perceived that the SNF repository posed a substantial threat to future generations' health (57%), safety (56%) and well-being (51%). The number of those assessing that the repository posed no threat to these or who were uncertain about it remained under one quarter (18-24%) in all these cases. As for threat to the present generation, almost half (45%) of the residents perceived that the repository posed a substantial threat to health in general while one third (32%) assessed that the SNF repository posed no threat to health in general or were uncertain of their opinion. (Kari, Kojo & Litmanen 2010, 64.)

#### 4.2.2 Local acceptance

The international nuclear waste management community has since the turn of the 2000s been well aware that the final disposal of SNF is not merely a technical undertaking. Instead, it has been assessed that the success of the industry's aspirations depends largely on gaining acceptance for a project, both nationally and, most importantly, locally. Thus the focus has shifted from obtaining a technically optimal solution to resolving final disposal in a socially and technically acceptable manner, and finding a willing and suitable site for a repository. (See Chapter 3.2.) How wholehearted this acceptance has to be, however, is debatable. It has been suggested that communities tend to develop pragmatic acceptance of risks, i.e. tolerating rather than willingly accepting them (Bergmans et al. 2008, 58-60, see also Simmons & Walker 1999).

In our survey the statements used to elicit information regarding the acceptance of the various final disposal scenarios were more geared towards actual acceptance than mere tolerance. The statements used in the survey (translated from Finnish to English) were: "Nuclear waste produced by TVO and Fortum should be disposed of in Finland", "Nuclear waste produced by TVO and

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<sup>13</sup> Up to 2011 the Energy Attitudes of the Finns survey also included a sample representing the inhabitants of Eurajoki. At that point, according to the survey, 46% of the residents considered final disposal in the Finnish bedrock safe and 34% did not (Kiljunen & AF-Consult 2018).

Fortum should be disposed of in Olkiluoto", "I accept expansion of the final disposal repository for the needs of TVO and Fortum", "I accept expansion of the final disposal repository also for the needs of other Finnish actors" and "I accept expansion of the final disposal repository for the purpose of importing SNF from abroad"<sup>14</sup>. In addition, two statements "The construction of more nuclear power in Finland should be allowed" and "The fourth nuclear power plant unit should be constructed at Olkiluoto" were used to elicit opinions regarding the new build of nuclear power.

Regarding the new build, the results indicated that, in Eurajoki there were slightly more of those who disagreed (42%) with the idea of constructing more nuclear power in Finland than of those who agreed (37%) with the idea. The figures did not change much when residents considered more specifically the further construction of nuclear power at Olkiluoto (47% disagreed, 38% agreed). (Kari, Kojo & Litmanen 2010, 90.)

In the case of final disposal, the results showed significant acceptance levels for the final disposal of SNF produced by TVO and Fortum, as over half (52%) *agreed* with final disposal in Finland (24% disagreed) and two fifths (42%) in Olkiluoto (36% disagreed). Regarding the scenarios for repository expansion, reception for expansion for current NPP operators was on around the same level as for final disposal in Olkiluoto in general (42% agreed, 39% disagreed) and thus clearly more favourable than reception for other scenarios, i.e. expanding the repository for the needs of other domestic actors (20% agreed, 62% disagreed) or for SNF of foreign origin (5% agreed, 89% disagreed). (Kari, Kojo & Litmanen 2010, 77.)

Taken together, these results show a considerable level of acceptance for final disposal in Eurajoki, especially considering the lower acceptance for nuclear power new build. However, acceptance was still far from overwhelming, and there was a clear indication that the existing domestic nuclear power companies' waste was more welcome than newcomers' waste, let alone that of foreign operators (Kari, Kojo & Litmanen 2010, 84). In comparison, the residents of the neighbouring municipalities reported attitudes which were more critical of current actors and less critical of the other scenarios, albeit the differences were relatively small (Kari, Kojo & Litmanen 2010, 76-77).

### 4.2.3 Rationality of acceptance –The usual suspects

As explained briefly in Chapter 1.3.2 and in more detail in Chapter 2.1.2, to learn more about the rationality of acceptance in the nuclear community, the local acceptance figures for expanding the repository were further examined to ascertain how well the data corresponded with certain theories (see Chapter 2.1.2) relating to acceptance of final disposal commonly used in environmental sociology, risk research, science and technology studies and related fields. The

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<sup>14</sup> As elaborated in Chapter 4.1 TVO and Fortum, named in these statements, are the operators of the current Finnish NPPs, i.e. the parties currently under the nuclear waste management obligation, and the owners of the nuclear waste management company Posiva.

cases examined were acceptance towards expanding the repository (1) for the current actors i.e. owners of Posiva, and on the other hand, (2) for other possible Finnish actors.

**Regarding information deficit.** Residents' views on whether they had sufficient information were evenly distributed. One third (34%) agreed that they had enough information, one third (33%) disagreed and one third (34%) was unable to say. Acceptance for expanding the repository correlated with information deficit variables in both of the cases under examination. In the case of acceptance of expansion for the current actors the strongest correlations were found with perceived information needs regarding health effects ( $\tau=-.278$ ), effects on everyday life ( $\tau=-.242$ ) and environmental effects ( $\tau=-.236$ ). In the case of acceptance of expansion for other possible domestic actors the correlations were weaker and the strongest correlation was found with perceived information deficit regarding the general safety of final disposal ( $\tau=-.190$ ). (Litmanen, Kojo & Kari 2010, 50-51.)

**Regarding social trust.** Residents' trust in Posiva was polarised, as two out of five (39%) reportedly trusted and two out of five (39%) reportedly did not trust Posiva regarding the risk assessment. Interestingly, residents were somewhat more trusting towards Posiva than towards the authorities, as one out of three (32%) reported trusting the authorities regarding the risk assessment. It should also be noted that, as the statements used to elicit responses concerned trust regarding the risk assessment, the responses reflect both trust in the ability and trust in the integrity of the actors as discussed in Chapter 2.1.2. Trust correlated with acceptance in both of the cases under examination and in both of the cases trust in Posiva correlated clearly more strongly with acceptance ( $\tau=.581$  for current actors,  $\tau=.527$  for the other domestic actors) than trust in the authorities ( $\tau=.333$  for current actors,  $\tau=.310$  for the other domestic actors). (Litmanen, Kojo & Kari 2010, 51-52.) On the other hand, however, the residents rated STUK as the most reliable source of information. Posiva was perceived as the second most trusted (37%) source of information regarding final disposal after STUK (44%), before Posiva's owners i.e. TVO and Fortum (34%), research institutes (30%) and universities (26%) (Kari, Kojo & Litmanen 2010, 42).

**Regarding benefit versus cost.** While the majority of the residents perceived that the repository would have a positive impact on employment (66%) and economic development (63%) in the area, the benefits of the disposal project as a whole were questioned by a significant proportion of the residents. Regarding the overall benefits of the disposal project, two out of five (39%) residents did not agree with idea that the benefits of the final disposal would exceed the costs, whereas slightly under one third agreed (31%). Moreover, concentrating more on the economic perspective, around half of the residents (47%) perceived that the economic benefits of the final disposal would not compensate the non-economic costs, whereas only one out of four (24%) thought otherwise. In the survey respondents were presented with a list of twenty different issues ranging from economic development to recreational opportunities and

asked to assess how they perceived the repository project would affect these issues, i.e. what kind of impact, cost or benefit, the repository would have on them. In case of acceptance of repository expansion for the current actors the strongest correlations were found with perceived positive impact on respondents' own satisfaction with the area as a place to live ( $\tau=.592$ ), respondents' own expectations for the future of their area ( $\tau=.582$ ) and respondents' own image of their area ( $\tau=.567$ ). In case of acceptance of repository expansion for the other domestic actors the top correlations were weaker but the issues were the same, although in a different order. The strongest correlations were found with perceived impact on respondents' own image of their area ( $\tau=.384$ ), respondents' own satisfaction with the area as a place to live ( $\tau=.394$ ) and respondents' own expectations for the future of their area ( $\tau=.356$ ). (Litmanen, Kojo & Kari 2010, 52-53.) Perceived impacts regarding economic development and employment had relatively low correlations (e.g.  $\tau=.302/\tau=.274$  for current actors) (Kari, Kojo & Litmanen 2010, 94).

**Regarding sense of moral obligation.** Slightly over two fifths (43%) of the residents agreed with the idea that the municipality had a moral responsibility to approve the final disposal as the NPP had been allowed into the area, whereas one third (33%) disagreed with the idea. The notion of moral responsibility had a clearly positive correlation with both acceptance of expansion for the current actors ( $\tau=.498$ ) and with acceptance of expansion for other domestic actors ( $\tau=.364$ ). (Litmanen, Kojo & Kari 2010, 52-53.)

**Regarding perceived risks and threats.** Like the benefits of the project, the safety of the disposal project was also questioned by a considerable part of the residents. The clear majority of the residents (58%) perceived that nuclear waste constitutes a constant threat to future generations whereas one out of four (24%) disagreed with the idea. Moreover, two out of five (42%) disagreed with the idea that nuclear waste can be safely disposed of in the Finnish bedrock, whereas one out of three (32%) agreed with the idea. As could be anticipated, perceived safety of disposal into the Finnish bedrock correlated really strongly with acceptance of expansion for the current actors ( $\tau=.655$ ), however, correlation with acceptance of expansion for other possible domestic actors was not nearly as strong ( $\tau=.337$ ). While the correlation between perceived threat to future generations and acceptance of expansion for the current actors was also strong ( $\tau=-.512$ ) it was also clearly weaker than in the former case. On the other hand, this situation was reversed when correlation with acceptance of expansion for other possible domestic actors was examined, as in this case the correlation with perceived threat towards future generations proved to be stronger ( $\tau=-.382$ ). (Litmanen, Kojo & Kari 2010, 53-54.)

**Regarding attitude to nuclear power.** As already discussed (Chapter 4.2.2), the residents were divided on the prospect of a nuclear new build. While around two out of five disagreed (42%) and agreed (37%) with the idea of constructing more nuclear power in Finland, still a small majority of the residents was opposed to a new build. This tendency was further affirmed when the residents' opinions regarding a new build at Olkiluoto were elicited and the num-

ber of those disagreeing was slightly increased, so that slightly less than half (47%) disagreed with the idea of a new build while around two out of five (38%) agreed. (Litmanen, Kojo & Kari 2010, 53-54.) Attitude to a nuclear new build correlated with acceptance in both of the cases under examination and in both cases attitude towards a new build at Olkiluoto correlated more strongly with acceptance ( $\tau=.644$  for current actors,  $\tau=.418$  for other possible domestic actors) than attitude towards a new build in Finland in general ( $\tau=.634$  for current actors,  $\tau=.382$  for the other domestic actors) (Litmanen, Kojo & Kari 2010, 53-54), as was to be expected.

#### 4.2.4 A community divided

Acceptance of the current final disposal project by Posiva, for its owners TVO and Fortum at the time of the survey, as already observed in Chapter 4.2.2, could be considered to be quite high at 42% and opposition, considering circumstances, relatively low at 36%. The difference in the share of the residents falling into the accepting and opposing categories was not, however, large enough to be called decisive. Consequently, it could further be claimed that this is an issue which, in effect, divided the residents. Looking more closely at those inclined to accept the disposal, and those inclined to oppose it, it also soon becomes evident that nuclear waste, in fact, has created quite a remarkable "social cleavage" in the area, thus dividing the community (see also Kari, Kojo & Litmanen 2010, 100-101).

Women were clearly more critical than men of final disposal in Olkiluoto. Of men, around half (52%) agreed with final disposal and under a third disagreed (27%), whereas of women two fifths (43%) *disagreed* with final disposal and only one out of three (33%) agreed with it. Secondly, the highly educated were more positively disposed towards the final disposal. The majority of those having only basic education (47%) disagreed with the final disposal, while those with vocational schooling were almost equally in favour (39%) and against (41%), whereas the majority of those who had studied in universities or polytechnics (54%), had institute-level schooling (47%) or had studied in high school (39%) agreed with the final disposal (among those with high school schooling only 22% disagreed). Thirdly, high income and high working position correlated with acceptance. The majority of those in senior managerial positions (63%), upper administration\* (50%) and lower administration\* (52%) as well as those whose annual incomes were 30 000 - 39 999€ (51%), 40 000-59 999€ (64%) or 60 000€ or more (67%) agreed with final disposal. Furthermore, those supporting the National Coalition Party (65%) and the Finnish Centre Party (51%) were most likely to agree with final disposal. (Kojo & Kari 2010, 8-9)

The division found in Eurajoki is consistent with the so-called 'white male effect' found in various cultural contexts. This phenomenon, quite regularly referred to in the international literature, highlights that white, affluent, formally educated males are seldom overly concerned about the possible negative effects of technological activities. This tendency to dismiss negative effects has been attributed, for example, to a disproportionate chance to benefit from tech-

nological advances and avoid possible costs, to feelings of power and control and to more individualistic and hierarchical world views. (Kojo, Kari & Litmanen 2012, 135-136, see also Finucane et al. 2009, Greenberg 2009.)

The question of race or ethnicity was not raised in the survey as Finland was at that time, and largely still is, culturally and racially a very homogenous country. No official statistics on race or ethnicity were at that time compiled in Finland, but according to reports submitted by Finland to the Council of Europe (ACFC 2004, ACFC 2010), the largest minorities in the country at the time of the survey were Swedish-speaking Finnish citizens (5%) and Russian speakers (1%), other minorities (Roma, Sámi people, Tatars and Jews) amounting less than half a percentage each. Foreign nationals living in Finland, at the time, numbered around 140 000, amounting to approximately half of the number of Swedish speaking Finns.

### **4.3 SNF management and reframing nuclear communities**

#### **4.3.1 Why focus on nuclear communities?**

As discussed earlier, in Chapters 1.1.1 and 1.1.2, siting hazardous facilities (or for that matter any facilities with potential negative effects) has become increasingly difficult in modern society and an SNF repository can be considered the archetype of an unwanted facility. Bergmans et al. (2008) depict the fundamental frame change that nuclear technology and SNF management experienced "from promising new technology to technological risk; from enthusiasm through ambivalence or scepticism to rejection", and how that change in framing has led to changes in siting practices and policy arrangements. Failure of the technocratic approach, leading to a crisis in siting, was generally attributed to neglect of the social aspects of waste management, as deliberation within the international nuclear/radioactive waste management community (see Chapter 3.2) also indicates. As a result of the crisis and consequent conclusions regarding the inadequateness of a technically driven siting process, the focus in siting moved from a purely technical viewpoint towards social and economic considerations as well as towards engaging stakeholders in the hope of a more consensual process. (Bergmans et al. 2008, 4,13-15.)

Thus, in order to avoid further waste management failures and new crises, the situation called for a socially negotiated resolution to SNF management. This so called 'participatory turn' duly turned the focus onto the host communities. As already mentioned earlier (Chapter 1.1.2), while the final disposal of SNF is a big international and national issue, it ultimately requires a local solution. In order for final disposal to be successful a facility (or facilities) must be located somewhere and, if a consensual solution to resolve the situation is really sought, the proposed community has to be, at least on some level, amenable to the idea of hosting a repository. In consequence, the acceptance of the host community has become crucial ingredient of what can be considered a success-

ful repository project (or in fact any other project concerning hazardous facilities).

Further, ever since it became obvious that gaining acceptance for the final disposal had become a pressing concern, it was likewise evident that existing nuclear communities were clearly more inclined to consider hosting an SNF repository than were greenfield sites, which in turn made these communities the best chance to resolve this problematic issue (see Chapters 1.1.5 and 3.3). Progress experienced in Finland and Sweden has raised hope in the international nuclear waste management community that this really could be the key to the apparent deadlock, as already mentioned earlier (see Chapter 1.1.).

#### **4.3.2 Framing and reframing nuclear communities through final disposal**

In the modern world it is in many cases possible to find scientific backing for various ways of seeing things, which in turn leads to different kinds of judgments regarding whichever issue is at hand. This makes framing enormously important. Definition of the situation involves assumptions of what the problem actually is, how to approach it and which actors and arguments are legitimate and relevant. From this point of view siting disputes are to be seen as struggles to establish which definition of the situation is to be accepted. (Lidskog 1994, 103.)

The final disposal of SNF became a topical issue at the time of awakening to technological hazards and the rise of environmental movements. Hence final disposal came under the microscope. As extremely hazardous waste, SNF would now have to be disposed of with diligent care and placed in carefully chosen safe and secure sites. At the same time, however, all attempts to secure such a site seemed predetermined to fail because of heightened risk awareness, controversies and the very nature of SNF as 'the ultimate LULU'. (See Chapters 1.1.1 and 1.1.2.) This focus is also apparent in the contemporary (and subsequent) research by Blowers and his associates discussed in Chapters 3.3 and 3.4. On the one hand the waste problem has to be solved, but on other this may be impossible to do satisfactorily, which poses profound moral questions. The nuclear oasis frame points out that the risks are uneven, that trying to exploit the vulnerability of nuclear oases is unfair and that something should be done to make the situation fairer. Blowers acknowledges the environmental justice movement and argues that: "Environmental justice, in its broader definition, provides a compelling empirical and theoretical counter-perspective" (Blowers 2002, 71).

The basic argument is that nuclear communities are already singled out and the way they are dependent upon the industry creates pressure to host a repository, the more so as failure to find a solution would in most cases leave them with the waste. In addition to this, the terms pragmatic acceptance and tolerability are often used to articulate that besides structural factors there are also socio-psychological factors at work in favour of the industry, as "these communities have already been taking calculated chances (consciously or unconsciously) with nuclear activities for years and are relatively accustomed to

what outsiders would regard as 'living dangerously'. While these communities are to a certain extent predestined as final disposal sites, on the other hand, they have proven that they will not blindly accept everything thrown their way. (Bergmans et al. 2008, 55,59, Chapter 2.2.1.) Under this predominant framing the industry is essentially seen as trying to use its leverage to impose the final repository on the community either struggling against all odds or in danger of falling victim to pragmatic acceptance.

Combining the aforementioned theorising and principled discussions in the public with the, already familiar controversies and nature of SNF as 'the ultimate LULU' demonstrates how nuclear waste management came to be framed predominantly as an unmanageable risk by society at large. This state of affairs, in turn, effectively brought the nuclear industry and its proponents to an antagonistic relationship with the rest of society forming a 'culture of confrontation' evident in most siting processes in the last decades of the twentieth century. (cf. Bergmans et al. 2008, 57.) Obviously this state of affairs is hardly acceptable from the point of view of the nuclear industry, and steps have been taken to remedy and redefine the situation.

As deliberated previously (Chapter 3.2), adversities encountered during the siting attempts drove the industry to reconsider the gravity and role of social aspects, and the extent of taking these aspects into consideration. As a consequence of this consideration the relation between technical and social dimensions was redefined so that it was understood that they are intertwined, and it would be, in fact, preferable to find a viable rather than a technically optimal site. Progress toward this end and gradual changes in the international nuclear waste management community's operating culture have been evident, at least, since the late 1990s. As a result of this progress, it can be argued in line with Bergmans et al. (2008, 33) that siting SNF in a modern way is about creating an environment where repository and local residents can comfortably coexist, which in turn, could be realised fully only by respecting the host community and its needs and by seeking a mutual understanding regarding the situation.

Under competing (re)framing, the industry is essentially seen as trying to seek understanding for its aspirations and to elicit 'industry awareness' within the community, which is to be convinced, due to integrating the industrial activity into the community's culture, of the merits of the project and the parties involved in it.

Next the findings of the study are examined in relation to the framings discussed earlier.

### **4.3.3 Findings seen through prevalent framing**

Eurajoki clearly fits into the frame of nuclear community (see Chapter 2.2.1). The municipality has a history with nuclear power and nuclear power units in the area, as discussed in Chapter 4.1, likewise with a low and intermediate-level radioactive waste repository and has previously demonstrated its consciousness of its nuclear identity through its choice of municipality slogans (see Kojo, Kari & Litmanen 2012, 129). But the question is how well the prevalent nuclear



oasis frame suits this case and whether a community with the industry awareness frame presents a proper challenge for this framing. Thus, the aim here is to examine how well the definition of nuclear oasis actually fits Eurajoki in light of the survey and what indications there are of features better suited to the challenging industry awareness frame.

Conforming to the nuclear oasis frame Olkiluoto is a relatively peripheral site located around 100 kilometres from nearest city of over 100,000 inhabitants. Eurajoki, the location of the site, is a small rural municipality, which at the time of the survey had around 5,900 inhabitants. The nuclear oasis hypothesis has already been used to explain to some extent the local decision-making regarding the SNF repository siting in Olkiluoto (Kojo 2009, Kojo & Richardson 2009, Litmanen 1994), and indeed, the municipality's economic dependency on the nuclear industry and its political interconnectedness with the industry (e.g. Kojo 2009) concurring with the nuclear oasis frame can be easily demonstrated. As noted in Chapter 4.1.3, the change in the municipality's stance towards final disposal coincided with a taxation reform affecting the municipality's income. It is quite clear that the reform, and the resulting financial crisis, caused the municipality to reconsider its position and change its view totally in just a few years in the 1990s. Local politicians wanted to safeguard the taxation revenue, while at the same time the industry had an interest in securing its foothold and ensuring a stable local political setting for new ventures, which led to principled discussions leading to the municipality's Olkiluoto Vision, in 1998.

Based on the survey results (see Chapters 4.2.1 and 4.2.2), and given that only one out of three inhabitants of Eurajoki considered final disposal in the Finnish bedrock safe, and just under one out of four inhabitants considered that the repository would pose no threat to future generations' health, safety and well-being, or found it hard to say if it does, the local acceptance of final disposal in Eurajoki was decidedly high at 42%. This is only 10% less than local acceptance of final disposal in Finland was in general, and incidentally also exactly the same percentage that accepted expansion of the repository for current NPP operators, and also, the same percentage that in a national survey (Litmanen et al. 2010) accepted final disposal in Eurajoki. Thus it may be concluded that in spite of perceived risks and threats inhabitants had quite positive attitude to final disposal and that "there really was no substantial NIMBY phenomenon to speak of in the community" (Kari, Kojo & Litmanen 2010, 94) and, additionally, there was no major activity against the project either (Kojo 2006a, 67-70, Kojo 2014, 120, Suominen 1998, 40-58).

Regarding economic and employment considerations, around two thirds of the inhabitants perceived that the repository had a positive impact on both employment and economic development in the area (See Chapter 4.2.3) and, furthermore, the perceived effects of the repository on both economy and employment correlated strongly with acceptance of final disposal (Kari, Kojo & Litmanen 2010, 57,94).

Thus, Eurajoki clearly meets all the key criteria for characterisation as one of the nuclear oases. Framed through this perspective the picture looks excep-

tionally clear, but let us examine what can be found when we incorporate a different one, and start looking for any indications of features that could instead give credibility to the challenging industry awareness frame.

#### 4.3.4 Findings seen through challenging framing

From the perspective of the industry awareness frame, the continued and close relationship between the industry and the municipality since the 1990s (e.g. Kojo 2009) suggests the development of industrial awareness. The abovementioned (Chapter 4.3.3) Olkiluoto Vision of 1998 can to some extent also be seen as evidence of industry awareness. The relations between the industry and the municipality already started to converge before the mid-1990s and the implementation of the EIA procedure triggered local discussions and the launch of a vision project for the municipality of Eurajoki. The municipality was consequently not only ready to locate a SNF repository for existing NPP units but also a possible new NPP unit. (Kojo & Kari 2010, 6.) Acceptance grew and opposition decreased greatly among the inhabitants as in 1992 around 50% of residents of Eurajoki disagreed and around 40% agreed with the final disposal but in 1999 around 60% *agreed*, and only 30% disagreed (see e.g. Kojo & Richardson 2009, 70, Kari, Kojo & Litmanen 2010, 82-83). Additionally, the modest level of compensation claimed (Kojo & Richardson 2009, 72, Kojo & Kari 2010, 6) can be taken as another sign of industry awareness. The municipality remained very modest in its demands although it was, at least to some extent, evident that they could push for more. While politicians were not unanimous in this regard, the intracommunity disagreements were not allowed to jeopardise the relationship with the industry. (Kojo & Kari 2010, 6.)

Furthermore, the municipality also took a positive stance towards repository expansions later on, in the 2000s, even though it has not been in dire economic straits as it was in the 1990s and thus not dependent on the nuclear industry as it was at the time of the financial crisis (Kojo, Kari & Litmanen 2012, 138). The continuum of liaison groups linking the municipality and the industry throughout the years can be interpreted to have played a part in the gradual institutionalisation of industry awareness (Kojo & Kari 2010, 6).

Based on the survey it can also be argued that, while economic and employment considerations clearly correlate with acceptance of final disposal (as stated above), the results do not ultimately support the notion of economic issues and dependency of the workforce being as central to the acceptance of SNF disposal as the nuclear oasis frame asserts. Examining the correlations between the perceived effects of the repository and the acceptance of final disposal, it was immediately obvious that the relative strength of the correlations between both economic and employment considerations and acceptance were not among the strongest (e.g. Litmanen, Kojo & Kari 2010, 53, see Chapter 4.2.3). In fact, regarding the final disposal for already established actors, according to a later (slightly different) analysis, the correlation of acceptance with economic development was only the 11th strongest, and with employment only the 15th

strongest, out of 20 correlations examined (Kari, Kojo & Litmanen 2010, 94, Kojo & Kari 2010, 10).

While exact correlations vary slightly (see Litmanen, Kojo & Kari 2010, 53, Kojo, Kari & Litmanen 2012, 138) depending on the method of analysis used, it is evident that the effects most closely related to acceptance, i.e. the impacts of the repository on respondents' own image of Eurajoki, own satisfaction with the area as a place to live, and own expectations for the future in the area (see Chapter 4.2.3), are clearly more closely related to symbolic and cultural dimensions and evaluations under the 'modern condition' set forth by the industry awareness frame than to the power relations and dependency stressed in traditional framing (see Chapter 3.4). These correlations relating to the well-being of the area<sup>15</sup> differ widely from those related to economic considerations<sup>16</sup> (or e.g. background variables), even slightly exceeding the correlations between perceived threats and acceptance (Kojo, Kari & Litmanen 2012, 132-138).

Thus, acceptance really seems to be related to the issues highlighted in the industry awareness framing. So framed, the results confirm the industry's goals of making "agreeable additions to quality of life" and making the facility to an important, positive part of the proposed host community. How things are evaluated, their perceived importance, given value and what kinds of connotations are raised become the key aspects for gaining acceptance. (See Chapters 3.2 and 3.4.) That considerations related to well-being are closely correlated to economic considerations (Kojo, Kari & Litmanen 2012, 141), however, raises serious questions regarding the validity of heavy focus of the framing on cultural and symbolic issues.

#### 4.3.5 Additional insights provided by the study

As noted earlier (Chapter 4.2.1), the inhabitants of Eurajoki seemed more concerned about the safety, health and well-being of future generations than that of the current generations. The high level of concern reported, however, did not correlate as such with acceptance as strongly as one might have expected. While the correlation of acceptance with concerns related to future generations ranked high among the correlations examined, acceptance of final disposal was still somewhat more closely related to concerns about own or family's safety and general safety, which correlated highly with acceptance. (Kojo, Kari & Litmanen 2012, 131-132.)

For many, the final disposal project seemed to blend in with other ongoing nuclear industry related activities, as around half of the inhabitants deemed it difficult to consider final disposal separately from these (Litmanen, Kojo & Kari 2010, 46, Kari, Kojo & Litmanen 2010, 95). This is also in line with the finding from Chapter 4.2.3 that acceptance of final disposal was closely related to fa-

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<sup>15</sup> According to the data analysis the internal consistency of these items (respondents' own image of Eurajoki, satisfaction with the area as a place to live, and expectations for the future in the area) is excellent ( $\alpha=.922$ )

<sup>16</sup> According to the data analysis the internal consistency of these items (economic development and employment in the area) is equally excellent ( $\alpha=.922$ )

vourable attitude towards nuclear power new build in the area. Interestingly, considerations related to the well-being of the area reported in the preceding chapter (see Chapter 4.3.4), were even more closely related to the new build than final disposal (Kojo, Kari & Litmanen 2012, 138).

As stated before (see Chapter 4.2.2), regarding final disposal, the aspirations of new actors were not met with the same degree of approval as those of already locally well-established actors. The disposal needs of possible newcomers were less tolerated by a wide margin, especially when foreign actors were considered. An intriguing observation is that this change is also mirrored in the change in the relationship between the considerations related to the well-being of the area and acceptance. When new actors were considered, these considerations had a relatively weaker correlation with acceptance, whereas the correlation between acceptance and benefits exceeding the costs grew relatively stronger. However, even with new actors, it can be seen that inhabitants valued overall benefits over economic benefits, so here too it appears that there are some additional considerations to take into account besides purely economic ones. (Kari, Kojo & Litmanen 2010, 89, Kojo, Kari & Litmanen 2012, 137.) Although it has to be noted that, as already pointed out in Chapter 4.2.3, the majority of inhabitants had a rather negative opinion regarding the benefits despite the compensation package (see e.g. Kojo 2009) negotiated with the industry (Kojo, Kari & Litmanen 2012, 137).

Chapter 4.2.4 explored how attitudes towards final disposal were generated. This does not, however, seem to alter the fact that economic and employment considerations are not as closely related to acceptance as other considerations related to the community and its well-being reported in the preceding chapter (Chapter 4.3.4). Women just viewed the effects of final disposal on these issues in a less favourable light than men. Related to this, for example Sjöberg (2009, 544-545) has argued that women tend to be more "precautious" in their attitudes than men, and in Finland research by Avolahti (2016, 226) has indicated that concern related to nuclear facilities, and especially to final disposal, is a more typical sentiment among women. In the same chapter, it was also established that affluent individuals were more inclined to take a positive stance towards final disposal. In this case it is evident, however, that more affluent people relate the abovementioned other considerations, explored in the preceding chapter (Chapter 4.3.4), more closely to economic factors than do other groups. For example, the correlation between perceived effect on economic development and perceived effect on respondents' own image of Eurajoki was considerably higher among those inhabitants earning 40,000 euros or more a year. (Kojo, Kari & Litmanen 2012, 141.)

## 5 DISCUSSION

### 5.1 The findings

In retrospect, it can be discerned that going nuclear happened in Eurajoki quite uneventfully. The decision on acquiring the NPP units in the first half of the 1970s went quite smoothly as it was made before the use and production of nuclear power was really considered an issue, and in addition, the SNF was to be exported (see Chapters 4.1.1 and 4.1.2). However, on its becoming a site for the final repository the situation was altogether different. The siting of the repository was contested even before it was actually considered, as Eurajoki demanded, and also obtained, assurances from the NPP operator that final disposal would not take place in the municipality even before the operator was obligated to look into domestic final disposal option. These assurances did not, however, stop the operator from including the municipality in the site screening process after it realised that a domestic final disposal option would after all be needed and eventually securing the site in the area. (See Chapters 4.1.2 and 4.1.3.)

The change of the municipality's position in the short time from the sharp stance taken against final disposal (1993) to the co-operation agreement (1995), to the Olkiluoto Vision (1998), and finally to the endorsement of application in 2000 for a DiP (see Chapter 4.1.3) was remarkable. Yet what stands out even more is that the inhabitants of Eurajoki were quite ready to accept this. Elsewhere, decisions like these have usually proved very problematic for the politicians and municipal officials, as the public has been known to reject such decisions quite harshly, as repository plans have been rejected over and over again.

It is more or less evident that, at the same time as the need for a domestic final disposal solution became enshrined in law, in view of the upcoming EU membership negotiations, the taxation reform and related financial crisis also opened a window of opportunity for the industry to act on its newly established need to secure a disposal site (see Chapters 4.1.3 and 4.3.3). What can be contested, however, is whether additional economic pressure combined with relative dependency from the industry was enough to secure the coveted long-

term public acceptance, which extended from the original final disposal plan to the related ventures afterwards.

In light of the data acquired during the first stage of the post site selection phase (see Chapters 1.3.1 and 4.1.4), it seems obvious that inhabitants' acceptance amounts to larger considerations pertaining to community well-being rather than more limited questions regarding economy and employment (see Chapter 4.3.4). The results indicate that the prevalent nuclear oasis frame is insufficient in scope as it concentrates too strictly on economic necessities and dependency. On the other hand, while the results show that acceptance really seems to be related to the issues stipulated by the industry awareness framing (like making agreeable additions and fostering positive connotations), that perspective also appears to be insufficient as it can be claimed that it, in turn, concentrates too strictly on the cultural and symbolic dimension. As the results show, acceptance is also closely related to economic factors. (See Chapters 4.3.3 and 4.3.4.)

In addition it was also noted that the acceptance of the proposed disposal project was heavily dependent on an already locally well-established actor and that, for many, the final disposal project seemed to blend in with already ongoing activities (see Chapter 4.3.5).

Frames are supposed to provide the perspective most accurately capturing the essential characteristics of the situation or the issue at hand (Chapter 3.1). The results indicate that, instead of focusing on leverage related to economic surplus and employment or, on the other hand, the importance of connotations raised by the final disposal project - it would be more beneficial to pay attention to the perceived effect of the repository on the general well-being of the community and, additionally, to the relationship between the project's implementer and the community.

## 5.2 Reflection

As seen (see Chapters 4.3.3, 4.3.4 and 5.1) the results of the study did not exactly fall into the premises of the pre-selected framings. Neither did the prevalent nuclear oasis approach nor the challenging industry awareness approach seem to really fit the data. Instead of the routes promoted by these approaches, the findings raised some new avenues for thought, as far as explaining the less opposed attitude towards final disposal in nuclear communities is concerned. However, there is rarely a chance "to boldly go where no one has gone before" (Roddenberry 1987) - and that is the case here, too.

### 5.2.1 The relationship between implementer and community

The idea of fostering good relations with the potential host community in hopes of securing a final disposal site is, of course, nothing new. Incentives and compensation have been used in siting at least since the late 1970's. "Approaches in

line with traditional economic theory of compensation" were not very successful, however, raising public outcries and accusations of bribery, i.e. the bribe-effect, and 'crowding out of public spirit' (see Kojo & Richardson 2014b, 3, also e.g. Di Nucci, Brunnengräber & Isidoro Losada 2017, 309,315, Frey, Oberholzer-Gee & Eichenberger 1996.)

With that in mind, at the turn of the millennium, researchers from the University of Antwerp and the University of Luxemburg developed for Belgium a methodology – elements of which would soon be adopted to other countries – that would allow the radioactive waste agency and a potential host community to engage in negotiations in a more holistic manner (Vanhove, Hooft & Bergmans 2005, Bergmans, Steenberge & Verjans 2006, 25-27,50-54). The partnership approach or 'partnering', where arrangements are made between the implementer and representatives of the local community to work together, has been linked to ensuring host community support both for a concept and a site (NEA 2010e, 17,back cover, NEA 2013, 21). However, as the partnership is seen as a way to support joint problem-solving and redistributing power through negotiation (Brans, Ferraro & Von Estorff 2015, 18); Eurajoki probably would not be the case to highlight as a successful case of partnering. The case of Eurajoki could be described as a case of 'bystander partnership' or 'mostly silent partnership', characterised by trust in the nuclear safety authorities and with economy as the primary concern, unlike Oskarshamn and Östhammar in Sweden (and communities in Belgium with low-level radioactive waste), where the local communities were closely engaged in the process in numerous ways. (Kari, Kojo & Lehtonen 2019, KYT2018 2019, 181.)

On the other hand, it could be deemed possible to achieve positive relations without such an extensive active engagement of the community (i.e. actual relationship building). It would be plausible that this could be done by demonstrating appropriate qualities consistently in day-to-day activities. Siegrist, Cvetkovich & Roth (2000, 360, see also Poortinga & Pidgeon 2006) indicate that we tend to rely on those we consider to have "appropriate guidelines and general principles for setting goals and procedures" i.e. those we consider to have similar salient values concerning the issue at hand, and that perceived similarity of those values relates to perceived increase of benefits and decrease of risks. Value similarity thus evokes social trust which, according to them, is especially important when the individual lacks the knowledge, or other resources, to personally make decisions e.g. about riskiness of technologies. Bronfman, Vázquez & Dorantes (2009, 687), in turn, highlight how according to the literature (apparent) honesty, integrity, transparency and competence influence social trust. Considering that Finland is a Nordic high-trust society, with a low-key protest culture<sup>17</sup>, and that the Finnish nuclear industry has a track record that is hard to match to start with, it would be likely that achieving positive, relatively trusting, relationship between an implementer and a local community would require somewhat less active engagement than in some other countries. Indeed, some researchers do warn against having too much trust only in social trust and

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<sup>17</sup> See Suominen (1999, 40-44)

stress epistemic trust as an underlying factor (see e.g. Sjöberg & Wester-Herber 2008).

### 5.2.2 Perceived effect on the general well-being of the community

Because of the shortcomings of the traditional economic theory of compensation, in fostering good relationships with potential host communities (see Chapter 5.2.1), the discussion on incentives and compensation recently started to open up towards a more broadly defined concept of added value i.e. additional value created for the benefit of the community (see Kojo & Richardson 2009, 2012, 2014a, 2019). Added value has also been repeatedly brought up, in connection with the aforementioned (see Chapter 5.2.1) partnerships (Hooft et al. 2002, Van Hove 2004, Bergmans 2008, NEA 2012).

The notion of creating additional value to the potential host community in the broad sense of the concept, i.e. producing something the community appreciates, is, of course, akin to creating perceived positive effect on the general well-being of the community. However, both community and well-being are somewhat elusive concepts. The concept of community was already touched upon earlier in the chapter concerning nuclear communities (Chapter 2.2.1), where it was noted that, in Finland, the municipality was a surprisingly workable approximation for community in this context, as surprisingly few Finns really did not identify themselves with the municipality – making residents' attachment to the municipality both location and identity based – and the municipality furthermore clearly being conscious of its "nuclear identity". Regarding well-being, conventionally objective well-being has been measured through material conditions including such dimensions as income, health, employment and education, whereas, subjective well-being research has concentrated on how individuals evaluate their lives using quality of life as a frame of reference (see Wiseman & Brasher 2008). As evaluation and thus also acceptance is based on the perceived qualities of the project (and related circumstances) some broad definition acknowledging this, along the lines of Wiseman & Brasher's definition of community well-being could be workable.

"Community wellbeing is the combination of social, economic, environmental, cultural, and political conditions identified by individuals and their communities as essential for them to flourish and fulfil their potential" (Wiseman & Brasher 2008, 358).

While it also has to be recognised that some conditions individuals use in their evaluations are not consciously identified, the fact remains that local residents and communities themselves constitute the final authority on community well-being. Additionally, in recent discussions the issue of sustainability as the prospect of upholding and enhancing community well-being or the welfare of the community has risen to the agenda (see McCrea, Walton & Leonard 2014, Magee, Scerri & James 2012, cf. Parris et al. 2014). All things considered, making community well-being – and expectations related to future community well-being – central to acceptance, accentuates the need for a bottom-up or delibera-



tively constructed understanding of how a final disposal project is evaluated, i.e. what conditions that have to be satisfied to achieve and uphold the acceptance. Grounding decisions and policies in the local context and factoring in local expectations has a potential to make them significantly more 'socially robust' (cf. Cotton 2017, 136,156).

### 5.2.3 Some observations regarding Eurajoki

In earlier chapters (Chapters 4.1.3, 4.3.3 and 5.1) the change in stance towards final disposal in Eurajoki was already connected to the financial situation following a taxation reform and the municipality's desire to safeguard its taxation revenue. In addition, the final disposal project was seen as a way to secure 'relative advantage' regarding a possible new NPP unit and, as a result, further taxation revenue to municipality (Kojo 2009, 179). Still, in order to further the project and to foster good community relations, compensation measures, although quite limited, were taken. The compensation measures used were more in line with additional value creation discussed in the preceding chapter (Chapter 5.2.2) than traditional economic theory of compensation mentioned earlier (Chapter 5.2.1), and were able to largely, although not entirely (see Lehtonen & Kojo 2019), avoid the bribe effect mentioned in the same context. The Vuojoki Mansion and Foundation and the Eurajoki Business Development Fund are good examples of arrangements to create added value (also having some continuance). The modest compensation claims already briefly mentioned (Chapter 4.3.4) on the part of the municipality also disclose how relationship building was also on the municipality's agenda, as it was at least somewhat evident that the municipality could have pushed for more. (Kojo & Kari 2010, 6, in more detail see Kojo & Richardson 2009, 55-75.)

It was contemplated previously (Chapter 5.2.1) that, although Eurajoki is not exactly the model case of partnership approach, the preconditions for creating positive relations between an implementer and a local community are exceptionally good in Finland, and thus it is plausible that a lesser amount of active engagement would be required than in some other countries. While working together in a collaborative manner and with an increasing degree of decision-making power delegated to the local community, which are considered typical of 'real participation' in local partnership (NEA 2013, 21-25), were kept at a low level at Eurajoki, this does not mean that the implementer remained idle. Posiva have taken some decisive steps to convince the community of the appropriateness of the premises of its operations. First of all, as Kojo (2002, 61-62) reports, by creative use of its own communications, and communications related to the EIA process, Posiva made itself the main interpreter of nuclear waste management towards potential host communities. Thus Posiva was able to define itself as reliable actor with high level of expertise and introduce positive visions regarding the final disposal project to the local discussions. Secondly, by establishing its headquarters in Eurajoki after the site selection, Posiva created the image of being in the same boat with the local community and, therefore, demonstrated a need to make good decisions on behalf of the com-

munity, and having to face the same potential consequences as the rest of the community in case of badly based decisions. Thirdly, it has ever since used its own locally distributed newsletter to create trust and increase acceptance of the final disposal project, both by depicting it as a common project that brings the community together and advances the common interests, and by letting readers understand that there had been active public participation in the project (Hänninen & Yli-Kauhaluoma 2014, 138,141-142).

Thus, Posiva has arguably played on emphasizing close relations, cultivating cultural integration and shared understanding which is the idea at the heart of the industry awareness approach (see Chapter 3.2). Furthermore, some added value was clearly created (see Chapter 4.3.4, also e.g. Kojo, Kari & Litmanen 2012, 137,140), and it has also been demonstrated how the waste management agency has been trying to tie the project to the "continuum of the good" in the area, a part of the development of the community (Yli-Kauhaluoma & Hänninen 2014). As far as the industry awareness approach highlights constructive and integrative relationships and partnerships (see Chapter 3.4) it clearly seems to have found the right line of approach – But, at the same time, it is clearly too simplified to reduce endeavours for sustainable, i.e. (in this case) societally durable, relationships, trust and creating added value merely under the label of 'embedding the project in the local culture' to create industry awareness.

### 5.3 Some thoughts on directions in which to go

In hindsight, there has been a clear theme throughout this study. It is too simplistic to assume that community acceptance could be built on mere economic considerations. At the same time, it is too simplistic to assume that that community acceptance could be built on mere cultural embeddedness. And, arguably, it also seems too simplistic to assume that cultural embeddedness alone would create enough additional incentive on top of the economic considerations, although it seems a very important piece of the puzzle. In my view, this tendency to examine social science issues related to nuclear waste management in a more encompassing manner, piecing out how different things fit together, seems to be generally gaining ground.

There are two ongoing discussions I would like to point out in this context that are clearly related to the questions at hand; Discussions regarding sustainable relationships and social licence to operate.

The NEA/FSC in its report 'Fostering a Durable Relationship Between a Waste Management Facility and its Host Community' (NEA 2007b) raised over ten years ago the subject of added value as a means to a sustainable relationship between a final disposal facility and the host community, pointing out many of the issues made salient in the reflection chapter (see Chapter 5.2). Unfortunately, the report itself rather stressed minor issues like aesthetics, attractiveness and convenience. While these issues are still prominent in the 2015 edition of the same report (NEA 2015a), the new report can be considered somewhat more

well-rounded, but still somewhat unambitious, as it seems to concentrate excessively on making a facility presentable and pleasing (see Chapter 3.4).

I tend to agree with Bergmans et al. (2008, 63) calling for more responsiveness to social needs and "a second phase in the process of developing a sustainable relationship between the waste and its host environment (whether it be geological, ecological, social or political)". Recently (Whitton et al. 2016) sustainability has been raised as a focal point in the assessment of the siting of new nuclear build in the United Kingdom. And, to be fair, the NEA has also indicated that sustainability and added value are themes that will persist as topics of discussion (NEA 2015a, 50), which provides opportunities for more in-depth contemplation of these issues. Incidentally, this seems to be the area where the NEA comes close to Blowers (2017, 246), who takes the view that there is an imperative to enhance the well-being of host communities, also taking care of future generations.

Social licence is a term occasionally emerging in discussions concerning the final disposal of SNF. The term has not, however, really been thoroughly discussed or operationalised in connection with nuclear waste management – even to the extent that there has been ambiguity regarding the issuer of such licence and some demands for clarification of the term (see NEA 2017b, 9,53,64). The contemporary use of the term 'social licence' and 'social licence to operate' (SLO) have spread rapidly from the mining industry to other industries, including the energy industry, in recent years (Boutilier, Robert G. 2014, 263-264). Much used core concepts of SLO are legitimacy, credibility and trust, which the implementer is trying to gain "[i]n the eyes of a host community" (Jijelava & Vanclay 2017, 1077-1079). Study on the usefulness of SLO as a framework for nuclear waste management started in Finland on the Finnish Research Programme on Nuclear Waste Management (KYT) in 2018 (cf. KYT2018 2019, 120-121). Especially interesting, bearing in mind how this study has brought well-being in focus, is that in the factor analysis done by Boutilier and Thomson (2011, app.A) an item measuring perceived contribution to well-being ranked as the top loading item on what the authors called socio-political legitimacy factor.

## 6 CONCLUSIONS

For decades, nuclear power industry and countries using nuclear power have been struggling to solve its "Achilles heel"; nuclear waste. Securing a site for the final disposal of SNF (and other civilian high-level nuclear waste) has turned out to be a formidable problem, culminating in inability to gain social acceptability and local approval for site selection. (Chapter 1.1, see also e.g. Cotton 2017, Metlay 2016, Kojo 2014.) Finland was the first country in the world to succeed in removing obstacles to the siting of an SNF repository, including gaining the local acceptance (Chapters 1.1.4 and 4.1.4, also e.g. Choi 2018, 45, Darst & Dawson 2010, 64). As a result, Eurajoki became the very first municipality where the views of local residents on the final disposal of SNF were elicited after completed and approved site selection, moving towards the construction phase. The subsequent granting of the construction licence has been described as "a milestone of global importance" (IAEA 2018c, 44-45) and "incredibly influential for nuclear waste politics", as well as the community role as "a crucial component" (Cotton 2017, 16).

Interest in Eurajoki and the concept of this study relate to the uniqueness of the situation in Finland and Eurajoki – Eurajoki literally being 'the first of its kind' – and, additionally, to the uniqueness of the survey data elicited from the residents at the post-site selection phase, after successfully concluded siting (see Chapters 1.3.1 and 4.1.4), and the insight it could bring to this situation. On the other hand, although there is no precedent for the successful siting of a final disposal facility for SNF, as a nuclear community, Eurajoki could also be considered a prime example of the marked tendency of nuclear communities to be more willing, or less opposed, to consider accepting final disposal facilities.

The study therefore concentrated on Eurajoki as a nuclear community, on local opinion on issues related to final disposal in this unprecedented situation and on the readiness of nuclear communities to consider the final disposal of SNF. (Chapters 1.1.4, 1.1.5 and 1.3.5.)

## 6.1 Main results

As listed earlier (Chapter 1.3.5) the aims of the dissertation were: 1) to form a picture of Eurajoki as a nuclear community and to examine the rationality of community acceptance in the case of Eurajoki, 2) to scrutinise the workings of the competing nuclear oasis and industry awareness frames and 3) to draw conclusions on the viability of the frames based on the findings and reflect on the way forward given the evidence gathered in the course of the study.

It was found that becoming a nuclear community, i.e. the siting of the NPP, had been quite uneventful in Eurajoki, but also that the municipality had taken a negative stance towards final disposal from quite an early stage. The change of stance was connected to taxation reform and the amendment of the Nuclear Energy Act (1420/1994). The local politicians' need to safeguard taxation revenue, combined with the industry's reinforced need to secure a site for the final disposal, led to co-operation and finally to the endorsement of Posiva's applications. While getting local politicians or officials to agree to the siting is not unheard of, what stands out is the inhabitants' apparent readiness to accept that decision. (Chapter 5.1.)

The data analysis showed a considerable level of acceptance of final disposal in Eurajoki in spite of perceived risks and threats. Additionally, there seemed to be no substantial NIMBY phenomenon in the community. However, the pre-existing domestic nuclear power companies' waste was clearly more welcome than that of potential newcomers', let alone that of foreign operators and for many the final disposal project seemed to blend in with other ongoing nuclear industry related activities. Moreover, a quite remarkable "social cleavage" became evident, in line with the recurrent finding that affluent, formally educated males tend to be less concerned than others about technological activities. (Chapters 4.2 and 4.3.5.)

Based on the analysis reported in Chapter 3 on the nuclear oasis and industry awareness frames, the core assumptions of the frames were then examined in relation to the results of the survey (see Chapters 4.3.3 and 4.3.4). The results indicate that the prevalent nuclear oasis frame is insufficient in scope, concentrating too strictly on the economic dimension and related power dynamics i.e. dependency and leverage. On the other hand, while acceptance is to a certain extent related to the issues characteristic of industry awareness framing (like making agreeable additions and fostering positive connotations), it falls short as the main frame of reference, as it, in turn, concentrates too strictly on the cultural and symbolic dimensions; The results clearly show the importance of the other factors, including those relating to economy and markedly factors related to community well-being. (Chapters 4.3.3–4.3.5 and 5.1) On the grounds of this examination it has to be concluded that both of the framings examined were too narrow and one-dimensional to form an accurate and sufficiently comprehensive picture of "What is it that's going on here?", i.e. the ques-

tion which frames are supposed to answer in order to provide a correct reading of the situation (see Chapters 2.3 and 3.1).

Considering the results of the study, not only was the acceptance of the proposed disposal project heavily dependent on a locally well-established actor, but it is also evident that inhabitants' acceptance culminated in more encompassing considerations related to community well-being, rather than narrower perspectives pertinent to the competing framings examined (cf. Chapter 5.1 and 5.3). Additionally, while Eurajoki is not exactly a typical example of partnering between industry and community, it is clear that the local nuclear waste management company has worked determinately in order to affiliate itself to the local community and make final disposal a common project, and on other hand, to tie the final disposal facility project to the "continuum of the good" in the area (Chapter 5.2.3).

All in all, the study demonstrated the importance of both the relationship between implementer and community and the perceived contribution of the project to the well-being of the community, from the community's point of view – And, related to these, themes of trust and added value were explored. In light of these observations, current discussions regarding sustainability, i.e. durable relationships and SLO, combining different aspects of legitimacy, credibility, accountability and trust leading to identification with a project, were highlighted – Both these approaches clearly considering the questions at hand, prioritizing community opinions and looking into issues related to nuclear waste management from a somewhat broader perspective. (Chapters 5.2 and 5.3.)

## 6.2 Direct implications

It has been clear for some time now that the international nuclear waste management community has been intent upon identifying a successful method for securing willing hosts for final disposal facilities for SNF. The progress towards a more participatory approach and gradual changes in the operating culture of the nuclear industry have been evident to the point that this has been referred to as the participatory turn. (Chapters 4.3.1 and 4.3.2.) Participation and local acceptance have also been major interests in social sciences research on nuclear waste management (Chapters 1.2.3 and 1.2.4).

In Finland the interest in community acceptance has been essentially practical. The main funder of the nuclear waste management, the Finnish Research Programme on Nuclear Waste Management, which funded the project continuum on which the original research for this dissertation is based, is interested in building competence for regulatory purposes and in being able to assess different ways and methods of implementing final disposal (see Chapter 1.3.1). Additionally, Posiva, already in its EIA, has acknowledged that it is essential to gain acceptance for the location of the facility, and that the best way to minimize conflicts is to implement the facility in co-operation with the community from characterisation phase to the decommissioning, with "efforts made to consider

any negative effects in advance" to alleviate or even prevent them (Posiva 1999a, 181-183).

The results indicated that the implementer needs to 'earn' its place in the community and instead of just providing economic benefits, the final disposal project should suit local views regarding what is appropriate and beneficial to the community, or the area in general. Thus, in line with Kojo & Richardson (2009, 81) the "community perspective is recommended in order to identify and address local needs and interests". Additionally, as the once granted acceptance, or social licence, cannot however be taken for granted, an enduring, i.e. sustainable, relationship between the project and the community is considered advisable (cf. Bergmans et al. 2008, 58,63).

While the facility project commenced from quite an advantageous starting point in Finland (Chapter 5.2.1) and implementer was already connected to the community through the NPP operator (Chapters 4.1 and 5.1), the implementer clearly also worked to become part of the community and was able to create some added value (Chapter 5.2.3). The community perspective has, at least to some extent, also been incorporated as a result of "Posiva's active quest for local visions", the strategy project initiated by the municipality and discussions in the liaison group regarding the requirements for continued co-operation (Kojo & Richardson 2009, 52,74, Kojo 2006b, 118).

So far, the final disposal project in Eurajoki has been able to avoid serious confrontations and has been able to secure both the site and the construction licence for the facility. Still, as noted, final disposal is a long-term activity that requires long-lasting relationships and therefore still needs to be paid due attention. However, in addition to the ongoing final disposal project in Eurajoki, the new nuclear power company Fennovoima started its own EIA process (Chapter 1.1.4) and an analysis of the approaches already used provides an opportunity also to evaluate Fennovoima's endeavours.

All in all, although the survey data was limited to a certain time point, the results of this study help to understand the relationship between the implementer and the local community and the social structures that maintain local acceptance. Final disposal was opened up as a social issue, focusing on its core, i.e. the criteria for acceptability. Thus the dissertation affords a better understanding of one of the fundamental conditions for final disposal. This means that the policies, strategies and practices, as well as decisions and actions of all parties can be evaluated from better grounds (including ethical aspects related to participation), and revised if needed.

The dissertation, of course, contributes also to the international discussion regarding the factors related to local acceptance for final disposal, and serves the international need for information on Finland's trailblazing final disposal project and one-of-the-kind situation in Eurajoki, as other countries considering or already pursuing final disposal are debating on appropriateness of different solutions regarding final disposal. In the case of final disposal, where efficiency of solution cannot really be evaluated due to the long time frame, how the decisions are made become all the more important (see Kuppler & Hocke 2018, 5).

## 6.3 The bigger picture

Although the focus of the study was on the local level and its interest was limited to one specific community, the reason for that interest, however, was not local. What makes Eurajoki interesting is, of course, its pioneering role in nuclear waste management and the way "the ultimate LULU" (Chapter 1.1.2), the final disposal facility, became acceptable. As noted above (Chapter 6.2), the results of the study can be very straightforwardly seen as an account of a successful siting experiment, indicating a fruitful approach to the siting of final disposal facilities for SNF and indeed other nuclear waste facilities.

However, on the other hand, the results of the dissertation relate and contribute to multiple ongoing discussions, such as the siting of various types of facilities and the implementation of different technologies as well as compensating for and mitigating adverse effects. Additionally, on a larger scale still, the results contribute to deliberations regarding for example socio-technicality and the governance of technology-related issues, assessing risks and uncertainty and even ethics pertaining to the complex relationship between technology and society.

The premise of the dissertation is (as outlined in Chapter 2.3) that there is a dialogical relationship between social actors and social structures, and on the other hand between the social structures and the cognitive structures of social actors. As co-constructions, the frames which guide our perceptions can be challenged and renewed and, hopefully, more appropriate frames adapted.

### 6.3.1 Brief overview on several related discussions

Considerations of siting, implementation and acceptability have been raised, for example, in relation to controversial technologies (Wolfe et al. 2002, 135), large infrastructure projects and contested infrastructures (Moser et al. 2015, 622), grand-scale or megaprojects (Cotton 2017, 35), potentially hazardous facilities (Jenkins-Smith & Kunreuther 2001), energy projects and contentious technologies (Whitton et al. 2016, 37), and renewable energy and carbon capture (Venables et al. 2012, 371). Compensation, mitigation and acceptability considerations have been raised in research on several occasions, both among the other considerations (e.g. Cotton 2017, Di Nucci & Brunnengräber 2017) and also individually (e.g. van der Veen, Spaans & Janssen-Jansen 2010, Kojo & Richardson 2014a, Lehtonen & Kojo 2019).

From a socio-technical point of view, technology and its implementation are embedded in and permeated by the social. Cotton (Cotton 2017, 28,151) notes how socio-technical framing shifts the emphasis towards incorporating social and ethical factors and community and stakeholder values into nuclear waste management. And, for example, regarding wind energy, it has been pointed out that it would be a mistake to not properly consider "how the implementation of the technology is part of a socio-technical system that interacts with the local community, the local environment, the key stakeholders and the



project developers" (European Wind Energy Association 2009, 404). Discussions on governance relate to the "participatory turn", mentioned in passing above (Chapters 4.3.1, 4.3.2 and 6.2), and understood broadly as a turn from government towards governance (Bergmans et al. 2008, 23,27, see also Kuppler & Hocke 2018, 4). Chilvers & Burgess (2008, 1884, see also Bulkeley & Mol 2003, 144) refer in this connection to the debate on "the 'new' governance of science, technology, and environmental risk and increasing public dialogue and engagement within these domains" – but raise the issue of framing and argue that some viewpoints can still be marginalised through practices, processes, design and politics contextualising participatory processes. Considering the results of the study, if indeed incorporating more social considerations to technology implementation and more accurate understanding of local values is sought after as these approaches suggest, it would be important that interaction is framed in a manner that includes the perceived effects on and implications for local community well-being of the projects proposed.

The same also applies to discussions related to risk and uncertainty. Regarding risk, Renn (1998, 52-54,61,66) asserts that risk refers to the possibility of consequences that affect something that is valued, i.e. consequences are socially interpreted and linked to group values. Limiting interest to e.g. physical or economic consequences would exclude other consequences, undesirable or desirable, from the considerations. As Henwood et al. (2008, 4,30) formulate it "what is perceived as risk and how that risk is perceived will vary according to the context in which, and from which, it is regarded". From this point of view sensitivity towards the "multiplicity and variability of frames" would be needed. Regarding uncertainty, it has also been argued in the same vein that any attempt to deal with uncertainty should include a plurality of perspectives and focus on "negotiating a mutually acceptable frame, or finding a workable relation between the different views and actors" (Brugnach et al. 2008, 2-4). Experiences from Belgium, on the siting of low- and intermediate-level radioactive waste, indicated that in the local context societal durability is stressed and a much wider range of information is considered relevant than is considered by experts (Laes, Schröder & Meskens 2009, 31,32). Lake (1993) refers to "residents' expectation of minimized uncertainty" but the demand for a durable, i.e. sustainable, relationship can also be seen as defending community well-being. Magee, Scerri & James (2012, 245,254,256) assert that "community sustainability can be treated as an extension of community wellbeing", combining interpretations regarding "prospects for individual and collective wellbeing, now and into the future". The results of the study, indeed, seem to suggest the importance of that among the "multiplicity and variability of frames" the views regarding community well-being, combining a wide range of information considered relevant locally, are taken into account when risks, uncertainties and sustainability are contemplated.

Concerning ethics, the themes addressed by this dissertation relate mainly to equality, fairness and justice in the distribution of risks, possible harms and benefits, and to procedural justice (cf. Krütli et al. 2012, 84,95, Gowda & Easter-

ling 2000, 918-919). Related to above deliberations on risks and uncertainties, it can be deduced that for an appropriate assessment of the distribution of risks, harms and benefits it would be advantageous to acknowledge what factors are locally considered relevant. Therefore, from the viewpoint of procedural justice, community preferences and values should be taken into consideration in the process. The results of the study stress the significance of well-being considerations in this assessment.

The theme of compensation and mitigation is also related to the question of ethics as it is considered unfair that a burden like a final disposal facility should be borne on behalf of all of society without adequate compensation and mitigation, and maybe even incentives (cf. Cotton 2017, 149, Di Nucci & Brunnengräber 2017, 307-308, Kojo & Richardson 2012, 41-43). In view of this a number of researchers (e.g. Kojo & Richardson 2019, Kojo & Richardson 2009, 81, van der Veen, Spaans & Janssen-Jansen 2010, 1013) have recommended integrating the community perspective into developing appropriate compensation/benefit packages to address local needs. As above, the results again suggest the importance of including well-being considerations in this deliberation. As Whitton et al. (2016, 39) assert, through learning community priorities 'likely areas of social impact' can be identified and both decision-making and mitigation improved.

### **6.3.2 Some additional considerations and suggestions**

It has now been shown that the siting of a final disposal facility for SNF can be done. However, although the siting process in Finland, in Eurajoki, has set an example of a successfully conducted siting process, it has to be appreciated that this is just a one case. While in certain nuclear related issues it is possible to refer to international or global nuclear regimes (see Findlay 2010) in such a localised issue as community acceptance, conditions within different national regimes and localities could vary a great deal. Moreover, applying the results to the implementation of other technologies would need additional consideration, even though the final disposal of nuclear waste can be considered an archetype of a LULU (see Chapters 1.1.1 and 1.1.2), contested infrastructure or hazardous facility, etc. (see Chapter 6.3.1) it entails rather distinctive concerns. On the other hand, the applicability of the results to different technologies and environments is, however, enhanced by emphasis on the local viewpoint, i.e. understanding local communities' ways of giving meaning to possible consequences, positive and negative. Ultimately those well-being issues which are considered essential, at any given time, arise from local considerations relating to the local environment and technology at hand.

All in all, rather than treating the results as practical guidelines for an actual siting process, I would like to propose that they should be seen as part of the larger discussions, suggesting that certain things should be paid careful attention; One promising way of interpreting both where to look for the reason for less opposing attitudes towards final disposal in nuclear communities and, in a wider sense, "What is it that's going on here?" (see Chapters 2.3 and 3.1).

This trail of thought would bring the focus of discussions more towards community well-being and also sustainability as an extension of this (guarding long-term well-being) (see Magee, Scerri & James 2012, 245,254). There are, of course, already some indications of this type of thinking, in various discussions linked to the relationship between technology and society, as demonstrated earlier (Chapter 6.3.1).

Understanding the dynamics of public and local acceptance represents challenge for both social sciences and governance. Addressing social acceptability through participation has increased in popularity (Chapters 4.3.1 and 4.3.2), but it has been noted that there are also traditional top-down and centralist practices and rationales existing alongside, and mixed with newer more egalitarian governance model (Bergmans et al. 2008, 27). Additionally, when there are problems, there has been a tendency to fall back on traditional, centralised interventions (cf. Cotton 2017, 48). In light of the results, it seems prudent to ground implementation in the context to which it is applied and what it means to an affected community in order to arrive at better and more legitimate decisions (cf. Cotton 2017, 136,230). For example, Bergmans et al. (2015, 350, see also Kojo & Richardson 2019) refer to stakeholder engagement not only as an opportunity to participate, but also as having a say on the issues which are deliberated upon – which, according to the results of the study, should include issues locally associated with community well-being.

Of course, the proposed well-being framing should be explored and tested both on itself and as part of certain other approaches. Clearly, more research is needed to verify this finding, and to assess whether it can be extended to other circumstances and other types of facilities. Obviously, the use of mixed or qualitative methods would also offer more insights into local residents' thoughts on well-being. While quantitative research designs are frequently used to examine residents' perceptions and can be used to research and test local acceptance determinants, there are definite limits to the ability of quantitative surveys to capture the subjective experiences of the local inhabitants, e.g. with theme interviews it would be possible to form a more detailed picture of local residents' thoughts regarding the community relationships, the salience of well-being issues and of the weight consciously attached to them in forming an opinion on the acceptability of the project. Longitudinal research could be used to assess to what extent the relevance of well-being issues varies over time, at different stages of the project, and comparisons to other more and less similar cases could be used to assess to what extent the results are generalizable. There are, however, already some indications that community well-being concerns relate to acceptance in other regimes (e.g. NWMO 2009, Laes, Schröder & Meskens 2009, Sjöberg & Drottz-Sjöberg 2001) and the implementation of other technologies (e.g. Boutilier, Robert 2017, Gross 2007, Leonard, McCrea & Walton 2016). Regarding other approaches well-being could be perceived as essential part of sustainability, SLO and additional value approaches have already been mentioned, likewise the possibility of including well-being considerations as part of compensation deliberations. Research on the usefulness of SLO frameworks in

the nuclear waste management sector was started under the Finnish Research Programme on Nuclear Waste Management in 2018. If the research proceeds to the empirical stage the inclusion of well-being considerations is included in the plans.

In addition to the abovementioned issues, I consider that governance and business ethics and democracy and public engagement in general are areas which could benefit from research looking further into community well-being issues. However, as far as further research topics are concerned, mapping factors from several approaches related to technology implementation, including well-being, to form a model of how attitudes towards contested projects are formed in the Finnish context, is perhaps the most interesting to me, as I see there a great opportunity to create some tangible utility for society in my immediate vicinity.

## SUMMARY

First of its kind: Eurajoki as a nuclear community and site for the final disposal of spent nuclear fuel.

The dissertation examines Eurajoki as a nuclear community pioneering in nuclear waste management. Eurajoki in Finland is the first municipality in the world where the siting of a final disposal facility for spent nuclear fuel (SNF) was concluded with the appropriate public and community acceptance.

Securing final disposal for SNF (and other civilian high-level nuclear waste) has constituted a long-standing problem for the international nuclear waste management community, culminating in inability to gain social acceptance and local approval. Therefore, the subsequent granting of the construction licence in Finland, after the successful siting, has been characterized as "a milestone of global importance".

The interest in Eurajoki stems from the uniqueness of the situation – Eurajoki literally being 'the first of its kind'. On the other hand, as a nuclear community, Eurajoki could also be considered a prime example of the marked tendency of nuclear communities to be more willing, or less opposed, to consider accepting final disposal facilities.

While identifying the reasons for this and a successful method for securing willing hosts for final disposal facilities for SNF has been a long-term mission of the international nuclear waste management community, understanding the dynamics of public and local acceptance – not only related to these types of facilities but also to the implementation of other technologies and the siting of other kinds of locally unwanted land uses – also pose a challenge from the viewpoint of both governance and social sciences.

The aim of the study is three-fold: 1) To form a picture of Eurajoki as a nuclear community and to examine the rationality of community acceptance in light of a resident survey. This is done by briefly recounting how Eurajoki became a nuclear community and site for the final disposal and exploring residents' opinions and their relation to certain theories from risk research, science and technology studies and environmental sociology. 2) To scrutinise the workings of the competing nuclear oasis and industry awareness frames by analysing them as the conceptual frameworks through which to interpret nuclear communities and by applying the competing viewpoints to the results of the survey. 3) To draw conclusions on the viability of these two frames based on the findings and reflect on the way forward given the evidence gathered in the course of the study.

The study explores the two framings and notes that their widely differing approaches are largely attributable to different stances towards modernization. Where the nuclear oasis frame, in effect, turns its back on 'advanced modernity' as a defining factor, leaning heavily on patterns of power related to economic and employment considerations and traditional integrating institutions persisting in nuclear communities, the industry awareness frame embraces the

post/late modern condition focusing heavily on the socio-cultural and symbolic dimensions of siting; culture, symbols and connotations.

The results, however, indicate that both concentrating strictly on economic necessities and dependency or, on the other hand, on cultural integration and cultural capacity is clearly insufficient and that inhabitants' acceptance culminates in more encompassing considerations related to community well-being rather than narrower perspectives pertinent to the competing framings scrutinised. Both the relationship between implementer and community and the perceived contribution of the project to the well-being of the community are highlighted.

The study suggests that the implementer needs to "earn" its place in the community and, rather than merely providing economic benefits, the final disposal project should fit into the local views regarding what is fitting and beneficial to the community, or indeed the area in general. While Eurajoki is not exactly a model example of partnering between industry and community, it is clear that the local nuclear waste management company made determined efforts to affiliate itself with the local community and, on the other hand, to tie the final disposal facility project to the "continuum of the good" in the area, while also creating some added value for the community.

The dissertation opens up final disposal as a social issue and affords a better understanding of one of the fundamental conditions for final disposal, namely local acceptance. This enables better informed evaluations of existing policies, strategies and practices (including governance and ethical aspects related to participation) and these can be revised if needed. While the results can, in a very straightforward manner, be seen as practical guidelines for the actual siting process of an SNF final disposal facility and creating long-term relationships with the community, the dissertation suggests that these should be seen as part of the wider discussions concerning the siting of various types of facilities and implementing different technologies, risks and uncertainty as well as participation, governance, ethics, compensating and mitigating adverse effects – and proposes that community well-being, combining a wide range of issues considered relevant from the local perspective should be considered as a promising way of framing various issues related to local acceptance.

## YHTEENVETO (FINNISH SUMMARY)

Ensimmäinen laatuaan: Eurajoki ydinteollisuuspaikkakuntana ja käytetyn ydinpolttoaineen loppusijoituspaikkana.

Tässä väitöskirjassa tarkastellaan Eurajokea ydinteollisuuspaikkakuntana (nuclear community) ja käytetyn ydinpolttoaineen loppusijoituksen suunnannäyttäjänä. Eurajoki Suomessa on ensimmäinen kunta maailmassa, missä käytetyn ydinpolttoaineen loppusijoituslaitoksen sijoitus on saatu vietyä läpi asianmukaisen julkisen ja paikkakunnan paikanvalinnalle antaman hyväksynnän kera.

Käytetyn ydinpolttoaineen (ja muiden korkea-aktiivisten ydinjätteiden) loppusijoituksen varmistaminen on ollut pitkäaikainen ongelma kansainväliselle ydinjätehuoltoyhteisölle, kulminoituen ylitsepääsemättömiin vaikeuksiin sosiaalisen hyväksyttävyyden ja paikallisen hyväksynnän hankkimisessa. Niinpä onnistunutta paikanvalintaa myöhemmin seurannutta rakennusluvan myöntämistä Suomessa onkin kuvattu "maailmanlaajuisesti merkittäväksi virsanpylvääksi".

Kiinnostus Eurajokea kohtaan nousee tilanteen ainutlaatuisuudesta – Eurajoen ollessa kirjaimellisesti "ensimmäinen laatuaan". Toisaalta ydinteollisuuspaikkakuntana Eurajokea voidaan pitää myös ensisijaisena esimerkkinä ydinteollisuuspaikkakuntien havaitusta taipumuksesta olla valmiimpia, tai vähemmän vastahakoisia, harkitsemaan loppusijoituslaitoksia.

Vaikka menestyksekkään menetelmän löytäminen halukkaiden isäntien varmistamiseksi käytetyn ydinpolttoaineen loppusijoitukselle on ollut kansainvälisen ydinjätehuoltoyhteisön pitkäaikainen missio, julkisen ja paikallisen hyväksynnän dynamiikan ymmärtäminen – ei vain tämän tyyppisiin laitoksiin liittyen, vaan myös muiden teknologioiden implementointiin ja muunlaiseen paikallisesti ei-toivottuun maankäyttöön liittyen – on haaste myös sekä hallinnon että yhteiskuntatieteiden näkökulmasta.

Tutkimuksen tavoite on kolmiosainen: 1) Muodostaa kuva Eurajoesta ydinteollisuuspaikkakuntana ja tarkastella paikallisen hyväksynnän rationaliteettia asukaskyselyn valossa. Tämä tapahtuu esittelemällä lyhyesti kuinka Eurajoesta tuli ydinteollisuuspaikkakunta ja loppusijoituspaikka, sekä tutkimalla asukkaiden mielipiteitä ja kuinka ne suhteutuvat tiettyihin riskitutkimuksen, tieteen ja teknologian tutkimuksen ja ympäristösosiologian teorioihin. 2) Arvioida, kuinka kilpailevat teollisuustietoisuuskehys (industry awareness frame) ja ydinkeidaskehys (nuclear oasis frame) toimivat. Tämä tapahtuu analysoimalla niitä käsitteellisinä viitekehyksinä ydinpaikkakuntien tulkitsemiseksi ja sovitamalla kilpailevia näkökulmia tutkimuksen tuloksiin. 3) Tehdä johtopäätöksiä kahden edellä mainitun kehyksen käyttökelpoisuudesta saatujen tulosten perusteella sekä pohtia jatkonäkymiä tutkimuksen aikana kerättyyn todistusaineistoon tukeutuen.

Tutkimuksen kehyksiä koskevassa tarkastelussa todetaan, että niiden toisistaan eriytyneet lähestymistavat juontavat juurensa varsin pitkälti erilaisesta suhteesta modernisaatioon. Siinä missä ydinkeidaskehys käytännössä kääntää

selkänsä 'pitkälle edenneelle modernisaatiolle' (Advanced Modernity) määrävänä tekijänä tukeutuen vahvasti talous- ja työllisyysnäkökohtiin liittyviin valtasuhteisiin ja ydinteollisuuspaikkakunnilla säilyneisiin perinteisiin integroiviin instituutioihin, teollisuustietoisuuskehys puolestaan ottaa jälki-/myöhäismodernin tilan (post/late modern condition) täysimittaisesti omakseen keskittyen voimakkaasti loppusijoituksen sosiokulttuuriseen ja symboliseen ulottuvuuteen, kulttuuriin, symboleihin ja konnotaatioihin.

Tulokset kuitenkin osoittavat, että keskittyminen tiukasti ekonomisiin tarpeisiin ja riippuvaisuuteen tai toisaalta kulttuuriseen integraatioon ja kulttuuriseen kapasiteettiin ei riitä, ja että asukkaiden hyväksyntä kulminoituu paikkakunnan hyvinvointiin laajemmin kuin tarkasteltujen keskenään kilpailevien kehysten rajatummasta näkökulmasta näyttää. Sekä hankkeen toteuttajan ja paikkakunnan välinen suhde että projektin panos paikkakunnan hyvinvoinnille, paikkakunnan omasta näkökulmasta, korostuu.

Tutkimus tuo esille, että hankkeen toteuttajan on "ansaittava" paikkansa yhteisössä ja pelkän taloudellisen hyödyn sijaan loppusijoitushankkeen tulisi sopia paikallisiin näkemyksiin siitä mikä on sopivaa ja hyödyllistä paikkakunnan kannalta, tai alueelle yleensä. Vaikka Eurajoki ei tarkkaan ottaen ole malliesimerkki teollisuuden ja paikkakuntien välisten kumppanuuksien solmimisesta (partnering), on selvää, että paikallinen ydinjätehuolto-yhtiö on tehnyt määrätietoista työtä linkittääkseen itsensä paikallisyhteisöön ja toisaalta liittääkseen loppusijoituslaitoshankkeen osaksi "hyvinvoinnin jatkumoa" alueella, luoden samalla myös jossain määrin lisäarvoa paikkakunnalle.

Väitöskirja avaa loppusijoitusta yhteiskunnallisena kysymyksenä mahdollistaen yhden loppusijoituksen perustavaa laatua olevan edellytyksen, eli paikallisen hyväksynnän, paremman ymmärtämisen. Tämä tarkoittaa, että olemassa olevia linjauksia, strategioita ja käytäntöjä voidaan arvioida paremmalta pohjalta (hallintaan (governance) ja osallistumiseen (participation) liittyvät kysymykset mukaan lukien) ja korjata mikäli tarpeellista. Vaikka tulokset voidaan nähdä, hyvin suoraviivaisesti tulkittuna, praktisina suuntaviivoina varsinaiselle käytetyn ydinpolttoaineen loppusijoituslaitoksen paikanhankintaprosessille ja pitkäaikaisten suhteiden luonnille sijoituspaikkakunnan kanssa, väitöksessä ehdotetaan, että niitä tulisi tarkastella osana laajempaa keskustelua koskien useiden erityyppisten laitosten sijoittamista ja erilaisten teknologioiden toteutusta, riskejä ja epävarmuutta sekä osallistumista, hallintaa, etiikkaa ja haitallisten vaikutusten lievittämistä ja korvaamista – ja esitetään paikkakunnan hyvinvointia, jossa yhdistyy laaja kirjo paikallisesta näkökulmasta merkittävänä pidettyjä kysymyksiä, lupaavaksi tavaksi kehystää erilaisia paikalliseen hyväksyntään liittyviä kysymyksiä.



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## ACCOUNT OF QUESTIONS IN THE 2008 SEURA QUESTIONNAIRE

### Questions related to final disposal:

1) How easy or difficult in your opinion it is to estimate the effects of the final disposal as a whole, apart from other nuclear related activities?

- Answers on five-step scale from very difficult to very easy.

2) Information of the final disposal can be obtained different ways. To what extent do you consult different sources of information to obtain this knowledge?

Newspapers

Television

Radio

Internet

Scientific publications

TVO News leaflet

Posiva Investigates leaflet

Public meetings, dialogue events

Information through work or education

Information through organizations and associations

Information through friends, co-workers, relatives etc.

- Answers on five-step scale from I do not consult at all to I consult actively.

3) Your internet usage in matters related to the final disposal project?

I visit pages of the authorities

I visit pages of the municipality of Eurajoki

I visit pages of the industry

I visit pages of research organizations

I visit pages offering alternative views

I participate in exchange of opinions or information

I participate in campaigns or political activities/associations

- Answers on six-step scale from not at all to several times in a week.

4) What kind of information needs do you have regarding final disposal related issues?

Safety of final disposal in general

Safety of transport

Safety of encapsulation

Safety after closure

Health effects

Environmental effects

Economic impacts

Effects on everyday life

Image impact

Repository's possible expansion

Decision-making at municipal level

Decision-making at national level

Decision-making at EU level

- Answers on five-step scale from no need for information to very great need for information.

5) How satisfied or dissatisfied are you regarding quantity of and confidence in information disseminated by different parties concerning final disposal?

Satisfaction regarding quantity / Satisfaction regarding confidence

TVO and Fortum

Posiva

Ministry of Trade and Industry/Economic Affairs and Employment

Other ministries

Radiation and Nuclear Safety Authority (STUK)

Local authorities

Political parties

Research institutes

Universities

NGOs

- Answers on five-step scale from highly dissatisfied to highly satisfied.

6) How constructing the final disposal facility in the area in your opinion affects the following issues?"

Own image of the area

Own image of Eurajoki in particular

Own expectations for the future in the area

Own satisfaction with the area as a place to live

Outsiders' image of the area

Functioning environment / atmosphere in the area

State of nature surrounding the final disposal facility

Development of the area generally

Demographic development in the area

Employment in the area

Economic development in the area

Availability of services in the area

Tourism in the area

Culture in the area

Development of education sector in the area

Farming and forestry in the area

Rural non-farm livelihoods in the area (fishing, hunting etc.)

Recreational opportunities in the area  
 City/municipality organization in the area  
 Traffic connections in the area

- Answers on five-step scale from negatively to positively.

7) Do you perceive the final disposal facility to cause a threat to any of these?

General safety  
 Own or family's safety  
 Safety of future generations  
 General health  
 Own or family's health  
 Health of future generations  
 General well-being  
 Own or family's well-being  
 Well-being of future generations

- Answering options: I do not, slight, explicit, high, hard to say.

8) In following is presented a number of opinions/statements of which we want to know your opinion

Nuclear waste constitutes a constant threat to the life of future generations.

The economic benefits of the final disposal of nuclear waste will not compensate the non-economic costs.

Neighbouring municipalities of Eurajoki should benefit economically from final disposal if it causes them drawbacks.

Nuclear waste produced by TVO and Fortum should be disposed of in Finland.

Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto.

I accept expansion of the repository for the needs of TVO and Fortum.

I accept expansion of the repository also for the needs of other Finnish actors.

I accept expansion of the repository for the purpose of importing SNF from abroad.

In my opinion I have enough information regarding the plan for final disposal.

I trust Posiva regarding the risk assessment of the final disposal project.

I trust the authorities regarding the risk assessment of the final disposal project.

Nuclear waste can be safely disposed of in Finnish bedrock.

Benefits of final disposal of nuclear waste will exceed the costs.

The Municipality of Eurajoki has a moral responsibility to approve the disposal of SNF as it has approved the location of NPPs in its area.

More nuclear power should be constructed in Finland.

The fourth NPP unit should be constructed in Olkiluoto.

- Answers on five-step scale from totally agree to totally disagree.

### **Background questions:**

9) Your gender?



- 10) Do you have under-age children?
- 11) Your birth year?
- 12) Your relationship status?
- 13) Municipality of residence?
- 14) Your residency's approximate distance from Olkiluoto?
- 15) Your level of education?
- 16) Your type of education?
- 17) Your socio-economic group
- 18) Your line of work?
- 19) What party would you vote if parliamentary elections would be held now?
- 20) Your annual personal income before taxes?

## LIST OF ORIGINAL PUBLICATIONS

### Publication I:

Kojo, M., Kari, M. & Litmanen, T. 2010. The socio-economic and communication challenges of spent nuclear fuel management in Finland: The post site selection phase of the repository project in Eurajoki. *Progress in Nuclear Energy*, 52(2), 168–176. (Short introduction available in Chapter 1.3.2.)

At each step of the writing process all the authors made significant contributions to the manuscript. However, in spite of the very close collaboration, certain aspects of the work can be attributed to certain authors.

In this article Kojo and Litmanen were in charge of outlining the Finnish nuclear waste policy and Kari regarding the survey and statistical analysis. Each of the writers was in charge of assessing one part of the findings and the conclusions were drawn together. Statistical analysis of the data was conducted by Kari.

### Publication II:

Litmanen T., Kojo M. & Kari M. 2010. The rationality of acceptance in a nuclear community: analysing residents' opinions on the expansion of the SNF repository in the municipality of Eurajoki, Finland. *International Journal of Nuclear Governance, Economy and Ecology*, 3(1), 42–58. (Short introduction available in Chapter 1.3.2.)

At each step of the writing process all the authors made significant contributions to the manuscript. However, in spite of the very close collaboration, certain aspects of the work can be attributed to certain authors.

In this article Litmanen was in charge of the introduction and developing the basic design of the study. Kari and Kojo worked on combining the concept of nuclear community with the idea of the rationality of public opinion, in contrast to allegations of public irrationality. The findings were assessed together. Statistical analysis of the data was conducted by Kari.

This article has also been used in Matti Kojo's (2014a) doctoral dissertation in political science presented to the University of Tampere.

### Publication III:

Kojo M. & Kari M. 2010. Pride-effect in a nuclear community. Local perceptions regarding spent nuclear fuel repository in the municipality of Eurajoki, Finland. In *WM2010 Improving the Future by Dealing with the Past, Final Proceedings*, paper no 10192. (Short introduction available in Chapter 1.3.3.)

At each step of the writing process, both authors made significant contributions to the manuscript. However, in spite of the very close collaboration, certain aspects of the work can be attributed to certain authors.

In this paper Kojo's interest in community benefits in the new phase of nuclear waste management in Finland was combined with Kari's interest in the

nuclear oasis and industry awareness approaches to nuclear communities. Statistical analysis of the data was conducted by Kari.

#### **Publication IV:**

Kari, M., Kojo, M. & Litmanen, T. 2010. *Community Divided. Adaptation and Aversion towards the Spent Nuclear Fuel Repository in Eurajoki and its Neighbouring Municipalities*. Jyväskylä: University of Jyväskylä; University of Tampere. (Short introduction available in Chapter 1.3.4.)

At each step of the writing process all the authors made significant contributions to the manuscript. However, in spite of the very close collaboration, certain aspects of the work can be attributed to certain authors.

In this report Kojo and Litmanen were in charge of the part introducing the Finnish nuclear waste policy and Kari regarding the survey and statistical analysis. Kari was also in charge of the analysis of the survey and provided abridged version of the conference paper analysing, Eurajoki as a nuclear community, included in the report. (An abridged version of **Publication II** was also included in the report.) Conclusions were drawn together. Statistical analysis of the data was conducted by Kari.

#### **Publication V:**

Kojo, M., Kari, M. & Litmanen, T. 2012. Nuclear community considering threats and benefits of final disposal. Local opinions regarding the spent nuclear fuel repository in Finland. *International Journal of Environmental Technology and Management*, 15(2), 124-145. (Short introduction available in Chapter 1.3.4.)

At each step of the writing process all the authors made significant contributions to the manuscript. However, in spite of the very close collaboration, certain aspects of the work can be attributed to certain authors.

In this article Kojo examined changes in local attitudes over time, opinions regarding the benefits and trust in relation to acceptance. Additionally he opened up nuclear community as a concept with the help of Kari. Kari conceptualised the article's nuclear oasis and industry awareness centred approach and raised the notion of community well-being as an important factor in local acceptance. Litmanen concentrated mainly on examining risk and safety issues in relation to acceptance. Statistical analysis of the data was conducted by Kari.

This article has also been used in Matti Kojo's (2014a) doctoral dissertation in political science presented to the University of Tampere.



## **ORIGINAL PAPERS**

### **I**

# **THE SOCIO-ECONOMIC AND COMMUNICATION CHALLENGES OF SPENT NUCLEAR FUEL MANAGEMENT IN FINLAND: THE POST SITE SELECTION PHASE OF THE REPOSITORY PROJECT IN EURAJOKI**

by

Matti Kojo, Mika Kari & Tapio Litmanen 2010

Progress in Nuclear Energy vol 52(2), 168–176

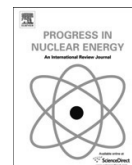
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# The socio-economic and communication challenges of spent nuclear fuel management in Finland The post site selection phase of the repository project in Eurajoki

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### A B S T R A C T

#### Keywords:

Nuclear waste management  
Repository project  
Perception of local impacts  
Communication challenges  
Finland

One of the key factors behind the expansion of nuclear energy policy in Finland is nuclear waste management. As in many countries, nuclear waste management agencies are still struggling with the siting of intermediate and low level nuclear waste management facilities, in Finland Posiva, the nuclear waste company owned by the two nuclear power utilities Teollisuuden Voima (TVO) and Fortum Power and Heat (FPH), has been excavating a underground characterization facility since 2004 in the Olkiluoto site in the municipality of Eurajoki. The facility under construction is meant to be for a part of the final repository for disposal of spent nuclear fuel (SNF).

The site selection process of the repository was launched in Finland in the early 1980s. The site selection process included different measures to inform and involve local citizens. For example, an Environmental Impact Assessment process was implemented by the nuclear waste company in the late 1990s. The siting process, which proceeded step by step, was successful as in January 2000 the local council of the municipality of Eurajoki approved the siting of the repository by 20 votes to 7. The Council of State made a favourable decision-in-principle (DiP) in December 2000 and Parliament ratified the decision in May 2001. Posiva has also applied for a decision-in-principle to extend the facility.

The aim of the paper is to introduce the first observations of the survey focused on local inhabitants. The paper addresses such questions as: What are the main impacts of the repository according to local residents? How can they obtain information about the repository? Which actors are seen as reliable sources of information regarding the final disposal of spent nuclear fuel? The survey was carried out in June 2008. The respondents ( $N = 3000$ ) were selected from the residents of the municipality of Eurajoki and the neighbouring municipalities using stratified random sampling.

The information provided by the survey is important as the municipality of Eurajoki is the very first municipality in the world where the views of local residents on the construction of a repository for the final disposal of spent nuclear fuel could be elicited after the decision of the site selection. The post site selection phase the municipality of Eurajoki is currently experiencing can provide information useful for other countries likely to face this phase in the future.

The paper is a part of the co-operation research project of the University of Jyväskylä and the University of Tampere. The research project "Follow-up research regarding socio-economic effects and communication of final disposal facility of spent nuclear fuel in Eurajoki and its neighbouring municipalities" is funded by the Finnish Research Programme on Nuclear Waste Management (KYT2010).

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## 1. Introduction

The aim of the article is to introduce the first results of a survey focused on local inhabitants in the municipality of Eurajoki and its

neighbouring municipalities.<sup>1</sup> The survey was carried out as a part of the research project SEURA (in English "Follow-up research on the socio-economic effects and communication about a final disposal facility for spent nuclear fuel in Eurajoki and its

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<sup>1</sup> The article is based on a presentation at the Conference "Energy Challenges in Northern Europe", 27–29 November 2008, Turku, Finland.

neighbouring municipalities"). The research project is being implemented in co-operation between the University of Jyväskylä, Department of Social Sciences and Philosophy, and the University of Tampere, Department of Political Science and International Relations. The project is funded by the Finnish Research Programme on Nuclear Waste Management (KYT2010, [www.ydinjatetutkimus.fi](http://www.ydinjatetutkimus.fi)).

According to the decision-in-principle of 2000 by the Council of State (VN, 2000, 8), Posiva has to update the Environmental Impact Assessment before submitting its application for a construction licence for the spent nuclear fuel repository. As environmental impacts are understood in a broad sense in Finland, meaning that social impacts are a part of the assessment process, there is a need to identify the most important impacts from the perspective of the local residents. One challenge, which has already been noted in Eurajoki (Kiljunen, 2007), is that survey results regarding attitudes towards nuclear waste show an increase in reservations rather than in confidence.

This paper is concerned with the post site selection phase. So far various countries have focused on the site selection phase, as the siting process has caused many problems. In Finland, however nuclear waste management is going through a new phase, which we call the post site selection phase. This new phase pays attention to the attitudes of the local residents of a selected municipality after the political decision on the repository site. In Finland the local council of the municipality of Eurajoki approved the application of the waste management company Posiva in January 2000. Thus the municipal council decided not to use its veto right granted in the Finnish Nuclear Energy Act. Posiva has been excavating an underground characterization facility, Onkalo, since 2004 on the Olkiluoto site. According to the time schedule, Posiva is to submit a preliminary application for a construction licence in 2009. By 2012 the company should submit the final application for a construction permit.

This post site selection phase itself can also be separated into different phases. According to Posiva, the phases are 1. construction of Onkalo, complementary characterization and planning, 2. construction and commissioning of the repository, 3. encapsulation and final disposal (Loviisa 1-2, Olkiluoto 1-2 and Olkiluoto-3) and 4. decommissioning and sealing of the final disposal facility. The time scale for these different post site selection phases ranges from the 2012 to decades around 2130. The sealing of Onkalo is scheduled to take place well over 100 years after the governmental construction permission. From that time onwards starts a completely new phase, which will last for thousands and tens of thousands of years. Finnish society's long-term stewardship of sealed nuclear waste facility also raises serious issues for the residents of Eurajoki and its neighbouring municipalities.

In recent years, there has been increasing interest in the issue of long-term stewardship. In general it refers to the set of activities that need to be undertaken at contaminated sites, including sites used for the disposal of hazardous wastes, after site remediation or cleanup has been implemented. This long commitment to nuclear waste repository requires long-term stewardship activities, to be accomplished at the site. Generally speaking, stewardship includes the physical and engineering controls, institutions, legal and scientific information, management practices and other mechanisms needed to protect people and the environment. In the literature this set of activities is also sometimes referred to as post-construction activities, because they take place after the remedy has been constructed. The core elements of stewardship include the following: site monitoring and maintenance, application and enforcement of legal or other mechanisms (often referred to as institutional controls) to restrict land and water use, information management, environmental monitoring, and emergency responses and financing when remedies or controls fail. (Bauer and Probst, 2000).

As the Finnish nuclear waste management is approaching the construction phase one aim of the survey was to find out how the local residents perceived the ongoing new phase. Thus the paper elicits the main impacts of the repository according to local residents. How do they obtain information about the repository? Which actors are deemed reliable sources of information regarding the final disposal of spent nuclear fuel? How do inhabitants perceive the threat of nuclear waste facility today and in the future?

The structure of the paper is as follows. In the second section we will briefly introduce the nuclear power programme in Finland and the milestones of Finnish nuclear waste policy. The third section concerns the site selection process in Finland. The following Sections 4–7 deal with the results of the survey. Basic information on the survey will be presented. In the last section eight some preliminary conclusions are drawn. Matti Kojo is the author of Sections 1–3 and 5, Mika Kari Sections 4 and 6 and Tapio Litmanen Sections 1 and 7. Section 8 is written together.

## 2. Milestones of nuclear waste policy in Finland

### 2.1. The nuclear power programme and the status quo in Finland

The nuclear power programme in Finland consists of four nuclear power plant (NPP) units. NPPs are located at two sites, in Loviisa some 100 kilometres east of the capital, Helsinki, and in Eurajoki, some 240 kilometres northwest of Helsinki (Fig. 1). All four reactors have been upgraded and their operating licences have been extended. In 2006 the four NPP units produced 22 TWh<sub>e</sub>,

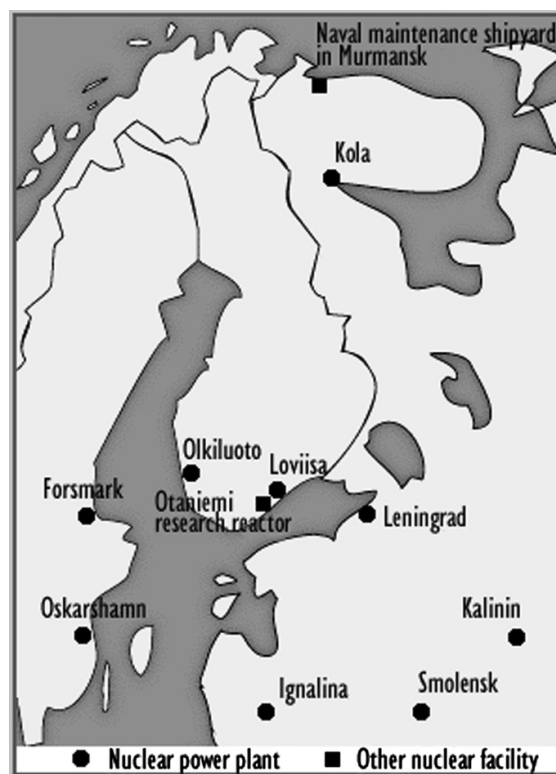


Fig. 1. Nuclear power plants and other reactors in Finland and nearby (STUK, 2006). "Leningrad" in the picture refers to Sosnovyi Bor NPP.

which was 28 percent of electricity production in Finland, making nuclear power the largest source of electricity nationally. Until 2006 the four reactors had generated 1700 tU of spent fuel. In 1981–1996 spent nuclear fuel generated in the Loviisa NPP was shipped to the Soviet Union and Russia. The return was based on the agreement signed between the Governments of Finland and the Soviet Union in 1969 regarding the use of nuclear energy in peacetime. The rest of the spent nuclear fuel is stored at the reactor sites in Loviisa and in Eurajoki (Olkiluoto). The four units produce 35 tU of spent fuel annually.

In May 2002 Parliament ratified the DiP application of TVO regarding a new 1600 MW European Pressurized Reactor. This new NPP unit is under construction in Olkiluoto, but it is over 36 months behind schedule. The nuclear power utilities TVO and FPH have already announced their plans to construct new NPP units. TVO submitted a DiP application in April 2008 and FPH in February 2009. Also a brand new company, Fennovoima Oy, submitted an application in January 2009. The new company, partly owned by E.ON, has three site alternatives in the municipalities of Pyhäjoki, Ruotsinpyhtää and Simo.

Thus there is competition between the power companies for a favourable decision-in-principle regarding the new NPP unit. The government is likely to make the decision some time in 2010. However, the leading ministers have differing views on the number of new NPP units needed. The ministers of the Centre Party of Finland, for example Prime Minister Matti Vanhanen, seem to be ready to accept one unit, whereas the National Coalition Party is demanding licences for several new units. The Green League, which is the second minor party in the government, is strongly opposed to the expansion of nuclear power. In the government's new long-term climate and energy strategy for Finland, approved in November 2008, nuclear option is left open by stating that the additional construction of nuclear energy generation would be necessary in the next few years, i.e. during the current government term.

The nuclear management company Posiva submitted a DiP application for extending the repository at the same time as its main shareholder TVO in April 2008. Posiva's application covers the disposal capacity of a maximum of 9000 tU. Furthermore, Posiva implemented an Environmental Impact Assessment (EIA) process for the further extension of the repository in 2008 because of the NPP application of FPH. A new DiP application was submitted by Posiva in March 2009. The aim is to extend the capacity of the repository to a maximum of 12,000 tU. However, Posiva has declared that the company will only take care of spent nuclear fuel produced by its owners, that is TVO and FPH. Thus Posiva rejects the idea of disposing of spent fuel produced by Fennovoima. Fennovoima has based its NPP plan on joint nuclear waste management with Posiva, but the competing companies have not even been able to start negotiations on the issue. Posiva has even gone so far as to deny the very existence of national nuclear waste management (Satakunnan Kansa, 12 Aug 2008).

According to the Nuclear Energy Act, nuclear waste producers, the utilities, are responsible for management and all costs of nuclear waste management. The Finnish Radiation and Nuclear Safety Authority, Säteilyturvakeskus (STUK), is responsible for safety aspects. According to the Nuclear Energy Act the Government shall ascertain that the municipality where the nuclear facility is planned to be located is in favour of the facility and that no facts indicating a lack of sufficient prerequisites for constructing a nuclear facility have arisen. Thus the local council of a proposed site of a nuclear facility is vested with the right of veto. Also a preliminary safety assessment from STUK is required. The Ministry of Employment and the Economy (until 31 December 2007 the Ministry of Trade and Industry) prepares the policy decisions regarding the nuclear waste management.

## 2.2. Finnish nuclear waste policy in brief

The four NPP units in operation were built in the 1970s. In 1978 the Atomic Energy Act, dating from 1957, was amended to take into account nuclear waste management. According to the amendments the licence holder (IVO and TVO) of a NPP unit assumes responsibility for all measures and costs relating to nuclear waste management. Under the Atomic Energy Act, detailed regulations were incorporated into the licences issued to NPP units (Posiva, 1999a, 3).

Spent nuclear waste policy for waste generated in Loviisa NPP was based on returning the fuel to the Soviet Union, as mentioned in 2.1 above. TVO negotiated for a reprocessing contract with the British company British Nuclear Fuels and the French company COGEMA. The board of TVO abandoned reprocessing plans in the early 1980s for purely financial reasons. The economical viability of reprocessing was assessed in 1990, but neither circumstances nor the costs had changed significantly (Posiva 1999a, 12–13). In February 2008 TVO argued on economic aspects as the company rejected the vision of reprocessing as a part of Finnish nuclear waste management in forthcoming decades (Satakunnan Kansa, 20 Feb 2008). The vision was stated by Jukka Laaksonen, the Head of the Radiation and Nuclear Safety Authority, in an interview (Loviisan Sanomat, 15 Feb 2008). Thus the possible revival of nuclear power programmes in Europe and elsewhere and rising uranium prices might pose new challenges for Finnish nuclear waste policy.

Although the utilities have each had their own nuclear waste policies since the early days of nuclear power production in Finland, there was some co-operation, too. In 1978 the companies set up the Nuclear Waste Commission of Finnish Power Companies (Ydinjäte-toimikunta, YJT) to coordinate R&D activities. Due to cooperation the first nuclear waste management programme was completed in September 1978. However, it took until 1995 before the utilities established a joint company, Posiva, for spent nuclear fuel management. The main input for closer cooperation was the amendment in 1994 to the Nuclear Energy Act of 1987. According to this amendment nuclear waste produced in Finland "shall be handled, stored and permanently disposed of in Finland" (Nuclear Energy Act 990/1987). Thus, the spent fuel policy of Loviisa NPP was changed.

In 1983 the Council of State made the decision-in-principle on the aims and schedules relating to implementation of nuclear waste management (NWM) and associated research and planning. The decision of 1983 also included the overall schedule for NWM in Finland. The Government's timetable was based on the schedule presented in the TVO programme (Raumolin, 1982, 5, 7) for the final disposal of spent fuel (Table 1).

Posiva submitted the application for the repository for spent nuclear fuel in May 1999. The amount of waste applied for was a maximum of 9000 tU. This amount covered the SNF produced in six NPP units. However, due to the TVO application of 2000 regarding the new NPP unit (OL-3 which is currently under construction) Posiva

**Table 1**  
Timetable for spent fuel final disposal.

1980–1982	Suitability study with safety analyses
1983–1985	Preparation for the preliminary site characterization
1986–1992	Preliminary site characterization in chosen areas (5–10 sites)
1993–2000	Additional siting studies (2–3 sites)
2001–2010	Detailed studies of chosen disposal site and preplanning of the siting and the encapsulation plant
2011–2020	Planning and construction of the disposal site and the encapsulation plant
2021–2050	Final disposal facility is operational
2050–2060	Closing of disposal site

Source: Raumolin (1982, 7).

changed its application in November 2000. The company asked the Council of State to decide the disposal of SNF produced in TVO's new unit, approximately 2500 tU, at the same time as TVO's reactor application. Disposal capacity was also decreased as the updated application covered only SNF produced by four NPP units in operation, approximately 4000 tU. The Council of the State made the decision-in-principle in December 2000. Parliament ratified the decision in May 2001. The favourable decision-in-principle regarding the extension was made in January 2001. The extension of the repository was approved by Parliament in May 2002 as Parliament voted for the construction of the new NPP unit.

The timetable of 1983 has so far been changed only once. In 2003 the Ministry of Trade and Industry decided that the companies must submit the final application for the construction licence by 2012 at the latest. As shown in Table 1, originally the aim was to submit the application in 2010. The change was argued for by safeguarding safety of the repository. The decision-in-principle of 2000 is valid until 2016. (Kojo, 2004, 232).

### 3. The site selection process in Finland

#### 3.1. From systematic to more flexible siting strategy

The concept of site selection strategy helps partly to understand why the siting process of a repository for spent nuclear fuel was so smooth in Finland. The formation of nuclear waste policy was described in brief in Subsection 2.2. There we explained how the policy setting changed and how the utilities started to cooperate in spent nuclear fuel management based on direct geological disposal. The reprocessing alternative was finally rejected in the mid 1990s. Section 3 focuses on explaining the chain of events by which the municipality of Eurajoki became the site of the repository. Firstly, the siting programme is analysed with the help of the concept of site selection strategy in 3.1 and secondly, the local decision-making process is introduced in 3.2.

According to Sundqvist (2002, 110) "a site selection strategy is the base from which the surrounding world is interpreted, and also identifies the tasks that have to be carried out. The strategy is used as a tool for understanding, interpreting and manipulating reality, and will therefore shape the identity of the organization as well as its view of the external world." While analysing Swedish nuclear waste policy Sundqvist has identified two different kinds of siting strategies: *systematic*, referring to a strategy based on the use of specific criteria and systematic comparisons between different regions, areas and sites, in a sequential order of distinct siting phases and *flexible*, referring to voluntariness and local acceptance by a municipality. The latter strategy is characterized by the possibility of "muddling through" without being constrained by excessively detailed requirements (Sundqvist, 2002, 125).

The site selection strategy gradually changed from systematic to more flexible in Finland in the 1980s–1990s (see Kojo, 2009, 168–174). According to Anttila (1995, 7) the elimination of potential sites was based on purely geological criteria in Finland. Thus, siting followed a classic elimination process (Richardson, 1998, 10). The site selection strategy was thus initially systematic. Litmanen (1994, 23, 139–141) and Anttila (1995), however, concluded already in the mid 1990s that the purely geological elimination process was in a state of change in Finland and that environmental and social criteria were being emphasised instead of purely geological criteria. For example, Litmanen (1994) was the first scholar to pay attention to local siting conflicts in Finland. Although the nature of the local conflicts and their feedback on the siting process were not as dramatic as in some other countries, the local conflicts did affect the site selection strategy applied. Gradually the informing and involvement activities of local residents were emphasised

(Kojo, 2005; Hokkanen, 2007) and the nuclear industry negotiated on closer partnership with the local politicians regarding the siting of a repository.

Deviation from the systematic siting strategy occurred in the early stages of the research. Litmanen (1994, 23) notes that geological criteria were applied to the selection of the areas, but that investigation sites were not chosen on strictly geological principles. Anttila (1995) makes the same comment on the site selection as Litmanen. Anttila states that in the selection of the final disposal site the importance of environmental and social factors clearly exceeded geological criteria in recent years. In the mid 1980s STUK emphasised the importance of selecting different geological environments (McEwen and Äikäs, 2000, 48), but at the end of 1990s ranking of the four candidate sites in the municipalities of Eurajoki, Kuhmo, Loviisa and Äänekoski was not required by the authorities. Posiva concluded in its DiP application that in all four areas researched it was possible "to show sufficiently large and sufficiently integrated rock capacities, where the conditions are chemically and mechanically sufficiently suitable and stable to provide a sufficient barrier to prevent the release of radioactive substances, and which are suitable for the construction of final disposal facilities" (Posiva, 1999b, App. 5, 28). Posiva (1999b, App. 5, 35) also stated that the containment capacity of the final disposal facility would be effective without the influence of the bedrock and Nature. The conclusion of the safety analysis was that "no surveyed area can be regarded as clearly safer than the others, neither does the safety analysis give any reason to discard any of the alternatives" (Posiva, 1999b, App. 5, 40). Thus, the conclusions of Posiva were in line with the recommendation of an international expert group who had proposed in 1993 that "choice of a site should not aim at finding the "best possible site", but a "suitable" site that complies with the safety criteria of a final disposal facility built in line with multi barrier principle." (Posiva, 1999b, 8.) The strategy applied called for a more sensitive approach on local level, too.

#### 3.2. Local decision-making in Eurajoki

Eurajoki in the 1970s became a nuclear community, that is, a municipality where nuclear facilities, like NPP units and waste storages, are located. Until 1993 the municipal report included a sentence forbidding the disposal of nuclear waste in Eurajoki. In the early days of TVO's nuclear power production spent nuclear fuel management was based on the plan to reprocess waste using a foreign reprocessing service. Indeed, under some pressure, TVO gave in 1980 a written undertaking not to dispose of spent nuclear fuel in Olkiluoto area. The company, however, needed to reconsider its nuclear waste policy towards the end of 1980s. As explained in Subsection 2.2 the reprocessing option was assessed to be too expensive. Later on the reprocessing option became illegal in Finland because of the 1994 amendment to the Nuclear Energy Act. Thus, TVO was in search of a site for a repository.

The siting process was already launched in the early 1980s (McEwen and Äikäs, 2000; Kojo, 2009). In 1985 TVO announced a list of 102 sites suitable for further research. Of these 101 were "a result of the systematic selection and elimination process" (Vieno et al., 1992, 22). The Olkiluoto site in Eurajoki was included in the list as an exception. According to the company's safety analysis, the site of the NPP was in a special position because of its short transport distance. The other reason given was that because of the rock block identification method, coastal areas were sparsely represented as the method used was, however, not suitable for coastal areas. (McEwen and Äikäs, 2000, 9, 46.) One screening phase took place in 1992–93. As the local opponents knew this, they tried to push the company by sharpening the forbidding sentence in the municipal report. At first the opponents were successful, but in



1994 the local council removed – after voting – the sentence and neutralized the stance of the municipality regarding the siting. In 1995 the municipality signed a cooperation agreement with TVO. One aim of TVO was to safeguard the development of nuclear waste management in Olkiluoto. The main interest of the municipality in signing was to safeguard its level of tax revenue as the taxation system was reformed in the early 1990s. The idea of compensation was also introduced in the agreement.

The cooperation between the municipality and TVO was further developed during the late 1990s. Sometime in 1996–97 TVO raised the siting issue. A series of discussions and negotiations were launched which resulted in a new municipal strategy, including the Olkiluoto vision, and signing the Vuojoki Agreement in 1999. In the Olkiluoto vision the municipality gave a positive statement on both the further construction of nuclear power and on siting the repository in Olkiluoto. In 1999–2000 the municipality negotiated a package of economic benefits with TVO and Posiva which helped the municipality to overcome the liquidity problems it faced due to the reimbursement of the real estate tax of the TVO nuclear facilities granted in 1993–94. (Kojo, 2009, 177–185). Thus, in a relatively short period, 1994–1998, the municipality of Eurajoki experienced a total change in stand regarding the siting of a repository. The negative statement was neutralized and finally a positive signal was given.

The local council of Eurajoki approved a positive statement on Posiva's DiP application in January 2000. As a precondition it was stipulated that only nuclear waste produced in Finland should be disposed of in Olkiluoto. Another precondition, not written in the statement, but stated in the compensation negotiations, was the requirement of compensation regarding the real estate tax of TVO nuclear facilities of 1994 (Kojo, 2009, 184).

#### 4. The survey

##### 4.1. Target population, sampling and the respondents

As it is the municipality of Eurajoki which was selected as the site for the repository, the main focus of our survey was naturally the residents of Eurajoki. However, the neighbouring municipalities were covered, too, as they have a role in the EIA and DiP process. Agewise it was decided that it would be best to limit interest to 16–75 year olds. The aim in dropping the lower limit a few years under 18 was to be able to some extent to compare the opinions of the young population to those of the adult population. Because the questionnaire would be implemented only in Finnish it was likewise natural to include only Finnish-speaking residents in the target population.

The survey was carried out as postal survey. The four-page questionnaire was sent to 3000 recipients on 3 June 2008. Recipients were chosen by stratified sampling conducted by Statistics Finland, which also supplied the addresses.

The reasons for using stratified sampling were purely pragmatic. Postal survey response rates tend to be low and Eurajoki is an especially heavily studied area. It made sense to be prepared for survey weariness and a very low response ratio. The aim was to ensure that there would be an adequate number of respondents from Eurajoki and decent representation from all neighbouring municipalities of Eura, Kiukainen, Lappi, Luvia, Nakkila and Rauma. As it turned out, the response ratio was quite normal for a survey research, but better be safe than sorry.

Returned questionnaires amounted to 616 which (with 3000 sent) gives us return rate of 21% and of those 616 as many as 606 qualified for analysis, which in turn means a response rate of 20%. The number of respondents from each municipality corresponded with stratified sample sizes (Tables 2 and 3).

**Table 2**  
Sample sizes.

	N	%
Eurajoki	1200	40
Other municipalities	1800	60
Eura	300	10
Kiukainen	300	10
Lappi	300	10
Luvia	300	10
Nakkila	300	10
Rauma	300	10
Total	3000	100

**Table 3**  
Respondents.

	N	%	Valid %
Eurajoki	245	40	41
Other municipalities	353	58	59
Eura	51	8	9
Kiukainen	59	10	10
Lappi	61	10	10
Luvia	55	9	9
Nakkila	60	10	10
Rauma	67	11	11
Missing	8	1	
Total	606	100	100

##### 4.2. Non-response analysis

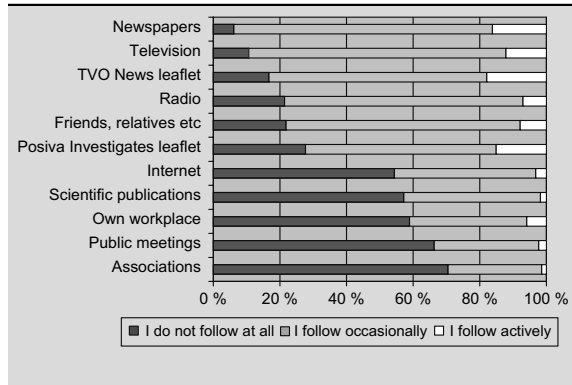
A non-response analysis was performed by comparing respondents' gender, age, relationship type, education level, education type, line of occupation, occupational status, party preference and income to information obtained from the Official Statistics of Finland, Statistics Finland and the Finnish National Board of Education. As a result, 3 biases were observed that would have to be taken into consideration in the final report. First, those who were married or in registered relationships were overrepresented by 10%, second, pensioners were overrepresented by 8% and third, respondents were better educated than inhabitants of the Satakunta region as a whole. In addition to these, it seems that those with low income were somewhat underrepresented, but this is difficult to assess because there were quite many (13%) who declined to report their income.

#### 5. Use of diverse sources of information

The one aim of the survey was to update information how local residents obtained their information on the nuclear waste disposal plan. Eleven different sources of information were listed in the survey and respondents were asked to report how actively they followed these sources. Options were from one to five in where one meant "I do not follow at all" and five "I follow actively" (Table 4).

According to the survey "TVO News" information leaflet was the most often actively used source of information on the nuclear waste disposal issue among the respondents in Eurajoki and neighbouring municipalities. Altogether 18% of respondents reported actively following the *TVO News*. By comparison, newspapers were actively followed by 16%. TVO has published the *TVO News* (before 2000 *Olkiluoto News*) four times a year since the late 1970s. The leaflet is delivered free of charge to every household in Eurajoki and all neighbouring municipalities. The "*Posiva Investigates*" information leaflet is quite actively read by local residents, with 15% of respondents actively following the Posiva leaflet. However, more than every fourth respondent (28%) did not follow Posiva's leaflet at all. One explanation for this is that the leaflet is not delivered directly to

**Table 4**  
Extent of monitoring different sources of information in Eurajoki and neighbouring municipalities to obtain information on nuclear waste disposal.



households in the municipalities of Kiukainen and Nakkila. The information leaflets of the nuclear industry seem to have gained their places as channels of information over the years. Informal social networks are also an important source of information. Almost one tenth (8%) of respondents reported that friends, workmates and relatives were an actively followed source of information in nuclear waste issues. The importance of Posiva personnel was also emphasised by Aho in her master's thesis on the building of trust in the safety of final disposal. Aho (2008) concluded that trust of the inhabitants of Eurajoki is mainly based on an image of the expertise of Posiva and its personnel, likewise their capabilities, honesty and the predictability of activity. The inhabitants assess disposal through the reputation of individuals and the company.

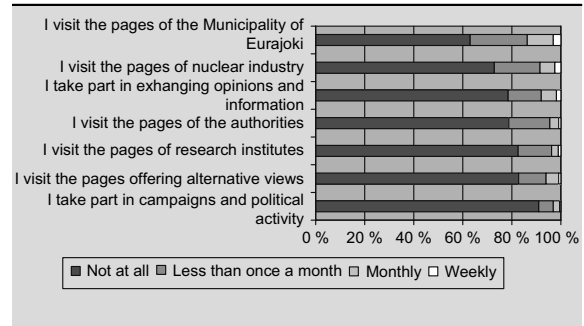
Ninety-four percent of respondents followed newspapers either actively or at least occasionally. Television is the second most commonly used source with 89%. Only 6% of respondents reported not following newspapers for information on nuclear waste disposal. Thus newspapers still cover the local population fairly well.

The survey results show well how certain sources of information are used rarely or not at all to obtain information on nuclear waste issues. The top 5 list of sources not used includes associations, public meetings, workplace, scientific publications and Internet. Of these public meetings have experienced a lack of participants since the early 1990s, when the public hearing of Perusvoima NPP application was organised in Eurajoki (Säynäsallo and Borg, 1992). The number of participants observed in the EIA meetings of Posiva in the late 1990s and in 2008 shows a declining trend (Hokkanen, 2007, 171, 179; Nurmi et al., in press). However, the public meetings certainly have their role in interaction in the future, too, as the meetings are the only arenas in which the different stakeholders can exchange views face to face.

The figures regarding the use of Internet are interesting. Internet seems to divide the respondents into those who do not use Internet at all as an information source (54%) and those who use it to some extent (46%). "Heavy users" are still quite few as only 3% of respondents reported using Internet actively as an information source. The previous survey on information acquisition was carried out in 1994, over ten years ago (Kurki, 1995). At that time Internet was not even mentioned as a possible source of information. In this survey there was a special interest in the use of Internet as one question was exclusively devoted to that issue.

The question focused on the use of Internet in the nuclear waste disposal issue and especially on how often the respondents visited certain web pages (Table 5). The response options are grouped into four categories. Originally the survey provided six options.

**Table 5**  
Frequency of certain activities and visiting certain web pages in relation to nuclear waste disposal issues.

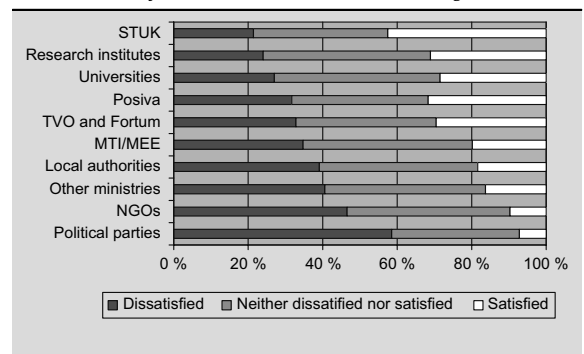


Most respondents do not use Internet at all in relation to nuclear waste disposal issues (Tables 4 and 5). Only a very small minority use Internet actively, that is weekly. Obviously such people have a certain role either in decision-making regarding nuclear waste management and/or their job is somehow related to nuclear waste management. The web pages of the municipality of Eurajoki and the nuclear industry (TVO, Fortum and Posiva) were most frequently visited of the options presented in the survey.

The respondents were also asked how satisfied or dissatisfied they were regarding their confidence in information disseminated by certain actors in nuclear waste management (Table 6).

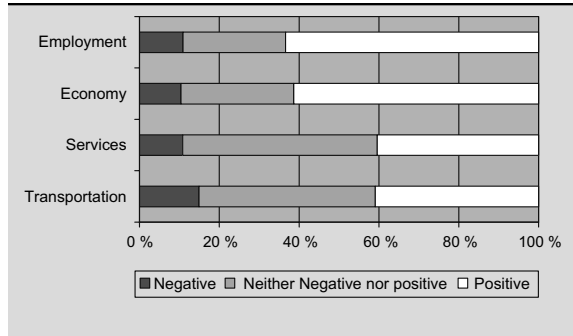
The respondents rated the Radiation and Nuclear Safety Authority (STUK) the most reliable source of information. The political parties got clearly the poorest ratings as almost 60% of respondents reported that they were dissatisfied with the political parties as source of information. Obviously the figure also reflects the low esteem for party politics in general. Although 19% of respondents were dissatisfied with STUK (4% were highly dissatisfied) STUK was on a level of its own regarding feelings of satisfaction. Interestingly, the nuclear industry (TVO, Fortum and Posiva) was slightly more highly valued than the Ministry of Employment and the Economy (until 31 Dec 2007 the Ministry of Trade and Industry). Thirteen percent were highly dissatisfied with Posiva compared to 15% highly dissatisfied with the Ministry of Employment and the Economy. When reading the figures in Table 6 one should keep in mind that depending on the actor from 34% to 45% of respondents could not or did not want to express their opinion.

**Table 6**  
Number (%) of respondents feeling confident (dissatisfied–satisfied) with information disseminated by certain main actors in nuclear waste management in Finland.

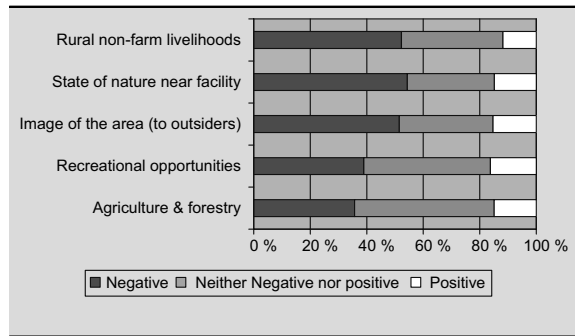


**Table 7**

Areas with the greatest number (%) of respondents assessing the final disposal facility to have a positive effect compared to those assessing it to have a negative effect.

**Table 8**

Areas with the greatest number (%) of respondents assessing the final disposal facility to have a negative effect compared to those assessing it to have a positive effect.



## 6. Environmental impacts of the final disposal facility project

In order to obtain a decision-in-principle from the Council of State for establishing a final disposal facility Posiva was required by law (468/1994) to present an Environmental Impact Assessment (EIA) to the authorities as part of the application. The EIA concerned the direct and indirect impacts of a project on the natural environment, human beings and the built environment and the financial and social impacts (Posiva, 1999a). It was completed in 1999. According to the assessment presented, impacts to the environment would be minor and attitudes towards the project in Eurajoki were positive and Posiva had permission to continue the project: However for the later final decision the Council of State required updated assessments (VN, 21.12.2000).

In the Posiva working reports for the previous year “Municipal image study 2006” (Corporate Image, 2007) and “The effects of the final disposal facility for spent nuclear fuel on regional and municipal economy assessment of socio-economical impacts” (Laakso et al., 2007) the impacts of the disposal facility project are seen in a favourable light. According to the image study “The residents of Eurajoki estimated the influence of final disposal on their municipality of domicile clearly more favourably than consumers elsewhere in Finland. The attraction of Eurajoki as a domicile and as a business location, as well as its attraction to tourists were alternatives for which the respondents gave positive estimates clearly more than negative. Eurajoki was perceived by the residents of the municipality as a developing, business friendly and agriculture and forestry intensive municipality and a good place to live...” (Corporate Image, 2007, abstract). Laakso et al. (2007) estimated that the effect of the disposal facility on employment would be significant and that this, in turn, would affect the size and the structure of the community, population, commerce and land use. They also state that the disposal facility would have a direct positive effect on the municipal economy through tax revenue and that the final disposal facility project has had an invigorating effect on the image of the municipality of Eurajoki.

The respondents to the KYT survey sent a rather more mixed message. Although 42% estimated that the final disposal facility would have a positive impact on the development of Eurajoki and its neighbouring municipalities in general, on the other hand 31% of respondents indicated that the facility would have a negative effect to the operating environment/atmosphere. Moreover, 40% of respondents estimated that the construction of the facility would have a negative effect on their own image of the area.

However, the respondents seemed to agree with Laakso et al. that the disposal facility would have a positive effect on the

employment market and economic development on the area. A positive effect was estimated by 63%, while 11% estimated a negative in the case of employment. In economic development 61% envisaged a positive impact and 10% a negative impact. Services (40%/11%) and transportation (41%/15%) were also estimated fairly widely to benefit from the construction of the facility (Table 7).

On the negative side, according to the survey data, the final disposal facility was widely considered to have a harmful impact on the rural non-farm livelihoods (fishing, hunting, forest product gathering etc.), the state of the natural environment near the facility and the image of the area (to outsiders). A negative effect was estimated by 52% and a positive effect by 12% in the case of the rural non-farm livelihoods, in the case of the state of the natural environment near the facility 54% anticipated a negative effect and 15% a positive effect. Negative consequences for the image of the area there anticipated by 52% positive consequences by 15%. Recreational opportunities (39%/16%) and agriculture and forestry (36%/15%) were also quite widely considered to be likely to suffer as result of the disposal facility (Table 8).

To sum it all up, most of the respondents estimated that some key economic areas would benefit from the construction of the final disposal facility but on the other hand many anticipated that the facility would have a negative effect on the image of the area, activities connected to nature and the natural surroundings of the facility.

## 7. The perceived threat of the facility today and tomorrow

In the survey the respondents were asked to react to various statements concerning the threats they perceive the repository might have. The general statement through which we measured how people perceive the safety of final disposal was: “The final

**Table 9**

Perception of the threat posed by the nuclear waste disposal facility, felt at least explicitly (%).

Dimension of risk perception	%
General safety	34
Own or family's safety	32
Safety of future generations	55
General health	45
Own or family's health	42
Health of future generations	56
General well-being	39
Own or family's wellbeing	37
Well-being of future generations	52

**Table 10**

Comparison of risk perception between men and women (mean value, scale ranging from 1 = I don't perceive a threat to 4 = I perceive a great threat, differences between the groups are highly significant, sig. < .000).

Dimension of risk perception	Mean value, men	Mean value, women
General safety	1.94	2.42
Own or family's safety	1.88	2.28
Safety of future generations	2.41	2.97
General health	2.07	2.61
Own or family's health	1.98	2.52
Health of future generations	2.42	2.99
General well-being	1.9	2.35
Own or family's well-being	1.82	2.33
Well-being of future generations	2.31	2.86

disposal of nuclear waste can be implemented safely in the bedrock of Finland". The percentage of those who agreed with the statement was 31, with 46% disagreeing. The other way to measure how people in Eurajoki and its neighbouring municipalities perceive the safety of the plans was to ask about what kind of threat nuclear waste poses to the lives of future generations. Nearly 60% of respondents agreed with the statement "Nuclear waste poses a continuous threat to the lives of future generations". Only 23% of residents disagreed with the statement.

Analysing the data from the point of view of those people who perceive the threat to be obvious illustrates the magnitude of the risk perception near the final disposal site of high-level nuclear waste. In light of the data we can conclude that 34% of people perceive the threat to the general safety of the final disposal repository as explicit or highly explicit, but for their own or family's safety the figure is little lower (32%). Three important figures can be seen in Table 9. Contemporary threat is not as obvious as the threat to the future generations. The final disposal repository poses a threat to the safety of future generations (55%), the health of future generations (55%) and the well-being of future generations (52%).

Compared to the present situation we can summarize that people anticipate future problems associated with final disposal. They not only perceive the issue from the perspective of contemporary generations, but assess the issue from the perspective of future generations.

Comparing the risk perception between men and women we see clearly that women perceive the threat to be more serious than do men (Table 10).

Another background factor indicating highly statistically significant differences between the groups was political affiliation (see Table 11). The most trusting people can be found among the voters of the National Coalition Party. Among the supporters of the conservatives the trust in nuclear waste management is greater on all dimensions measured than, for instance, among the supporters of the Finnish Centre Party and the Social Democratic Party, even

though their voters either do not seem to perceive so evident a threat from the nuclear waste facility. The fourth group of politically committed people who are quite trusting is the supporters of the True Finns. It is very surprising that the perception of risk among the adherents of this populist and right-wing oriented party is closer to that of the three biggest parties than to that of the other smaller parties. The most risk-averse people can be found among the adherents of the Christian Democrats, the Left Alliance and the Green League. Christian Democrats perceived the threat to contemporary generations in both safety and well-being issues to be greater than did the supporters of the Left Alliance. Quite surprisingly, Christian Democrats were concerned about the safety (mean value = 3.00) and well-being (mean value = 3.00) of future generations, but not so much as were the Left Alliance supporters. The voters of the Left Alliance were more concerned about the threat nuclear wastes might pose to contemporary and future generations. They perceived that nuclear waste facility constituted a real threat to public health (mean value = 2.90), to their own or family's health (mean value = 2.81) and to the health of future generations (mean value = 3.27). At the extremities are the supporters of the Conservatives and Greens. The supporters of the Green League perceived threat or great threat and in contrast conservatives perceived no threat at all or minor threat. All other politically committed people were located between these two extremes. It is important to emphasise that even though the conservative-minded people in Eurajoki and its neighbouring municipalities were not concerned about the risk of the nuclear waste facility to present generations, they still perceived some kind of threat to the general safety (mean value = 2.18), health (mean value = 2.26) and well-being (mean value = 2.18) of future generations. This was also a prevalent trend among the voters of other parties; even though today or in the near future nuclear waste management may function somehow, they were really worried about future generations. Systematically on all of these three dimensions, safety, health and well-being, the figures show that people, irrespective of their political affiliation, are more concerned about future generations than about present generations. In light of the figures one may state that people understand how society and especially the local region have committed to taking care of high-level nuclear waste for a long time. One may surmise that this long-term stewardship is one factor affecting to those ratings.

## 8. Summary

The municipality of Eurajoki and its neighbouring municipalities as the very first region in the world are entering the post site selection phase of the repository for spent nuclear fuel. In Eurajoki the concept of nuclear community is assuming a whole new dimension as the municipality and the local residents are preparing for the construction and operation phases of the repository.

**Table 11**

Comparison of risk perception between supporters of different parties (mean value, scale ranging from 1 = I don't experience threat to 4 = I experience great threat, differences between the groups highly significant, sig. < .000).

Dimension of risk perception	The National Coalition Party	The Finnish Centre Party	The Finnish Social Democratic Party	True Finns	The Christian Democrats in Finland	The Left Alliance	The Green League
General safety	1.78	1.99	2.09	2.25	2.71	2.64	3.17
Own or family's safety	1.72	1.91	2.03	2.06	2.64	2.59	2.84
Safety of future generations	2.18	2.41	2.70	2.84	3.00	3.32	3.78
General health	1.93	2.17	2.32	2.47	2.71	2.90	3.26
Own or family's health	1.85	2.01	2.29	2.50	2.57	2.81	3.17
Health of future generations	2.26	2.44	2.77	3.06	2.93	3.27	3.68
General wellbeing	1.84	1.96	2.23	2.31	2.77	2.36	3.06
Own or family's wellbeing	1.84	1.84	2.09	2.34	2.50	2.45	2.89
Wellbeing of future generations	2.18	2.29	2.66	3.03	3.00	3.27	3.65

The paper highlights some challenges of this new phase. The focus is on socio-economic and communication challenges, although possible changes facing the whole of Finnish spent nuclear fuel policy were mentioned, too. As indicated in Section 7 the residents perceive a threat, especially with regard to the safety, health and wellbeing of future generations. Thus, the main challenge is to find ways to mitigate the feeling of threat.

It is not so surprising that people in Eurajoki and its neighbouring municipalities follow what newspapers write about nuclear waste management. Local inhabitants can be regarded as the guinea pigs of this unique nuclear project. There is global interest in the development of Finnish nuclear waste management as it has been proclaimed to be solving the problem of high-level nuclear waste. The survey data indicated that 94 percent of respondents follow newspaper reports on nuclear waste disposal issues either actively or at least occasionally. However, activity in following the nuclear industry's own information leaflets is somewhat surprising. Both *TVO news* (18%) and *Posiva Investigates* (16%) leaflets were in actively used by local residents. Besides these information sources people also trust their friends and relatives. We can only assume that behind the official information from the nuclear industry and information processed by the journalists local region process unofficial information coming straight from people who are involved in nuclear power or from people who have adopted a critical stance towards the industry. The everyday face-to-face interaction with friends, workmates and relatives in processing information related to nuclear waste management is used more than for instance Posiva's leaflet, Internet or scientific publications.

The socio-economic and communication challenges indicate that ensuring local acceptance also needs active involvement and communication measures after the political decisions on the site selection. The partnership between the municipality and the nuclear industry needs conscious considered development where the perceived impacts and threats of the residents must be taken into account.

### Acknowledgement

The authors want to acknowledge the Finnish Research Programme on Nuclear Waste Management (KYT2010, [www.ydinjatetutkimus.fi](http://www.ydinjatetutkimus.fi)) for funding. The conclusions presented in the paper are solely those of the authors.

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## II

# **THE RATIONALITY OF ACCEPTANCE IN A NUCLEAR COMMUNITY: ANALYSING RESIDENTS' OPINIONS ON THE EXPANSION OF THE SNF REPOSITORY IN THE MUNICIPALITY OF EURAJOKI, FINLAND**

by

Tapio Litmanen, Matti Kojo & Mika Kari 2010

International Journal of Nuclear Governance, Economy and Ecology vol 3(1),  
42-58

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## **The rationality of acceptance in a nuclear community: analysing residents' opinions on the expansion of the SNF repository in the municipality of Eurajoki, Finland**

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**Abstract:** The project to build a final disposal repository for Spent Nuclear Fuel (SNF) in the municipality of Eurajoki, Finland, is approaching its 2012 deadline for the application of a construction licence. At the same time, the nuclear waste company Posiva is already planning to expand the disposal capacity of the repository. This paper addresses the question of acceptance among the residents of Eurajoki regarding the repository's expansion, and examines what aspects should be taken into consideration when explaining local opinions. The local acceptance figures for Eurajoki are analysed in relation to assumptions of the six common explanation types. The relationship between information deficit, social trust, benefit-cost calculation, perceived moral responsibility, perceived risks and threats, and acceptance of nuclear power, on the one hand, and local acceptance of expanding the repository both for current actors and for possible other domestic operators, on the other, is explored. The data provided in the paper is based on a survey carried out in June 2008. The respondents were selected from the residents of the municipality of Eurajoki and the neighbouring municipalities using stratified random sampling ( $N = 3000$ ). The response rate of the survey was 20% ( $N = 606$ ).

**Keywords:** local opinions; acceptance; expansion; repository; final disposal; spent nuclear fuel; SNF; Olkiluoto site; Eurajoki, Finland.

**Reference** to this paper should be made as follows: Litmanen, T., Kojo, M. and Kari, M. (2010) 'The rationality of acceptance in a nuclear community: analysing residents' opinions on the expansion of the SNF repository in the municipality of Eurajoki, Finland', *Int. J. Nuclear Governance, Economy and Ecology*, Vol. 3, No. 1, pp.42–58.

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## 1 Introduction

The problem of nuclear waste has been the Achilles heel of nuclear power for decades. While more than nine in ten (93%) Europeans stress that there is an urgent need to find a solution to the problem rather than leaving it unsolved for later generations, the vast majority of people (72%) also share the view that there is no safe way of disposing of high-level radioactive waste (Eurobarometer, 2008, p.24 see also OECD, 2009). A recent European Union (EU) report (EU, 2008) gives an overview of the current status of radioactive waste and spent fuel management in the EU. Among the current 15 EU countries using nuclear power, only Finland, Sweden and France are mentioned as countries which will have operational high-level nuclear waste and Spent Nuclear Fuel (SNF) disposal facilities by 2025, with Germany and Belgium possibly following suit by 2040. Other countries have not been able to advance their nuclear waste management programmes due to different societal, political and economic reasons. The report highlights that even countries with small-scale nuclear programmes, such as Finland, are able to build their own national repositories because of international cooperation, long-term political commitment, modern governance concepts, building using a step-by-step approach, and early involvement of national and local stakeholders to ensure sound public consultation and acceptance. The report stresses, "Such modern governance concepts have successfully laid the foundation of the Finnish and Swedish approaches."



At the general level, attitudes towards nuclear power in Finland can be regarded as following the trend stated in the Special Eurobarometer 297 (Eurobarometer, 2008). The report concludes that the citizens of countries which already use nuclear power are quite often considerably more likely to support nuclear energy than citizens of other countries (Eurobarometer, 2008, p.6). The strongest support for electricity production using existing nuclear power capacities can be found in the Czech Republic, Lithuania, Hungary, Bulgaria, Sweden and Finland. Nevertheless, when interpreting these results, one must keep in mind that the question of the Eurobarometer survey was formulated to measure general acceptance of nuclear power, not, for example, new build of nuclear power. In contrast to the general attitudes of Europeans towards the idea of using nuclear technology for electricity production, there are at least serious doubts over the model of final underground disposal. A slim majority (43%) of respondents in the EU accept the statement that the most appropriate solution for long-term management of high-level radioactive waste is underground disposal. However, over a third (36%) oppose the idea and around a fifth (21%) are undecided on the issue (Eurobarometer, 2008, p.23.) The most pressing perceived issues of concern regarding the construction of a deep underground disposal site near to respondents' homes are the possible effects on the environment and health (51%) and the risk of radioactive leaks (30%) (Eurobarometer, 2008, p.36). Even though Finland has the strongest public support for deep underground disposal (65% agree, 29% disagree) in the EU, the great majority of Finns agree with the statement that there is no safe way of disposing of high-level radioactive waste (81% agree, 15% disagree).

Many countries are currently considering their nuclear power policy and addressing the need to increase the share of nuclear power in electricity production. From this perspective, the societal questions surrounding Finnish nuclear waste management are interesting. Both Finland and Sweden have reached a decision regarding the actual site of the SNF repository, but in Finland the possible further construction of nuclear power has increased the need to expand the already accepted capacity of the repository. While many countries are still debating the appropriate means of dealing with their nuclear waste, the nuclear industry in Finland is asking permission to expand its disposal capacity. Although general public acceptance of the plans can be regarded as one of the crucial criteria for the advancement of national nuclear waste management, we stress the importance of studying the issue also from the perspective of the residents of the host area of the proposed repository. This article therefore aims to provide updated information on the opinions of the residents of the municipality of Eurajoki concerning the repository for SNF in Finland.

In Finland, the SNF repository project is approaching the 2012 deadline for the construction licence application phase. The Olkiluoto site in the municipality of Eurajoki was chosen as the site for further investigation in accordance with the Decision in Principle (DiP) of the Finnish Government in 2000. The DiP was ratified by Parliament in May 2001. The local residents have thus lived through the post-site selection phase for nearly one decade. During this phase, the nuclear waste company Posiva, among others, has started bedrock excavations for the Underground Rock Characterization Facility (ONKALO) in Olkiluoto. The residents have also experienced years of risk communication after the site selection in 2001.

At the same time, as Posiva prepares for the next phase, the company is already planning to expand the disposal capacity of the repository to 12 000 tU in the wake of Finland's renewed nuclear energy policy. It is not only the owners of Posiva, namely Teollisuuden Voima (TVO) and Fortum Power and Heat (Fortum), who need more disposal capacity. A brand new company, Fennovoima (2009, p.11) is also interested in disposing its SNF in Posiva's repository. All three companies have submitted DiP applications of their own for a new Nuclear Power Plant (NPP) unit (Kojo and Litmanen, 2009).

The expansion of the SNF repository has been approved by the local council of the municipality of Eurajoki to date. The repository expansion was approved without voting in connection with the TVO NPP project in December 2008 (one dissenting opinion), and again in August 2009 by 22 votes to 4 in connection with the Fortum NPP project. According to the Nuclear Energy Act, the local council has the right of veto. The original DiP application of Posiva was approved by the local council in 2000. According to an opinion poll, 59% of the residents of the Municipality of Eurajoki would have accepted the siting in 1999 if safety assessment by the authorities had indicated the community to be safe as a final disposal site for nuclear waste (Posiva, 1999, pp.165–168).

However, recent surveys (Kiljunen, 2007; Kojo *et al.*, forthcoming; 2010) indicate that local attitudes are showing increasing reservations rather than confidence regarding the disposal of SNF in Olkiluoto. Furthermore, data shows that over 50% of the residents perceived at least an explicit threat to the health, safety and well-being of future generations posed by the repository (Kojo *et al.*, forthcoming; 2010, pp.174–175; see also Aho, 2008; Posiva, 2008, pp.111–116).

This paper addresses two key questions: do the residents of the municipality of Eurajoki accept the plans of the nuclear waste company to expand the SNF repository in Olkiluoto? What aspects should be taken into consideration when explaining the local opinions of the nuclear community? The paper provides background information on local opinions which can be used to facilitate the development of risk communication and other areas of Finnish risk mitigation policy. The structure of the paper is as follows: In the second section the theoretical framework of the paper is introduced. The third section provides basic information on the survey carried out as part of the research project in June 2008. The fourth section focuses on the survey results. In the last section some preliminary conclusions are drawn.

## **2 Focus on the rationality of the nuclear community**

As a theoretical framework, we apply the concept of *nuclear community* constituted by the municipality of Eurajoki with two operating NPP units and the repository of intermediate and low-level nuclear waste in the Finnish context. Furthermore, a new 1600 MW European Pressurized Reactor and the Underground Rock Characterization Facility which is to be a part of the SNF repository are under construction in Olkiluoto.

A Nuclear Energy Agency (NEA) report (NEA, 2007, p.42) concluded that “host communities have already integrated the industrial activity and cognitive understanding into their local culture. This has been referred to in the past simply as ‘familiarity’ but in fact it may be called an existing cultural basis for facility development (...) Developing joint solutions consists of building on and adding to that existing cultural basis”. This

means that people may perceive a facility as a new addition to existing nuclear activity. Our survey indeed shows that half of all respondents (49% of Eurajoki respondents) stated that it is difficult to consider the disposal of SNF separately from the other activities related to the nuclear industry.

In this paper, a nuclear community is defined as a municipality which is economically heavily dependent on and politically interrelated with the operations of the nuclear industry (see more about the case of Eurajoki in Kojo, 2009; see also Bergmans *et al.*, 2008). Due to its economic dependency, long history and close cooperation with the nuclear industry, the majority of the population of a nuclear community are more positively disposed towards nuclear power than the general public (Easterling and Kunreuther, 1995, p.162; Eiser *et al.*, 1995; Kiljunen, 2007; van der Pligt, 1992, pp.75–89).

Easterling and Kunreuther (1995, p.123) identified four factors that determine whether or not an individual opposes or tolerates a proposed repository. The factors are as follows:

- 1 the extent of risk that the repository appears to impose on the health of nearby residents
- 2 anticipated impacts on the physical environment and the local economy
- 3 the degree to which building the repository appears appropriate from the social welfare standpoint
- 4 the perceived fairness of the siting process.

Nevertheless, a favourable view of these factors does not automatically guarantee local acceptance. Krannich and his colleagues (1993) concluded in a study of attitudes of rural Nevada residents that responses to the proposed SNF repository appeared to be influenced by a complex set of factors, ranging from the unique sociocultural settings to widely divergent experiences linked to past and present nuclear testing and to cross-generational risk perceptions. An interesting finding was that residents of the communities nearest to Yucca Mountain expressed lower levels of concern over and greater support for a repository than, for example, among urban Nevadans, and that opposition and concern were strongest in the communities farthest from the potential repository site, and lowest among those located nearest (Krannich *et al.*, 1993, p.284).

Thus, a number of diverse aspects have to be taken into consideration when trying to understand the rationality of a nuclear community. As Slovic and his colleagues (1993) pointed out, when assessing the societal and political problems surrounding nuclear waste management, the public cannot be blamed for ignorance or irrationality. The investigators emphasised that the real causes of the problems of trust are “deeply rooted in the adversarial nature of our social, institutional, legal, and political systems of risk management” (Slovic *et al.*, 1993, p.84).

Instead of focusing on broader societal and political issues, we concentrated on the rationality of the residents of the nuclear community. The local acceptance figures for Eurajoki were analysed in relation to the assumptions of the six explanation types often used in research literature when studying the acceptance of different kinds of risks. The first assumption was an *information deficit* (Slovic, 1987; Wynne, 1995; Desvousges *et al.*, 1993). According to this assumption, opposition to the SNF repository is due to inadequate or incorrect information among the local lay people. In the survey, opinions

regarding this assumption were elicited by the statement “In my opinion I have enough information on the final disposal project.” Furthermore, respondents were asked a series of questions about their information needs regarding final disposal-related issues (Kojo *et al.*, 2010).

The second assumption was *social trust* in the main actors responsible for disposal safety (*cf.* Desvousges *et al.*, 1993; Mushkatel *et al.*, 1993). In Finnish SNF management, the Radiation and Nuclear Safety Authority (STUK) and the developer Posiva play the key roles with regard to safety issues. Opinions regarding this assumption were thus elicited in the survey by the two statements “I trust Posiva in the risk assessment of the final disposal project” and “I trust the authorities in the risk assessment of the final disposal project.” In a recent article, Sjöberg and Herber (2008) called into question whether there is too much trust in social trust. According to them, more emphasis should be placed on epistemic trust and antagonism. We share the view that general trust is not the only factor behind the acceptability of a risky technology. Therefore, we suggest that also moral questions associated with the SNF repository have to be addressed (see assumption 4).

The third assumption was the respondent’s *personal benefit-cost calculation* (*cf.* Fischhoff *et al.*, 2009). According to conventional compensation theory, “to win the support of a prospective host municipality, the compensation offered has to be large enough to offset the net disutility imposed by the facility” (Frey *et al.*, 1996). The literature (Vari *et al.*, 1994; Jenkins-Smith and Kuhnreuther, 2001; Chung *et al.*, 2008; Kojo, 2009; Kojo and Richardson, 2009) suggests that economic compensation may play an important role in the siting process. However, one should be aware of disagreement regarding how far the cost-benefit analysis should be extended into the realm of social and political consequences (van der Pligt, 1992, p.164). There have also been a number of cases where proposals of compensation have caused a bribe effect, resulting in a negative disposition (Frey *et al.*, 1996). Opinions regarding the benefit-cost assumption were elicited by the two survey statements: “The economic benefits of the final disposal of nuclear waste will not compensate the non-economic costs” and “The benefits of the final disposal of nuclear waste will exceed the costs.” In addition, a series of questions was asked about the perceived impacts of the repository without reference to a benefit-cost comparison (*cf.* Kojo *et al.*, 2010).

The fourth assumption focused on *moral responsibility*. The moral and ethical questions regarding SNF issues have been investigated at least from the perspectives of the moral legitimacy of certain organisations, the legitimacy of the technology, and distributional, procedural and intertemporal inequity or cross-generational equity (Krannich *et al.*, 1993; Easterling and Kunreuther, 1995; Frostenson, 2008). We wanted to analyse the moral question from a rather different perspective. In our survey, the moral aspect is based on the assumption that the residents of a nuclear community may feel a moral responsibility to manage nuclear waste because an NPP is located in the municipality. In the case of a nuclear community, moral responsibility is also closely connected to benefits. If residents perceive the net utility due to the nuclear industry’s being located in the municipality, they may feel that it is their duty to also take care of the end of the nuclear fuel cycle. Opinions regarding the moral aspect were elicited by the survey statement “The municipality of Eurajoki has a moral responsibility to approve the disposal of nuclear waste as it has approved the location of NPPs in its area.”

The fifth assumption addressed *perceived risks and threats*. The field of study of risk perception is too vast to cover in brief, but studies of the perception of nuclear waste risks have revealed that there is a discrepancy between the public's perception of the risks associated with SNF repositories and the view of the experts; that the public tend to fear nuclear technology regardless of how well engineered they are; that the radiation risks are perceived qualitatively differently than other health risks; and that strong negative cognitive images are associated with nuclear wastes (Desvousges *et al.*, 1993; Easterling and Kunreuther, 1995, pp.131–132; Slovic, 1987; Slovic *et al.*, 1993). Opinions regarding perceived risks were elicited by the two survey statements “Nuclear waste constitutes a constant threat to future generations” and “Nuclear waste can be safely disposed of in Finnish bedrock.” Opinions regarding perceived threats were elicited by a separate series of survey questions.

The sixth assumption focused on the attitude to *further construction of nuclear power*. We share the view of Dunlap and his colleagues (1993, p.147) and Desvousges *et al.* (1993, p.206) that one useful factor in explaining peoples' attitudes towards repository issues is their overall view of nuclear energy. Given that siting issues are related to other nuclear issues, the acceptance of expanding the final disposal facility was also compared to support for nuclear power. Opinions regarding support for nuclear power were elicited by the two statements “More nuclear power should be built in Finland” and “A fourth nuclear power plant unit should be built in Olkiluoto.”

With the help of the above assumptions, the local acceptance figures regarding the expansion of the SNF repository in Eurajoki were analysed. Opinions regarding local acceptance for currently applicable expansion scenarios were elicited by the two statements “I accept expanding the final disposal repository for the needs of TVO and Fortum” and “I accept expanding the final disposal repository for the needs of other Finnish actors.” Posiva submitted two applications for the expansion of the repository for the SNF produced by the possible new NPP units of TVO and Fortum (Nurmi *et al.*, 2009, pp.13–17).

### 3 The survey

Our target population consisted of 16–75 year-old Finnish-speaking (native language) residents of Eurajoki and its neighbouring municipalities. The survey was carried out as a postal survey. The questionnaire was sent to 3000 recipients on 3 June 2008. Recipients were chosen by stratified sampling conducted by Statistics Finland, which also supplied the addresses. The use of stratified sampling ensured an adequate number of respondents from Eurajoki as well as good representation from all neighbouring municipalities (Table 1).

The number of questionnaire responses amounted to 616, representing an initial response rate of 21%. Of the questionnaires returned, 606 were acceptable for analysis, thus giving an overall response rate of 20%. The number of respondents claiming to be residents of Eurajoki numbered 245. The number of respondents from each municipality corresponded very closely with the stratified sample sizes.

In this paper, the focus is exclusively on those respondents residing in the municipality of Eurajoki. A nonresponse analysis was performed on this data by comparing respondents' gender, age, marital status, level of education, type of education, line of work, occupational status, political affiliation and income to information obtained

from the Official Statistics of Finland, Statistics Finland and the Finnish National Board of Education. As a result, three biases were observed that should be taken into consideration. Firstly, those who were married or in registered relationships were overrepresented by 9%; secondly, supporters of the Centre Party of Finland were underrepresented by 9%; and thirdly, respondents were better educated than the inhabitants of the Satakunta region as a whole. In addition to these, those in the low-income bracket were somewhat underrepresented, but to what extent is difficult to assess as many respondents (12%) declined to report their income.

**Table 1** Sample sizes and respondents

<i>Municipality</i>	<i>Sample size</i>		<i>Respondents</i>		
	<i>n</i>	<i>%</i>	<i>n</i>	<i>%</i>	<i>Valid %</i>
Eurajoki	1200	40	245	40	41
Neighbouring municipalities	1800	60	353	58	59
Eura	300	10	51	8	9
Kiukainen	300	10	59	10	10
Lappi	300	10	61	10	10
Luvia	300	10	55	9	9
Nakkila	300	10	60	10	10
Rauma	300	10	67	11	11
Missing			8	1	
<i>Total</i>	3000	100	606	100	100

Note: Owing to rounding off the figure do not add up accurately to 100%.

According to the survey, 42% of the residents of the municipality of Eurajoki accepted the expansion of the repository for the needs of TVO and Fortum. A total of 39% were opposed to it. The remaining 19% could not or would not give an opinion. However, the majority of residents did not accept the expansion for the needs of other possible Finnish actors. Only 20% accepted this, whereas 62% opposed it. Men held more tolerant opinions than women. In total, 50% of male respondents accepted and 31% were opposed to expansion for the needs of TVO and Fortum, whereas only 36% of women accepted expansion and as many as 47% were opposed to it. In the case of expansion for the needs of other possible Finnish actors, 26% of men accepted and 56% were opposed to the expansion, whereas 13% of women accepted and 67% were opposed to it. The expansion of the repository for imported SNF was totally rejected by the residents of Eurajoki, with 89% being opposed to any expansion for this purpose and only 5% accepting it. The opinions of men regarding possible SNF importing were slightly more tolerant than those of women. Of the men, 86% were opposed and 8% accepted SNF imports, while of the women, 91% were opposed and only 1% accepted it. The SNF import issue is nevertheless beyond the scope of this paper, since the Finnish Nuclear Energy Act prohibits the import and export of nuclear waste.

**Table 2** Acceptance of the final disposal repository expansion in the municipality of Eurajoki by gender (%)

<i>I accept the expansion for ...</i>		<i>Agree (%)</i>	<i>Neutral (%)</i>	<i>Disagree (%)</i>
TVO and Fortum	Women	36	17	47
	Men	50	19	31
	All	42	19	39
other domestic operators	Women	13	20	67
	Men	26	18	56
	All	20	19	62
imported waste	Women	1	8	91
	Men	8	6	86
	All	5	7	89

#### 4 Results

A comprehensive analysis was carried out using two opinion survey statements exploring the level of acceptance of the repository expansion. The figures included in this analysis consisted only of those respondents which declared themselves Eurajoki residents (N = 245). Expansion statement 1 was “I accept the expansion of the final disposal repository for the needs of TVO and Fortum” and expansion statement 2 was “I accept the expansion of the final disposal repository also for the needs of other Finnish actors.” The five-step Likert scale used with these statements (and other statements and questions in the questionnaire) was changed to a three-step scale in order to obtain more distinct results. The relationship between the expansion statements and the aforementioned assumptions regarding acceptance of the repository (see Section 2) was then investigated using correlation analysis. The reported correlation coefficients are Kendall’s rank correlation coefficients (Kendal’s tau-b). Kendall’s tau-b is a nonparametric measure of association that takes ties into account. In cases where multiple variables were used to measure the relationship between assumptions and expansion statements, only the highest correlations are reported.

##### 4.1 Information deficit

In general, respondents’ views on whether they had sufficient information on the final disposal project were evenly distributed. One-third (34%) agreed with the statement “In my opinion I have enough information on the final disposal project”, one-third (33%) disagreed and one-third (34%) were unable to say.

As can be seen in Table 3, the correlation analysis indicated that two expansion statements correlate with information deficit variables. Persons stating a need for more information on health effects, environmental effects of SNF, effects on everyday life or safety of capsulation correlated negatively with acceptance of expansion of the repository for the needs of TVO and Fortum. Persons stating a need for more information on these issues are less likely to be willing to accept the expansion of the repository. The correlation between the level of information and the perceived seriousness of risk is also

found in other studies (e.g., Desvousges *et al.*, 1993, p.206). An interesting notion is that the correlation with these variables and expansion statement 2 is weaker than in the case of expansion statement 1. Overall, the testing of the information deficit factor reveals that the correlation in both cases is rather weak and that the direction of correlation is mainly negative. One can conclude that this factor has little relation to the acceptance of the expansion of the repository.

**Table 3** Correlation between information deficit and acceptance of repository expansion

Stated information deficit regarding ...	Acceptance of the expansion for...	
	TVO and Fortum	other domestic operators
	(Expansion statement 1)	(Expansion statement 2)
general safety of SNF	-.200 (p = .001, N = 237)	-.190 (p = .001, N = 239)
safety of transport	-.184 (p = .002, N = 236)	-.174 (p = .004, N = 237)
safety of encapsulation	-.228 (p = .000, N = 236)	-.155 (p = .010, N = 236)
health effects	-.278 (p = .000, N = 238)	-.150 (p = .012, N = 238)
environmental effects	-.236 (p = .000, N = 238)	-.157 (p = .009, N = 239)
effects on everyday life	-.242 (p = .000, N = 236)	-.157 (p = .008, N = 238)
municipal decision making		-.156 (p = .009, N = 237)
safety after closure	-.226 (p = .000, N = 237)	
image impact	-.204 (p = .000, N = 235)	

#### 4.2 Social trust

Trust in Posiva is polarised. According to our data, exactly the same percentage of residents of Eurajoki both trust and do not trust (39%) the company. The share of those who cannot or will not express their views on the trustworthiness of Posiva is 22%. An interesting finding is that trust in authorities in risk assessment is lower than in the case of Posiva; 32% of respondents agreed with the statement “I trust the authorities regarding the risk assessment of the final disposal project”, with 39% of respondents disagreeing with the statement and 30% being unable to say. In analysing the explanatory power of social trust, it was found that both expansion statements correlate with trust in both Posiva and the authorities (Table 4). A strong correlation can be found between trust and expansion statement 1. A weaker but still notable correlation was found between trust and expansion statement 2. Nevertheless, a distinction must be made between these two actors. For instance, trust in Posiva predicts acceptance of expansion statement 1 better than trust in the authorities. This can be interpreted as a sign of trust in the locally operating commercial nuclear waste company. The authorities’ expertise in risk assessment is perceived to be weaker. On the other hand, the respondents rated STUK the most reliable source of information among the main actors in Finnish nuclear waste management when both groups of respondents, the residents of Eurajoki and the residents of neighbouring municipalities were analysed (Kojo *et al.*, 2010, p.173).



**Table 4** Correlation between social trust and acceptance of repository expansion

<i>Trust in ...</i>	<i>Acceptance of the expansion for...</i>	
	<i>TVO and Fortum</i>	<i>other domestic operators</i>
	<i>(Expansion statement 1)</i>	<i>(Expansion statement 2)</i>
Posiva's expertise	.581 (p = .000, N = 238)	.333 (p = .000, N = 238)
authorities' expertise	.527 (p = .000, N = 240)	.310 (p = .000, N = 241)

### 4.3 Benefits and other impacts

Our data indicate that the benefits of the disposal project are questioned by some residents. This is at least the case when interpreted on the basis of the statement “The economic benefits of the final disposal of nuclear waste will not compensate the non-economic costs.” The number of respondents sharing this view is greater (47%) than the number disagreeing with the statement (24%). In addition to these figures, the percentage of ‘don’t know’s’ is rather high (29%). Analysing the issue of benefits from a slightly different perspective, one finds that there is distrust regarding the overall benefits of the disposal project. Whereas 39% of respondents do not agree with the statement “The benefits of the final disposal of nuclear waste will exceed the costs”, 31% agree with the statement and 29% are unable to say.

Table 5 indicates how strongly residents’ positive understanding of their own home district correlates with expansion statement 1. Understanding of the municipality’s current and future positive situation and satisfaction with the area increase acceptance of the repository expansion for the needs of TVO and Fortum. There is a weaker correlation between these variables and expansion statement 2. This may mean that residents do not accept the repository expansion so readily for the use of other nuclear operators. A negative correlation can be found between the economic statement and expansion statement 1. If a person considers that the economic benefits do not compensate for the drawbacks, this correlates with opposition to the repository expansion for TVO’s and Fortum’s use, but also with the expansion for the needs of other nuclear operators. A negative attitude towards the expansion is more likely to be found among people who estimate the disadvantages of the repository to be greater than the economic benefits. In contrast, a resident’s positive assessment of the impacts of the repository is linked with acceptance of the expansion both for present operators and possible new operators.

### 4.4 Moral responsibility

One dimension of residents’ perceptions of their own municipality’s responsibility can be seen in Table 6. Acceptance of the expansion is more likely to be found among people reporting a moral responsibility to accept the disposal of nuclear waste because the NPP is located in Eurajoki. If an individual associates the municipality’s moral obligation to take care of nuclear waste, she/he is more likely to accept the repository expansion for the needs of TVO and Fortum and also for the needs of other operators. The descriptive figures demonstrate that 43% share the view of a moral obligation, but 33% do not acknowledge a moral responsibility.

**Table 5** Correlations between certain benefits/impacts and acceptance of the repository expansion

<i>Perceived benefit of or impact on ...</i>	<i>Acceptance of the expansion for...</i>	
	<i>TVO and Fortum</i>	<i>other domestic operators</i>
	<i>(Expansion statement 1)</i>	<i>(Expansion statement 2)</i>
respondents' own image of their area	.567 (p = .000, N = 235)	.394 (p = .000, N = 236)
respondents' own expectations for the future of their area	.582 (p = .000, N = 236)	.356 (p = .000, N = 237)
respondents' own satisfaction with the area as a place to live	.592 (p = .000, N = 235)	.384 (p = .000, N = 236)
<i>Attitude to the statement ...</i>		
"Economic benefits of final disposal of nuclear waste will not compensate the non-economic costs."	-.544 (p = .000, N = 235)	-.374 (p = .000, N = 236)
"Benefits of final disposal of nuclear waste will exceed the costs."	.553 (p = .000, N = 228)	.415 (p = .000, N = 229)

**Table 6** Correlation between perceived moral responsibility and acceptance of the repository expansion

<i>Attitude to the question of ...</i>	<i>Acceptance of the expansion for...</i>	
	<i>TVO and Fortum</i>	<i>other domestic operators</i>
	<i>(Expansion statement 1)</i>	<i>(Expansion statement 2)</i>
Eurajoki's moral responsibility	.498 (p = .000, N = 229)	.364 (p = .000, N = 230)

4.5 *Risks/Threats*

Based on Table 7, the general notion is that the more that people associate risks with the repository, the greater their opposition to the idea of the expansion. All of the other variables in the table also follow this line with the exception of the last variable, which elicits a different line of response. This can be interpreted as follows: the safer an individual perceives the disposal to be, the more willing she/he is to accept the repository expansion for the needs of TVO and Fortum. The correlation between expansion for the needs of other companies and safety is weaker than for the needs of these two companies. The descriptive figures indicate that, for instance, the majority of respondents (58%) share the view that "Nuclear waste constitutes a constant threat to future generations." A total of 24% of respondents disagreed with the statement. The statement "Nuclear waste can be safely disposed of in Finnish bedrock" changes the figures such that 42% disagree, 32% agree and 26% are unable to say.

4.6 *Pro nuclear*

The respondents were asked about their attitudes towards nuclear power with two statements: "The construction of more nuclear power in Finland should be allowed" and "The fourth NPP unit should be constructed in Olkiluoto." Eurajoki residents seem to disagree with the general idea of constructing more nuclear power facilities (37% agree,

42% disagree and 20% are unable to say) and the figures are quite the same when respondents are asked more specifically about further construction in Olkiluoto (38% agree, 47% disagree and 15% are unable to say). The correlation between the attitude towards nuclear and the idea of expansion of the repository is shown in Table 8. It indicates how especially the favourable attitude towards the construction of more NPPs in the respondents' vicinity increases the acceptance of the repository expansion for the needs of TVO and Fortum. The correlation between a general positive attitude towards nuclear power and acceptance of the expansion for the needs of TVO and Fortum is slightly lower. In the case of other nuclear operators' needs, the correlation is much lower.

**Table 7** Correlation between risks/threats and acceptance of the repository expansion

<i>Perceived risk or threat to ...</i>	<i>Acceptance of the expansion for...</i>	
	<i>TVO and Fortum (Expansion statement 1)</i>	<i>other domestic operators (Expansion statement 2)</i>
general safety	-.531 (p = .000, N = 239)	-.381 (p = .000, N = 241)
own or family's safety	-.502 (p = .000, N = 239)	-.345 (p = .000, N = 240)
safety of future generations	-.477 (p = .000, N = 239)	-.336 (p = .000, N = 240)
health of future generations	-.504 (p = .000, N = 240)	-.338 (p = .000, N = 241)
general health	-.480 (p = .000, N = 238)	
<i>Attitude to the statement ...</i>		
"Nuclear waste constitutes a constant threat to future generations."	-.512 (p = .000, N = 239)	-.382 (p = .000, N = 240)
"Nuclear waste can be safely disposed of in Finnish bedrock."	.655 (p = .000, N = 239)	.337 (p = .000, N = 240)

**Table 8** Correlation between attitude towards nuclear power and acceptance of repository expansion

<i>Attitude to ...</i>	<i>Acceptance of the expansion for...</i>	
	<i>TVO and Fortum (Expansion statement 1)</i>	<i>other domestic operators (Expansion statement 2)</i>
more nuclear power in Finland	.634 (p = .000, N = 229)	.382 (p = .000, N = 230)
fourth NPP unit at Olkiluoto	.644 (p = .000, N = 229)	.418 (p = .000, N = 231)

## 5 Findings

The survey indicated that less than half (42%) of the residents of the municipality of Eurajoki are willing to accept the expansion of the repository for the needs of the 'older' nuclear operators, TVO and Fortum. The disposal needs of possible newcomers are less tolerated. The assumption that the nuclear community's residents' lack of information on

final disposal issues explains their acceptance of or opposition to the expansion of the SNF repository is not very accurate. Although there is a correlation, the correlation is rather weak when compared to the other factors analysed. More explanatory power can be found among the factors of social trust, perceived benefits, perceived risks and, in particular, attitudes to nuclear power. How individuals perceive the moral responsibility of a nuclear community to accept certain new nuclear waste management activities is also closely related. These results reinforce the findings of some other studies (cf. Dunlap *et al.*, 1993; Slovic *et al.*, 1993) that other factors than knowledge and information about nuclear waste have a more important bearing on the way that the residents of nuclear communities rationalise the acceptability of different nuclear waste activities. Nonetheless, the question of information and knowledge cannot be ignored. As Desvousges *et al.* (1993) stress, there is a need for two-way communication about risks. The top-down model of risk communication needs to be reevaluated to enable information flow also from the public in order to create more dialogue. After the early 1990s, nuclear waste management has indeed passed through a 'participatory turn' in a number of countries (Bergmans *et al.*, 2008).

An intriguing finding was the correlation between 'self-respect' or respect for one's own community and acceptance of the expansion. The more that people value their local district and its future, the more likely they are to accept the expansion for the needs of TVO and Fortum. This finding is in line with the findings of other studies in which the residents of nuclear communities have given more support for the SNF repository siting than residents of other communities. For instance, Krannich *et al.* (1993, p.284) indicated that opposition and concern were strongest in the communities farthest from Yucca Mountain, and lowest among those located nearest to the repository site. Even though familiarity with nuclear activities may increase acceptance of a repository siting or expansion of a repository, one must keep in mind that ambivalence towards nuclear waste management will exist among the local population (Dunlap *et al.*, 1993, p.166).

In general, if, after cost-benefit analysis an individual draws the conclusion that the disadvantages outweigh the benefits, he or she is more likely to be opposed to the repository expansion. Perceived risks do correlate with acceptance of the repository expansion. Those perceiving SNF disposal as safe are more likely to support the expansion, but those who perceive risks are more likely to reject the idea. These findings concur with those of earlier studies on the acceptance of repository siting (*e.g.*, Easterling and Kunreuther, 1995, p.162; Krannich *et al.*, 1993, p.278). Another curious finding is that a general attitude towards nuclear power has a weaker explanatory power than acceptance of an NPP unit in the vicinity of Eurajoki. We can surmise, therefore, that familiarity with the nuclear industry, as associated with the 'self-respect' of a nuclear community, bears considerable explanatory power with respect to such findings.

### **Acknowledgement**

This paper was first prepared for the VALDOR 2009 Symposium held on 8–11 June 2009 in Stockholm, Sweden. The paper forms part of a joint research project of the University of Jyväskylä and the University of Tampere. The research project 'Follow-up research regarding socio-economic effects and communication of final disposal facility of spent nuclear fuel in Eurajoki and its neighbouring municipalities is funded by the Finnish Research Programme on Nuclear Waste Management (KYT2010; [www.ydinjatetutkimus.fi](http://www.ydinjatetutkimus.fi)).

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### III

## **PRIDE-EFFECT IN A NUCLEAR COMMUNITY. LOCAL PERCEPTIONS REGARDING SPENT NUCLEAR FUEL REPOSITORY IN THE MUNICIPALITY OF EURAJOKI, FINLAND**

by

Matti Kojo & Mika Kari 2010

Final Proceedings of WM2010 paper no 10192

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WM2010 Conference, March 7-11, 2010, Phoenix, AZ

**Pride-effect in a nuclear community**  
**Local perceptions regarding spent nuclear fuel repository in the municipality of Eurajoki,**  
**Finland – 10192**

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**ABSTRACT**

The aim of the paper is to analyse local people's opinions regarding the siting of a spent nuclear fuel (SNF) repository in the municipality of Eurajoki, Finland. The municipality is seen as a nuclear community as it hosts two NPP units and has a third unit currently under construction. In addition, excavations for an underground rock characterization facility have been underway at the Olkiluoto site since 2004. The paper argues that a level of community pride exists among the local residents, which is based on a nuclear identity that is favourable to the expansion of nuclear activity. This is referred to in the paper as the pride-effect in a nuclear community. Understanding this pride-effect is important when building a long-term relationship between the nuclear industry and the local community.

The paper deals with two hypotheses based on concepts of nuclear oasis and industry awareness. From the view point of the nuclear oasis hypothesis, favourable opinions of residents in a nuclear community can be explained at least to some degree by familiarity, but mainly by dependency. According to the nuclear oasis hypothesis, nuclear communities are products of unequal power relations and the process of peripheralization. Another interpretation is offered from the view point of industry awareness. According to the industry awareness hypothesis, communities that already have nuclear installations within their locality have an existing cultural basis for facility development, as they have integrated the industrial activity and cognitive understanding into their culture. The perceived pride-effect appears to be related to industry awareness.

Analysis of the survey data collected in Eurajoki suggested that understanding towards SNF siting issues is more likely to be found among men and more prosperous residents. Women and less-advantaged people seem more likely to repel SNF from "their backyard". The postal survey was carried out in June 2008.

**INTRODUCTION**

Spent nuclear fuel (SNF) management has gained major progress in Finland and Sweden. In Finland, the Olkiluoto site located in the municipality of Eurajoki was approved to be the site for the SNF repository. The decision was taken first in January 2000 at the local level. At the national level, the Finnish government issued a Decision-in-Principle (DiP) in December 2000 and Parliament ratified the DiP later the same year. Since 2004, the nuclear waste management company Posiva has excavated an Underground Rock Characterization Facility which is planned to be part of the SNF repository in the future. Expansion of the repository is also under

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preparation due to the applications regarding further construction of nuclear power in Finland [1]. In Sweden, the Swedish Nuclear Fuel and Waste Management Company, SKB, decided in June 2009 to select the Forsmark site in the municipality of Östhammar as the site for the final repository for Sweden's SNF. According to the SKB schedule, the licensing application will be submitted in 2010.

An important aspect in both countries' cases is the voluntariness of the municipality. In Finland, the municipality of Eurajoki announced its willingness to host the SNF repository already over a decade ago [2]. Before the siting decision, the municipality of Eurajoki even competed against the town of Loviisa, which was one of the four candidates in the Finnish site selection process in the late 1990s. In Sweden, the two final candidate municipalities chose a more egalitarian approach by negotiating together with SKB for an Added Value Programme to secure benefits also for the municipality that was not proposed to host the repository [3]. The progress made in Sweden and Finland raises the question why these municipalities were willing to host a repository when numerous surveys have indicated that nuclear waste facilities – even those for low-level waste – are perceived by the public to be high-risk and are highly unpopular?

The aim of the paper is to analyse local people's perceptions of the SNF repository in the municipality of Eurajoki, Finland, from the point of view of two conflicting interpretations. Literature proposes two interpretations: the nuclear oasis hypothesis and the industry awareness hypothesis. Based on the nuclear oasis hypothesis, the favourable opinions of a nuclear community's residents towards nuclear activity within their community can be explained to some degree by familiarity with nuclear technology, but mainly by economic dependency on the nuclear industry and by unequal power relations and the process of peripheralization. This interpretation represents the 'mainstream' explanation for the local decision-making in Eurajoki regarding the SNF repository siting [4, 5].

The industry awareness hypothesis offers an alternative interpretation. According to this hypothesis, communities that already have nuclear installations within their locality have an existing cultural basis for facility development, as they have integrated the industrial activity and cognitive understanding of it into their culture. The industry awareness hypothesis suggests that in a community with this capability, social construction of the SNF disposal project is in line with the perceptions and interests of local residents. The differences in cultural resonance with the SNF repository have been compared between the Finnish candidate municipalities from point of view of social constructionism [4, 6]. It has been suggested that familiarity with large industrial technology systems, such as the forest industry in the Finnish case, offers a base for cultural resonance with nuclear waste technology [4]. This assumption has, however, proven false in the case of the heavily forest industry-dependent Finnish town of Äänekoski, where the majority of local residents, despite heavy exposure to the forest industry, wholly opposed the idea of hosting the SNF repository. The latest results suggest that industry awareness is actor-dependent. In Eurajoki, cognitive understanding seems to be related to familiarity with the existing actor. The survey data also indicated that local acceptance is not based on nationality, as not all domestic nuclear companies are welcome. Thus, acceptance within nuclear communities cannot be automatically attained with respect to all nuclear activities [7]. Industry awareness, if it does exist in Eurajoki, does not mean that newcomers will be welcomed with open arms. The

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perceived pride-effect among the local residents of Eurajoki also seems to be connected with the nuclear industry's long-standing history within the host municipality.

The main argument of the paper is that the municipality of Eurajoki is entering a new phase in the nuclear community life-cycle. The once highly rejected siting of the SNF repository is turning into a project of local pride – at least partly. The relationship of the nuclear community with the nuclear industry is no longer defined as matter of dependency, but as voluntariness and willingness to co-operate and create added value for the contracting parties.<sup>1</sup> However, a split in attitudes towards the siting of the SNF repository does seem to exist [7, 8]. Clearly, therefore, not all residents view the repository with pride.

The paper is structured as follows: Sections 2 and 3 introduce the main concepts and hypotheses applied in the paper. Section 2 is based on the paper written for the ICEM'09 Conference [7]. In Section 4, the development of nuclear community in the case of the Eurajoki municipality is discussed in the light of the abovementioned hypotheses. In Section 5, basic information on the postal survey is given. The survey introduction is based on the article by Kojo, Kari and Litmanen [8]. In Section 6 empirical data concerning the pride-effect is analysed. This is done by comparing the residents' perceptions between an established actor and a newcomer. In the last Section, conclusions are drawn.

#### **THE TWO HYPOTHESIS: NUCLEAR OASIS AND INDUSTRY AWARENESS**

'Nuclear communities' can be characterised as "communities who host nuclear activities and are conscious of their nuclear identity" [9]. A community's inhabitants are familiar with nuclear activity, which in turn is often seen as a mixed blessing: bringing economical advantages but also a psychological burden and, possibly, problems with respect to the community's image. Trusted community members with experience in the nuclear sector are often in a bridging role between the ordinary citizens and the nuclear experts. [9]

The term 'nuclear oases' was introduced by Andrew Blowers at the turn of the 1990s. Blowers points out that nuclear waste repositories have been rejected when proposed for greenfield locations. Sites that already host waste sites or other nuclear facilities, and their adjacent communities, are the only places where they may be welcomed. Blowers acknowledges that these sites may welcome nuclear waste partly due to familiarity with the industry and growth within the nuclear culture, but primarily emphasises the aspect of dependency. According to Blowers, nuclear oases are products of unequal power relations and the process of peripheralization. A dependent workforce, economic leverage and government support gives a nuclear industry power, whereas communities themselves tend to be remote and economically and politically marginal to start with, and dependence tends to render them monocultural, subject to economic risk and relatively powerless, their fortunes controlled by external influences. [10, 11, 12]

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<sup>1</sup> The Vuojoki Mansion and Foundation ([www.vuojoki.fi](http://www.vuojoki.fi)) and the Eurajoki Business Development Fund are examples of locally shared aims to create added value.

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'Communities with industry awareness' is a phrase used to promote the opposite view to that presented by Blowers. The NEA report [13] claims that readiness to consider hosting a radioactive waste management facility should not be seen as (or at least not primarily as) a sign of dependency. Instead, the reason for this lies in cultural integration. Communities that already have nuclear installations within their locality have an existing cultural basis for facility development, as they have integrated the industrial activity and cognitive understanding into their culture. The NEA report [13] states that "Developing joint solutions consists of building on and adding to that existing cultural basis." Where others see threats, these communities see needs that can be met using a familiar energy source. From this point of view, the SNF facility could even be viewed as a point of pride.

All in all, communities hosting nuclear activity where waste is already stored or produced have a level of familiarity with the subject, some knowledge of the risks and impacts that nuclear facilities bring, as well as an interest in continued co-operation with the industry. Added to this, the nuclear industry is already present within the community. It is no wonder, therefore, that it is easier for the nuclear industry to develop a dialogue with these communities than non-nuclear communities and "...experience worldwide shows that it is with nuclear host communities that progress in facility siting has been made quickest." [14].

#### **THE RECENT DEVELOPMENT IN GOVERNANCE OF NWM**

Bergmans *et al.* [9] note that radioactive waste managers across Europe have turned to more participatory and voluntary approaches, with a focus on existing nuclear communities, such as the municipality of Eurajoki<sup>2</sup> in Finland. Voluntariness as a holistic approach was never explicitly included in the Finnish site selection strategy as in Sweden [15]. However, due to the veto right granted in the Nuclear Energy Act for the host municipality, local approval by the municipality council was required during decision-in-principle phase [2]. The 'participatory turn' of the Finnish nuclear waste governance took place gradually in the 1990s [2, 5, 16]. When compared internationally, the turn in Finland was a rather modest one. The effectiveness of the environmental impact assessment (EIA) procedure in decision-making in Finland has been criticized [5, 17]. One explanation for the ineffectiveness of EIA is the existence of alternative, more prominent, yet closed, arenas. The narrowly and in advance framed alternative [5] and local compensation arrangements [2] can be given as examples.<sup>3</sup>

One aspect which seems to be missing from many assessments of the Finnish case [21, 22, 23, 24] is the local negotiations conducted regarding the location-related benefits of the repository. For example, Vira<sup>4</sup> [25] refers to this aspect only by reporting how the representatives from the municipality of Loviisa and Eurajoki started talking with Posiva "*about possible forms of*

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<sup>2</sup> The Olkiluoto area in the municipality of Eurajoki currently hosts two nuclear power plant units, and a third is under construction. TVO, the company that owns and operates NPP in Olkiluoto (including the unit under construction) has also submitted an application to the Council of State for a Decision-in-Principle for the construction of a fourth NPP unit at Olkiluoto. Regarding waste storage, TVO also has on-site pool-type interim storage for spent nuclear fuel, and a low- and intermediate-level radioactive waste repository (bedrock disposal) at the power plant site.

<sup>3</sup> SNF management as a part of the Finnish political system and culture has not been evaluated in detail to date. Two general overviews are, however, available [19, 20].

<sup>4</sup> Dr Juhani Vira is Vice President for research at Posiva.

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*support and cooperation in case either of their areas was chosen*". According to Vira, this took place in 1998. On the other hand, the importance of the veto-right of the proposed host municipality granted under the Nuclear Energy Act of 1987 was well understood by the nuclear industry management. The possibility of an impasse, with all four candidate municipalities saying "no" was also considered by the industry [25, 26] and by the ministry [27]. This situation was, however, avoided due to the 'pragmatic acceptance' and/or 'industry awareness' of the local politicians of the Eurajoki municipality.

The most recent development in the governance of nuclear waste management is the emergence of discussion on the arrangement of benefit/safety packages. Benefits are viewed, for example, in terms of concepts of community partnership and durable relationship. Although many different kinds of arrangements have existed over the years, it is only relatively recently that such benefit-sharing arrangements have been openly discussed, at least in Europe. Literature [3, 13, 28, 29, 30, 31] offers an overview, although not very detailed, of the broad spectrum of benefit types applied in the field of nuclear waste management.

Bergmans *et al.* [9] refer to various forms of 'pragmatic acceptance' (or 'tolerability') of nuclear communities. They state that (some) nuclear communities are more prepared than non-nuclear communities "*to place their faith in the safety cases of additional facilities*". Furthermore, according to them "*these communities have already been taking calculated chances (consciously or unconsciously) with nuclear activities for years and are relatively accustomed to what outsiders would regard as 'living dangerously'*" [9]. In fact, Vira [25, also 2] gives a kind of insight into the perceptions of a nuclear community. Vira states that, for the municipality of Eurajoki, the choice was between the already existing interim storage and geological repository. The former would always need maintenance and supervision, whereas the latter would require no attention from future generations. Thus, a safer place than the storage pools already familiar to the local residents was provided. Furthermore, this option offered potential benefits.

The concept of pragmatic acceptance seems to be related to industry awareness. Bergman *et al.* (2008) suggest that in volunteering nuclear communities the 'culture of confrontation' is less present and there is perhaps more trust in the manageability of the nuclear waste question. The whole problem tends to be framed in a more nuanced and pragmatic way. This 'pragmatic acceptance' certainly helps to open up local negotiations on benefits. For example, Vira [26, 32] reports how Posiva also wanted to avoid a culture of confrontation, as the company chose a site between the municipality of Loviisa and Eurajoki. The company preferred a host municipality with a permissive political culture, ensuring that the interests of the nuclear industry are taken into account at local level [2].

### **EURAJOKI: A NUCLEAR OASIS OR A HOST WITH INDUSTRY AWARENESS?**

The nuclear oasis hypothesis has been used to some extent to explain the local decision-making regarding the SNF repository siting in Olkiluoto [2, 3, 4]. The economic dependency of the municipality on the nuclear industry has been seen as one of the main motivations of local politicians to approve the siting. The reform of the real estate tax system in the early 1990s and the resulting financial crisis of the municipal economy caused local politicians to reconsider their relationship with TVO. They wanted to safeguard tax revenue, while at the same time the interest

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of the nuclear industry was to safeguard a more stable local political setting for their business activity. The attitude of the municipality towards the siting changed in four years. In December 1994 its former negative statement was withdrawn, in August 1995 a co-operation agreement was signed with TVO, and in December 1998 the Olkiluoto Vision, including a positive statement on the SNF repository siting, was approved. [2.]

How did this change take place? And how can it be explained? According to the nuclear oasis hypothesis, the dependency of the municipality on the nuclear industry should have increased. This interpretation is verified, for example, by the fact that the state needed to compensate the losses in municipal finances caused by the early 1990s tax reform. Later, the municipality and the nuclear industry agreed on co-operation aimed at safeguarding the interests of the contracting parties.

On the other hand, there is also some evidence of industry awareness. For example, according to annual surveys, the confrontation culture decreased in Eurajoki during the 1990s. In 1992 over 50% of residents of Eurajoki disagreed with disposal of nuclear waste in Olkiluoto, whereas in 1999 some 30% disagreed. At the same time, the number of those agreeing increased from around 40% to over 60%. [3, 33.] The analysis of local decision-making regarding the siting process and the development of the relationship between the municipality, or more precisely the leading politicians, and the nuclear industry indicates that relations started to become closer already before the mid 1990s and the implementation of the EIA procedure. However, local discussions regarding Posiva's EIA procedure seem to have had an input towards the launch of a vision project for the Municipality of Eurajoki. [2.] The Olkiluoto Vision of 1998 is evidence of industry awareness. The municipality was not only ready to locate a SNF repository for legacy waste, but it was also willing to locate a possible new nuclear power plant unit. Another sign of industry awareness is the modest level of compensation claimed (Kojo and Richardson 2009, 72). Local politicians were, to at least some extent, aware that they could push for more, but remained modest in their demands.<sup>5</sup> Politicians were not unanimous regarding compensation, but the intracommunity disagreements have not paralyzed the relationship with the industry. In addition, the numerous liaison groups set up over the years to liaise between the municipality and the nuclear industry have played a part in the gradual institutionalization of industry awareness.

### **THE SURVEY DATA**

As the municipality of Eurajoki was selected as the site for the repository, the main focus of our survey was the residents of Eurajoki itself. However, the neighbouring municipalities were also covered as they, too, have a role in EIA and Decision-in-Principle (DiP) procedures. The survey was focussed on the 16–75 year age bracket. The purpose of lowering the age limit below 18 was to enable comparison of the opinions of the youth population with those of the adult population. The questionnaire was conducted in Finnish only, and only Finnish-speaking residents were included in the target population.

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<sup>5</sup> Local discussions in Eurajoki gradually became more benefits-focused. TVO's nuclear waste office raised the issue of local benefits already in the mid 1980s [34], although benefits were not assessed and discussed systematically until the EIA procedure. At that time, compensation negotiations were not mentioned and the issue has remained something of a taboo in relation to nuclear waste facility siting.

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The survey was carried out as a postal survey. The four-page questionnaire was sent to 3,000 recipients on 3 June 2008. Recipients were chosen by stratified sampling conducted by Statistics Finland, which also supplied the addresses. The reasons for using stratified sampling were purely pragmatic. Postal survey response rates typically tend to be low and, in addition, Eurajoki is a highly studied area. The sampling method therefore needed to take into account possibility of survey 'weariness' and a very low response ratio. The aim was to ensure that there would be an adequate number of respondents from Eurajoki and decent representation from all neighbouring municipalities of Eura, Kiukainen, Lappi, Luvia, Nakkila and Rauma.

The number of returned questionnaires amounted to 616 (of 3,000 sent), giving us return rate of 21%, and of those 616 as many as 606 qualified for analysis, resulting in a total response rate of 20%. The number of respondents stating that they were residents of Eurajoki numbered 245. The number of respondents from each municipality corresponded very well with the stratified sample sizes. (Table I.)

Table I. Survey sample sizes and respondents.

	Sample sizes		Respondents		
	n	%	n	%	Valid %
Eurajoki	1200	40	245	40	41
Other municipalities	1800	60	353	58	59
Eura	300	10	51	8	9
Kiukainen	300	10	59	10	10
Lappi	300	10	61	10	10
Luvia	300	10	55	9	9
Nakkila	300	10	60	10	10
Rauma	300	10	67	11	11
Missing			8	1	
Total	3000	100	606	100	100

In this paper we look in to the data formed of those 245 stating that they were residents of Eurajoki. A non-response analysis was performed on this data by comparing the respondents' gender, age, marital status, level of education, type of education, line of work, occupational status, political affiliation and income with information obtained from the Official Statistics of Finland, the public authority Statistics Finland, and the Finnish National Board of Education. As a result, three biases were observed that should be taken into consideration. Firstly, those who were married or in registered relationships were overrepresented by 9%. Secondly, supporters of the Centre Party were underrepresented by 9%. Thirdly, respondents were better educated than the inhabitants of the Satakunta region as a whole. In addition, it seems that, those in the low income group were somewhat underrepresented, although the extent of underrepresentation is difficult to assess as a high proportion of respondents (12%) declined to report their income.

## ANALYSIS

How, then, did the residents of Eurajoki feel about the siting of the SNF repository at the Olkiluoto site? In the survey, five statements relating to acceptance of the SNF repository and its

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expansion were posed [7]. In Figure 1, the respondents are classified into three groups: supporters, neutral respondents and opponents, according to the responses given to the statement "Nuclear waste produced by TVO and Fortum should be disposed of at Olkiluoto". The survey respondents were given the response options in a five-step Likert style scale from 1 'Totally Disagree' to 5 'Totally Agree'. For this analysis, the scale was changed to a three-step scale as shown in Figure 1.

According to the survey, less than half (42%) of the respondents agreed with statement and 36% disagreed. Almost every fourth respondent had a neutral attitude. Women were clearly more critical than men towards the final disposal of SNF in Olkiluoto, as 43% of women disagreed whereas more than half of men (52%) agreed with the statement. The issue is gendered in Eurajoki. Age-wise, the rising generation (those born after 1990–) was highly critical towards the SNF disposal (54% disagreed; 31% agreed). On the other hand, the new generation (1980–89) seemed to have adopted a very positive attitude towards the SNF disposal (29% disagreed; 41% agreed).

Attitudes were affected by the respondent's position in working life. Those in the top leading positions were more likely to agree than those not working or unemployed. Workers held more critical attitudes than farmers or the self-employed / employers. The same trend was seen when attitudes were classified in relation to personal income per year. Of those earning more than 60,000 euros annually, almost 70% agreed and only 17% disagreed with the statement. Supporters of the three main political parties (Finnish Centre Party, National Coalition Party and Social Democratic Party) had the most positive attitude towards the statement. Supporters of the Left Alliance, Green League and Christian Democrats are more likely to be opponents of the disposal plan [8].



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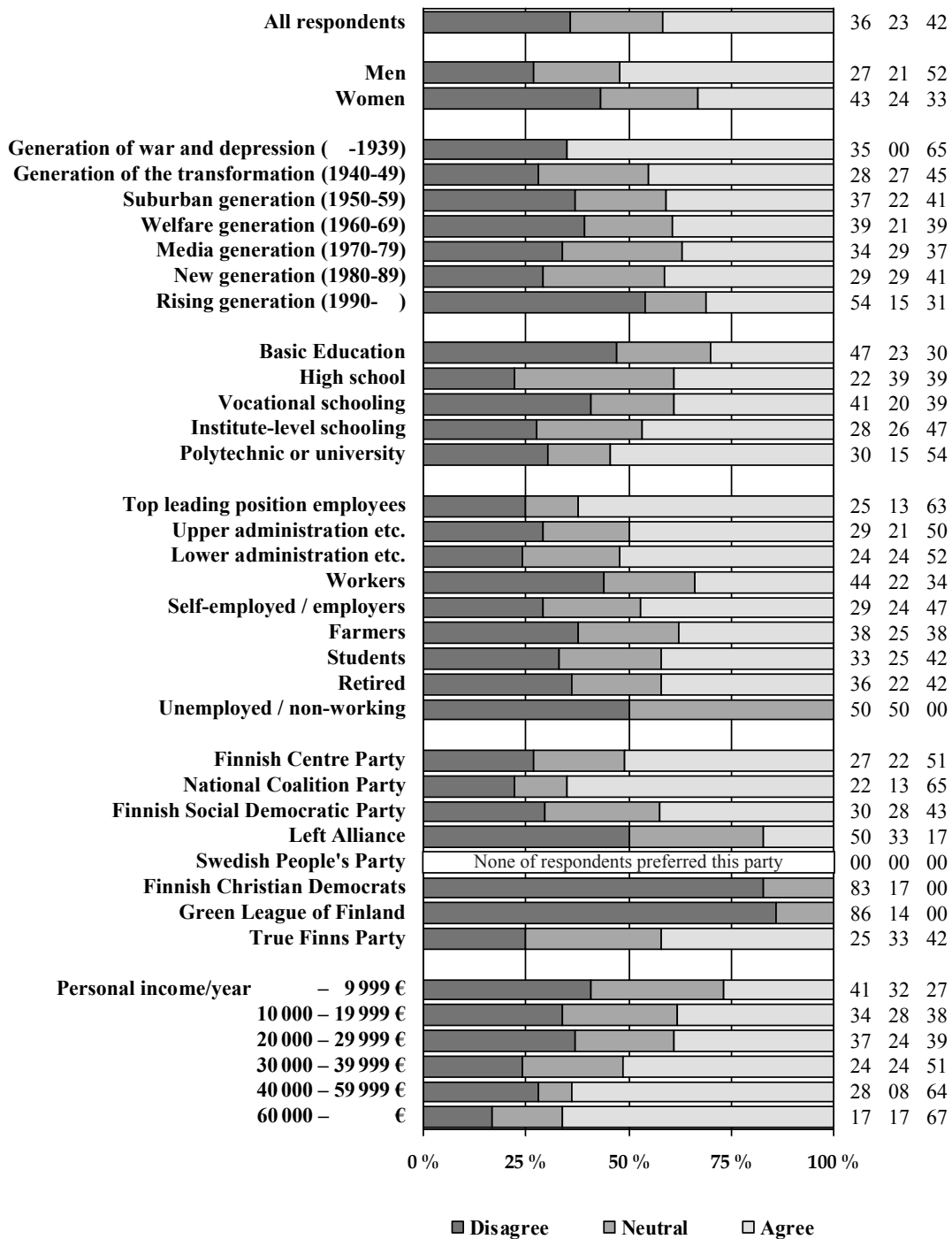


Fig. 1. Attitudes towards the statement 'Nuclear waste produced by TVO and Fortum should be disposed of at Olkiluoto' per socio-economic group (%).

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Survey respondents were presented with the question 'In your opinion, how does constructing the final disposal facility in the proposed area effect following issues?', followed by a list of 20 issues<sup>6</sup>. Answers were given in a five-step Likert style scale from 1 'Negatively' to 5 'Positively'. For this analysis, the scale was changed to a three-step scale to give more cases in different subgroups. The reported correlation coefficients are Kendall's rank correlation coefficients (Kendall's tau-b). Kendall's tau-b is a non-parametric measure of association that takes ties into account. Of the list of twenty issues, nineteen correlated statistically highly significantly and one (traffic connections) almost statistically significantly with the statement 'Nuclear waste produced by TVO and Fortum should be disposed of at Olkiluoto', demonstrating that the perceived impacts of the final disposal facility have a concrete affect on the residents' opinions towards the SNF facility. The issues showing the highest correlation with our statement regarding disposal at Olkiluoto are shown in Table II.

Table II. Highest correlations ( $\tau > .400$ ) between the benefits / impacts named in the survey and attitudes towards the statement 'Nuclear waste produced by TVO and Fortum should be disposed of at Olkiluoto' (Kendall's tau-b).

Perceived benefit or impact on	Correlation with statement
Respondents' own image of Eurajoki in particular	.455 (p= .000, N=237)
Respondents' own satisfaction with the area as a place to live	.442 (p = .000, N=234)
Respondents' own expectations for the future of the area	.424 (p= .000, N=236)
Respondents' own image of the area	.421 (p= .000, N=235)
Functioning environment / atmosphere of the area	.414 (p= .000, N=234)
State of the natural environment near to the final disposal facility	.406 (p= .000, N=234)

It is notable that issues such as employment, economic development and attainability of services do not feature in the list of top ranking correlations. Of these, economic development ( $\tau = .302$ ) ranked 11th, employment ( $\tau = .274$ ) 15th, and attainability of services ( $\tau = .259$ ) 18th. This indicates that acceptance is more closely related to industry awareness factors than nuclear oasis factors. The issues highlighted relate to general wellbeing in the community rather than economic pressures.

On other hand, Tables III and IV show that the relationship between the perceived impacts of the final disposal facility and opinions regarding final disposal at Olkiluoto is not straightforward. As can be seen in Table III, if the final disposal facility is perceived to have a positive impact on

<sup>6</sup> Own image of the area, own image of Eurajoki in particular, own expectations for the future in the area, own satisfaction with the area as a place to live, outsiders' image of the area, functioning environment / atmosphere in the area, the state of the natural environment surrounding the final disposal facility, development of the area generally, demographic development in the area, employment in the area, economic development in the area, attainability of services in the area, tourism in the area, culture in the area, development of the education sector in the area, farming and forestry, rural non-farm based livelihoods (fishing, hunting etc.), recreational possibilities in the area, city/municipality organization in the area, and traffic connections in the area.

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one's own view of Eurajoki, this correlates quite well with a positive view of final disposal at Olkiluoto and, vice versa, if the disposal facility is perceived to have a negative impact on one's own view of Eurajoki, this relates quite well (although not as closely) with a negative view of final disposal at Olkiluoto. From Table IV, however, can be seen that this is not exactly the case when we examine the correlation between the perceived impact of the facility on economic development and opinion towards final disposal. The relationship between perceived negative impact and negative view of final disposal at Olkiluoto seems to be quite strong, but if the final disposal facility is perceived to have a positive impact on economic development, this does not correlate nearly as closely with a positive view towards final disposal at Olkiluoto.

Table III. Attitudes towards the statement 'Nuclear waste produced by TVO and Fortum should be disposed of at Olkiluoto' compared to respondents' own image of Eurajoki, per category of perceived impact of the final disposal facility (%).

<b>Attitude towards the statement</b> <b>Perceived impact</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>
<b>Positive</b>	12	15	73
<b>Neutral</b>	30	34	36
<b>Negative</b>	61	21	18

Table IV. Attitudes towards the statement 'Nuclear waste produced by TVO and Fortum should be disposed of at Olkiluoto' compared to economic development in the area, per category of perceived impact of the final disposal facility (%).

<b>Attitude towards the statement</b> <b>Perceived impact</b>	<b>Disagree</b>	<b>Neutral</b>	<b>Agree</b>
<b>Positive</b>	27	21	53
<b>Neutral</b>	41	29	31
<b>Negative</b>	71	19	10

In the survey, residents' opinions regarding the possible expansion of the SNF repository were queried [7, 8, 35]. In 2008–2009 Posiva submitted two DiP applications for expansion for the needs of its owners Teollisuuden Voima (TVO) and Fortum Power and Heat (FPH), both of which have submitted a DiP application of their own for construction of a new NPP unit. However, competition for a license has tightened due to the entry of a new player, Fennovoima. This company also submitted a DiP application for a NPP unit, bringing the total number of companies currently interested in further construction in Finland to three. The Finnish

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government is not likely to issue all applications.<sup>7</sup> The new company, which is not a shareholder of Posiva, is interested in co-operating with Posiva in final disposal of SNF at Olkiluoto. So far, Posiva has not negotiated with Fennovoima, most likely due to the abovementioned competition.

This situation enabled a comparison of residents' opinions regarding acceptance of the SNF repository expansion for the needs of different actors. As previously, the five-step Likert scale used with these statements was changed to a three-step scale. The results show that the number of respondents (42%) agreeing with the expansion for the needs of Posiva's owners (TVO and FPH) was precisely at the same level as acceptance of disposal of SNF at Olkiluoto [Fig. 1; 7]. Only a small increase in opposition took place as 39% of respondents disagreed with the statement "I accept the expansion of the final disposal repository for the needs of TVO and Fortum" and 36% disagreed with SNF disposal at Olkiluoto [see Fig. 1]. Opinions are, however, clearly different if the SNF repository expansion is done for the needs of other Finnish actors. The survey suggests that if that were the case, the local acceptance level would decrease. Only 19% of respondents agreed with the statement "I accept the expansion of the final disposal repository also for the needs of other Finnish actors" and 62% disagreed with it. Thus, if local acceptance is seen as an indicator of industry awareness, then the results suggest that the level of 'industry awareness' is different when comparing the two situations. It is not only the SNF disposal that is evaluated by local residents, the actor, too, is taken into considerable account.

In Table V, the correlations between acceptance of expanding the repository for different actors and different perceived impacts are shown. Table V indicates how strongly residents' positive understanding of their own home district correlates with acceptance of expanding the repository for the needs of TVO and Fortum. Understanding of the present and future positive situation of Eurajoki and satisfaction with the local area increase acceptance of expansion of the repository for the needs of TVO and Fortum. There is a weaker correlation between these variables and acceptance of expanding the repository for needs of other Finnish actors [35]. The order of the list of statements having the highest correlation is also slightly different. In the case of possible other Finnish actors, the statement suggesting benefits scores the highest correlations, whereas in the case of TVO and Fortum the highest correlation is with the statement related to the respondents' own satisfaction with their local area as a place to live. This suggests that slightly different issues, and in a different order, are valued in relation to actors in different positions. An established actor (in this case TVO and FPH as the current owners of Posiva) is perhaps already part of the local culture and, thus, more readily regarded as a subject of local pride, whereas a newcomer is evaluated initially in terms of possible benefits. The outsider needs to earn its place and respect in the eyes of the local residents. The newcomer will, however, be much less readily accepted than an established actor.

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<sup>7</sup> According to the Nuclear Energy Act of 1987, a Decision-in-Principle must be first issued by the government and, if granted, the DiP must be further ratified by Parliament.

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Table V. Highest correlations between the benefits / impacts named and the statements presented in the survey, and attitudes towards the statements regarding acceptance of expanding the final disposal repository for the needs of different domestic actors (Kendall's tau-b).

Perceived benefit or impact on	Correlation with acceptance of expanding the repository for TVO and Fortum	Correlation with acceptance of expanding the repository for possible other Finnish actors
Respondents' own image of the area	.567 (p= .000, N=235)	.394 (p= .000, N=236)
Respondents' own expectations for the future of the area	.582 (p= .000, N=236)	.356 (p= .000, N=237)
Respondents' own satisfaction with the area as a place to live	.592 (p= .000, N=235)	.384 (p= .000, N=236)
Economic benefits of final disposal of nuclear waste will not compensate the non-economic costs	-.544 (p= .000, N=235)	-.374 (p= .000, N=236)
Benefits of final disposal of nuclear waste will exceed the costs	.553 (p= .000, N=228)	.415 (p= .000, N=229)

## CONCLUSIONS

The aim of the paper was to analyse the residents' perception of the SNF repository in the municipality of Eurajoki, Finland. According to the postal survey conducted in June 2008, less than half (42%) of the respondents in Eurajoki agreed and 36% disagreed with the statement "Nuclear waste produced by TVO and Fortum should be disposed of at Olkiluoto". The municipal council of Eurajoki issued a positive statement regarding the siting of the SNF repository in Olkiluoto, Eurajoki, in January 2000 [2]. The highest correlations ( $\tau > .400$ ) between this statement and the perceived benefits / impacts listed in the survey indicated that local acceptance is more closely related to industry awareness factors than nuclear oasis factors. Issues such as employment, economic development and attainability of services were notably missing from the top ranking correlations list (Table II). Of those listed, economic development ( $\tau = .302$ ) was 11th, employment ( $\tau = .274$ ) 15th and attainability of services ( $\tau = .259$ ) 18th in the ranking. Conversely, economic issues were ranked at the top of the agenda by local politicians during the compensation negotiations held in the late 1990s [2]. The nuclear oasis approach is also frequently used to explain the early phases of local decision-making regarding nuclear facility siting. The highest correlation ( $\tau = .455$ ) was with the statement regarding respondents' own image of Eurajoki, and the second highest ( $\tau = .442$ ) was with the statement regarding respondents' own satisfaction with the area as a place to live. This is seen as an indication of pride-effect in the nuclear community. Pride-effect during the post site selection phase seems to be related to perceptions of wellbeing in the host municipality. Pride is, however, closer related to an established actor than a newcomer. Furthermore, local acceptance is actor-dependent, suggesting that residents of a nuclear community do not automatically 'tolerate' all actors of the nuclear technology sector. Industry awareness is therefore not purely technology related, but has something to do with individual actors and their relations with the host municipality and its residents. This might be explained by a lack of social trust between the newcomer and the local residents.

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## ACKNOWLEDGEMENTS

This paper was accomplished as part of the following projects:

“Follow-up research regarding socio-economic effects and communication of final disposal facility of spent nuclear fuel in Eurajoki and its neighbouring municipalities” research project of the University of Jyväskylä and the University of Tampere. The project is funded by the Finnish Research Programme on Nuclear Waste Management (KYT2010 <http://www.ydinjatutkimus.fi>).

Two theories – one reality. Analysing Eurajoki as nuclear community. Dissertation research project founded by the Finnish Doctoral Program in Social Sciences; Graduate School for Cultural Research of Power and Governance.

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## IV

# **COMMUNITY DIVIDED. ADAPTATION AND AVERSION TOWARDS THE SPENT NUCLEAR FUEL REPOSITORY IN EURAJOKI AND ITS NEIGHBOURING MUNICIPALITIES**

by

Mika Kari, Matti Kojo & Tapio Litmanen 2010

Research report

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Mika Kari

Matti Kojo

Tapio Litmanen



# COMMUNITY DIVIDED

Adaptation and Aversion towards  
the Spent Nuclear Fuel Repository  
in Eurajoki and its Neighbouring  
Municipalities

Mika Kari – Matti Kojo – Tapio Litmanen

**COMMUNITY DIVIDED**

*Adaptation and Aversion towards the Spent Nuclear Fuel Repository  
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ISBN 978-951-39-4148-2 (paperback)

ISBN 978-951-39-4149-9 (PDF)

Cover design: Laura Konttinen

## Abstract

The report introduces the results of a survey conducted in the municipality of Eurajoki, the first municipality in the world to approve of the final disposal of spent nuclear fuel (SNF) within its own boundaries, and its neighbouring municipalities regarding issues connected to SNF repository project. Furthermore, two approaches to interpret the rationality of a nuclear community are discussed. The nuclear oasis approach suggests that local acceptance is based on the heavy dependency of a small, peripheral municipality on the powerful nuclear industry. The challenging industry awareness approach interprets the readiness to accept the siting of a SNF disposal repository from the perspective of cultural adaptation. A community and its residents have close relations to the nuclear industry, which produces cultural adaptation, integration and understanding of nuclear activities.

The findings indicate that those residents of Eurajoki who perceived the impacts of the repository to be positive to the general socio-cultural development of the municipality were more willing to accept an SNF repository in Olkiluoto. The importance of economic and employment factors behind the acceptance were identified, but the value of these issues was weaker than more general socio-cultural satisfaction factors. Such findings speak on behalf of the industry awareness approach. However, the picture is more complicated as the residents' cultural adaptation to the nuclear industry is neither harmoniously advanced nor homogeneously dispersed.

There is a latent social cleavage in the area studied. This means that there is a hidden division or dividing line of members into two factions or groups, among which there is a potential for conflict. For instance, there is a discrepancy between women and men in most issues. From the political point of view the findings suggest that residents in favour of the final disposal plan are most likely to be found among the supporters of the Coalition Party, the Centre Party and in some cases also the Social Democratic Party. Residents with a negative attitude towards the final disposal plan are more likely to be found among the supporters of the Green League and the Christian Democrats. The analysis of the data also indicates that the attitudes of those with higher income, better education, and occupational status are considerably more positive towards the final disposal than of those with lower income, less education, and lower occupational status. In some cases the differences are quite remarkable. People with higher incomes seem to deny or tolerate the risks of nuclear waste disposal or in some cases to hesitate about the risks.

Both the Finnish Radiation and Safety Authority (STUK) and the nuclear industry have succeeded in establishing a fairly trusted position as an information provider in the localities, but still the very same social division can be seen among the receivers of the information. This means that there are also local people who do not trust these actors as sources of information. Comparing the present findings to those drawn from the survey of 1994 one can say that the need for information seems to have changed from issues concerning safety towards issues concerning environmental and health effects.

The report is based on a resident survey conducted in June 2008 (Sample size 3000, response rate 20%, N=606). The research project was funded by the Finnish Research Programme on Nuclear Waste Management, KYT2010 ([www.ydinjatetutkimus.fi](http://www.ydinjatetutkimus.fi)).

Key words: *Spent nuclear fuel, nuclear waste, final disposal, opinions, Eurajoki, Finland.*

## Tiivistelmä

Eurajoki oli ensimmäinen kunta maailmassa, joka hyväksyi käytetyn ydinpolttoaineen loppusijoituksen alueelleen. Tämä raportti esittelee Eurajoella ja sen naapurikunnissa toteutetun käytetyn ydinpolttoaineen loppusijoitusprojektia koskevan mielipidekyselyn tuloksia. Lisäksi raportissa käsitellään myös kahta erilaista lähestymistapaa, joiden avulla voidaan tulkita ydinteollisuuspaikkakunnan suhdetta loppusijoitukseen. Ydinkeidas - lähestymistapa esittää, että paikallinen hyväksyntä käytetyn ydinpolttoaineen loppusijoituslaitokselle perustuu pienen, syrjäinen kunnan suureen riippuvuuteen voimakkaasta ydinvoimateollisuudesta. Haastava teollisuustietoisuus -näkökulma tulkitsee valmiutta hyväksyä loppusijoituslaitos kulttuurisen sopeutumisen näkökulmasta. Yhteisöllä ja sen asukkailla on läheiset suhteet ydinvoimateollisuuteen, mikä synnyttää kulttuurista sopeutumista, integroitumista ja ymmärrystä ydinteollisuuden toiminnalle.

Tulokset osoittavat, että ne Eurajoen asukkaat, jotka kokevat loppusijoituslaitosprojektin vaikutukset myönteisiksi kunnan yleiselle sosio-kulttuuriselle kehitykselle, ovat valmiimpia hyväksymään käytetyn ydinpolttoaineen loppusijoituslaitoksen Olkiluotoon. Taloudellisten ja työllisyys tekijöiden havaittiin olevan merkittäviä hyväksynnän kannalta, mutta näiden tekijöiden painoarvo oli heikompi kuin yleisten sosio-kulttuuristen tekijöiden. Tämän kaltaiset havainnot puhuvat teollisuustietoisuus-lähestymistavan puolesta. Todellisuus on kuitenkin monimutkaisempi, koska asukkaiden kulttuurinen sopeutuminen ei etene harmonisesti, ilman säröjä, eikä levittäydy tasaisesti.

Tutkimuksessa havaittiin piilevä sosiaalinen jakautuneisuus. Tämä tarkoittaa, että piilossa oleva jako erottelee jäsenet kahteen leiriin tai ryhmään, joiden välillä on olemassa konfliktin mahdollisuus. Esimerkiksi naisten ja miesten mielipiteet eroavat useimpien loppusijoitusasioiden suhteen. Puoluepoliittisesta näkökulmasta tulokset viittaavat siihen, että loppusijoitukseen suojeasti suhtautuvia löytyy todennäköisimmin Kansallista Kokoomusta, Suomen Keskustaa ja joissakin tapauksissa myös Suomen Sosialidemokraattista Puoluetta kannattavien riveistä. Loppusijoitukseen kielteisesti suuntautuvia asukkaita löytyy todennäköisemmin Vihreän liiton ja Suomen Kristillisdemokraattien kannattajien joukosta. Aineiston analyysi osoittaa myös, että suurempi tuloisten, paremmin koulutettujen ja paremmassa ammattiasemassa olevien asenteet ovat huomattavasti myönteisempiä loppusijoitusta kohtaan kuin heidän, joilla on matalammat tulot, alhaisempi koulutustaso ja heikompi ammattiasema. Jossain tapauksissa erot ovat todella huomattavia. Henkilöt, joilla on suuremmat tulot, näyttävät kieltävän tai sietävän loppusijoituksen riskit tai jossain tapauksissa epäröivän riskien suhteen.

Sekä Säteilyturvakeskus (STUK) ja ydinvoimateollisuus ovat onnistuneet vakiinnuttamaan melko luotetun aseman tiedonlähteinä paikallistasolla, mutta silti edellä mainittu sosiaalinen jako voidaan havaita myös tiedon vastaanottajien keskuudessa. Tämä tarkoittaa sitä, että paikallisissa asukkaissa on myös niitä, jotka eivät luota näihin toimijoihin tiedonlähteinä. Kun nykyisiä havaintoja verrataan vuonna 1994 tehdyn kyselyn havaintoihin, voidaan todeta että tiedon tarve näyttää siirtyneen turvallisuusasioista ympäristö- ja terveysvaikutusten suuntaan.

Raportti perustuu kesäkuussa 2008 toteutettuun asukaskyselyyn (Otos 3000, vastausprosentti 20%, N= 606). Tutkimusprojektia rahoitti Kansallinen ydinjätetutkimusohjelma, KYT2010 ([www.ydinjatetutkimus.fi](http://www.ydinjatetutkimus.fi)).

Avainsanat: *Käytetty ydinpolttoaine, ydinjäte, loppusijoitus, mielipiteet, Eurajoki, Suomi.*

## Referat

I denna rapport introduceras resultaten från en enkätundersökning som genomfördes i Euraåminne (på finska Eurajoki) och dess grannkommuner angående använt kärnbränsle. Euraåminne var den första kommunen i världen som godkänd slutförvaring av använt kärnbränsle inom sin egen kommungräns. Vidare diskuteras två olika tolkningsätt av rationaliteten i en kärnkraftkommun. Enligt kärnkraftsoas-tolkningen anses ett lokalt godkännande i en liten kommun basera sig på ett starkt beroende av kärnkraftsindustrin. Industrimedvetenhetstolkningen i sin tur föreslår att lokalbefolkningens villighet att acceptera slutförvaringsanläggningen sker genom kulturell anpassning. En kommun och dess invånare har ett mycket nära förhållande till kärnkraftsindustrin, vilket leder till kulturell anpassning, integration samt förståelse gentemot kärnkraftverksamhet.

Resultaten från enkätundersökningen tyder på att de invånare i Euraåminne som anser att slutförvaringsanläggningen har en positiv inverkan på kommunens sociokulturella utveckling är mer villiga att acceptera slutförvaringsanläggningen för använt kärnbränsle i Olkiluoto. Vikten av ekonomiska och sysselsättningsfaktorer i godkännandet av slutförvaringsanläggningen identifierades också, men dessa faktorer var svagare än belåtenhet gentemot mer generella sociokulturella faktorer. Dessa resultat försvarar det industrimedvetna tolknings sättet. Helhetsbilden är dock mångfasetterad eftersom den kulturella anpassningen gentemot kärnkraftindustrin varken framskrider enhetligt eller sprider sig homogent.

En latent social klyfta kan upptäckas i det studerade området. Detta tyder på en osynlig fördelning eller splittring bland invånare till grupper och organisationer inom vilka konflikter kan möjligen uppstå. Till exempel kan man se skillnader i kvinnors och mäns åsikter i de flesta frågorna. Resultaten visar även att de invånare som ser positivt på projektet, tillhör sannolikt Samlingspartiet, Centern i Finland och även i vissa fall Finlands Socialdemokratiska parti. De invånare som ställer sig negativt gentemot slutförvaringen av kärnbränsle, är högst antagligen anhängare av De Gröna och Finlands kristdemokrater. Analysen antyder även att invånare med högre inkomster, utbildning och arbetsposition inställer sig mer positivt gentemot slutförvaringen än de med lägre inkomster, utbildning och arbetsposition. I vissa fall är skillnaderna stora. Invånare med högre inkomster verkar dessutom förneka eller tolerera riskerna av kärnavfallshanteringen, eller i vissa fall ställa sig tveksamma mot riskerna.

Både Strålsäkerhetscentralen (STUK) och kärnkraftsindustrin har lyckats etablera sig som förtroendehavande informatörer i kommunerna, men även bland invånarna som tar emot informationen är den sociala klyftan synbar. En del av den lokala befolkningen litar alltså inte på dessa institutioner som informationskällor. När man jämför de nuvarande resultaten mot resultaten från enkätundersökningen som genomfördes år 1994, kan man se att informationsbehovet har skiftat från frågor gällande säkerhet till frågor om miljö och hälsa.

Denna rapport baserar sig på en enkätundersökning som genomfördes i juni 2008 (Urvalsstorlek 3000, svarsfrekvens 20%, N=606). Forskningsprojektet har finansierats av det Nationella kärnavfallshanterings forskningsprogrammet KYT2010 ([www.ydinjatetutkimus.fi](http://www.ydinjatetutkimus.fi)).

Nyckelord: *Använt kärnbränsle, kärnavfall, slutförvaring, opinion, Euraåminne, Finland.*

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## Abbreviations and terms

<b>COGEMA</b>	Compagnie Générale des Matières Nucléaires. Industrial group involved in all stages of the uranium fuel cycle. Subsequently AREVA NC a part of the AREVA Group (NC in the name meaning nuclear cycle).
<b>DiP</b>	Decision-in-Principle. According to Finnish Nuclear Energy Act (1987/990 §11-15,§18) the construction of a nuclear facility of considerable general significance requires in Finland a government decision-in-principle (by the Council of State, ratified by Parliament) that the project is in line with the overall good of society. The Government has to also ascertain that the municipality is in favour of the facility. After DiP a construction licence may be granted if other prerequisites set in Nuclear Energy Act are met.
<b>E.ON</b>	E.ON AG. Power and gas company. Part owner of Fennovoima (see Fennovoima).
<b>EIA</b>	Environmental Impact Assessment. Assessment of the possible impact that a proposed project may have on the environment, consisting of the natural, social and economic aspects. Required of all nuclear facilities including final disposal facility (see Final disposal facility).
<b>Fennovoima</b>	Fennovoima Oy. Power company. A newcomer to the Finnish energy markets and to the Finnish nuclear industry.
<b>Final disposal</b>	Permanent disposal of nuclear waste (see Nuclear waste).
<b>Final disposal facility</b>	Entirety comprising the rooms for the final disposal of the nuclear waste and the adjoining underground and aboveground auxiliary facilities. (See Final disposal and Nuclear waste.)
<b>Fortum</b>	Fortum Power and Heat Ltd. Energy company. An established actor in Finnish energy markets and in Finnish nuclear industry (formerly IVO, Imatran Voima Oy), a part of the Fortum Consortium. Fortum owns Posiva together with TVO (see Posiva and TVO).
<b>IVO</b>	Imatran Voima Oy. Former state-owned power company, subsequently (after privatisation) Fortum Power and Heat Ltd a part of the Fortum Consortium.
<b>JYT2</b>	Julkishallinnon ydinjätetutkimusohjelma, Public Sector's Research Programme on Nuclear Waste Management, 1994–1996.
<b>JYT2001</b>	Julkishallinnon ydinjätetutkimusohjelma, Public Sector's Research Programme on Nuclear Waste Management, 1997–2001.
<b>KYT2010</b>	Kansallinen ydinjätehuollon tutkimusohjelma, Finnish Research Programme on Nuclear Waste Management, 2006–2010.
<b>MEE</b>	Ministry of Employment and the Economy, former MTI Ministry of Trade and Industry.
<b>MTI</b>	Ministry of Trade and Industry, subsequently MEE Ministry of Employment and the Economy.
<b>MW</b>	Megawatt. Measure of power, equals one million watts.
<b>NGO</b>	Non-Governmental Organisation. A voluntary organisation which is not created by a government, with no governmental status or function and whose agenda is not set by a government.
<b>NIMBY</b>	Not-In-My-Backyard. Phrase used to illustrate the phenomenon of serious opposition to locating something considered undesirable in one's neighbourhood.

<b>NPP</b>	Nuclear power plant. Nuclear power production facility or facility complex which may include several adjacent NPP units, nuclear power plant units producing nuclear power.
<b>Nuclear fuel</b>	Material that can be used in a nuclear reactor to derive nuclear energy. The fuel most widely used by nuclear plants for power generation is uranium (see Uranium).
<b>Nuclear waste</b>	The Finnish Nuclear Energy Act (1987/990 §3) defines nuclear waste as radioactive waste in the form of spent nuclear fuel or in some other form, generated in connection with or as a result of the use of nuclear energy. The term is used in this report in a limited sense as a more convenient way expressing spent nuclear fuel. (See also SNF.)
<b>Posiva</b>	Posiva Oy. An expert organisation for the final disposal of spent nuclear fuel. Owned by Fortum and TVO (see Fortum and TVO).
<b>Repository</b>	Term meaning a place where things (in this case radioactive material) are deposited or stored and also a burial place. Used in this report as a synonym for (and more convenient way to express) final disposal facility (see Final disposal facility). [Although we use a broad interpretation of the term it can also be used more narrowly to refer only to underground parts of the facility or even only to the actual storage space(s) underground, but we saw no reason for such a strict interpretation in this context.]
<b>SEURA</b>	Seurantahanke käytetyn ydinpolttoaineen loppusijoituslaitoksen sosio-ekonomisista vaikutuksista ja tiedonvälityksestä Eurajoen ja sen naapurikuntien asukkaiden näkökulmasta, Follow-up research regarding the socio-economic effects and communication of final disposal facility of spent nuclear fuel in Eurajoki and its neighbouring municipalities.
<b>SNF</b>	Spent nuclear fuel. Fuel discharged from a nuclear reactor. (see Nuclear waste.)
<b>STUK</b>	Säteilyturvakeskus, The Finnish Radiation and Nuclear Safety Authority.
<b>TKS report</b>	Tutkimus, kehitys, suunnittelu, research and technology development report. A licensee under a waste management obligation has to submit periodically to the authorities (see MEE and STUK) about the planned nuclear waste management activities, a sufficiently detailed report containing plans for the following year and covering the next few years is to be updated every three years.
<b>TEKY</b>	Teollisuustietoisuus ja käytetyn ydinpolttoaineen loppusijoituksen hyväksyttävyyden tutkimusprojekti, Industry awareness and acceptance of final disposal of spent nuclear fuel research project.
<b>tU</b>	Tons of uranium. Uranium is radioactive heavy metal used as nuclear fuel. (See also Nuclear fuel and SNF.)
<b>TVO</b>	Teollisuuden Voima Oyj. Energy company. An established actor in Finnish energy markets and in Finnish nuclear industry. TVO owns Posiva together with Fortum (see Posiva and Fortum).
<b>TWh<sub>e</sub></b>	Terawatt-hours of electricity. Major energy production is usually expressed as terawatt-hours for a given period. A terawatt-hour is the amount of energy equivalent to a steady power of 1 terawatt (TW) running for 1 hour (1TW = 1,000,000 MW [see MW]).
<b>VTT</b>	Valtion teknillinen tutkimuskeskus, Technical Research Centre of Finland
<b>YJT</b>	Voimayhtiöiden ydinjätetoimikunta, Nuclear Waste Commission of Finnish Power Companies

## Foreword

As a small, typical rural municipality located in south-western Finland Eurajoki has gone through a great transformation. In the 1970s the municipality became the second location in Finland to host two nuclear power plant (NPP) units. The transformation process from a tranquil Eurajoki to a more lively nuclear community has not been without controversy. The problem of spent nuclear fuel (SNF) has been topical in the municipality ever since the 1970s. Until 1993 the municipality was negatively disposed towards the disposal of high-level nuclear waste in its area, but the next year, in 1994, the local council of Eurajoki removed the sentence forbidding the final disposal of nuclear waste in Eurajoki from the municipal report. In 1995, the municipality started more serious cooperation with the power company Teollisuuden Voima Oyj (TVO) on issues of nuclear waste management. On the grounds of the cooperation the municipality issued a positive statement to Posiva Oy's (Posiva) application in January 2000 for a Decision-in-Principle (DiP) for the construction of a final disposal facility for spent nuclear fuel. When Parliament ratified the DiP in May 2001, Eurajoki became a pioneering community by accepting the siting of the repository for the disposal of SNF. The siting decision has now been taken and the project has proceeded to the so called post site selection phase. This phase started with the planning, research and development work and it is expected to continue until 2020, when the repository should start its operations. The operational phase should continue at least until 2120. It will end with the decommissioning of the aboveground encapsulation plant and sealing of the repository.

Our report focuses on how the residents of Eurajoki and its neighbouring municipalities perceive their unique situation as test subjects of nuclear waste management. Ten years after the local decision-making, 17 years after the first sign of a change in the official opinion and over forty years of nuclear history, the local residents are still continuously assessing their commitment. The timeline, however, is short compared to the operation of the disposal repository, around 80–100 years, not to mention the timeline of the final disposal, which is thought to last tens of thousands of years, even hundreds of thousands years. A decision of such a great societal importance as this one certainly requires different kinds of analyses. Various stakeholders such as politicians, journalists, decision-makers, authorities, representatives of industry and the general public are curious: how local people in the area perceive different aspects of the repository project, and what are their opinions concerning final disposal of SNF in general at the moment, as once again Eurajoki is in the focus of wide international interest. Parliament ratified the positive Decision-in-Principle regarding the fourth NPP unit (Olkiluoto 4) and the expansion of the SNF repository at Olkiluoto Island in Eurajoki in July 2010. In addition to the Olkiluoto 3 NPP unit which is already under construction, this means that considerably more spent nuclear fuel will be generated and the timeline of the final disposal will also be changed. While various stakeholders have an interest in analyses at this stage of the project, one can surmise that future generations will also assess the decision from their own perspective, which increases the importance of analysing and documenting present attitudes towards this complex issue. In this report we offer an in-depth review of local attitudes in 2008.

The authors want to express their gratitude to several people and bodies for supporting and helping the conduct of the SEURA research project "Follow-up research regarding the socio-economic effects and communication of final disposal facility of spent nuclear fuel in Eurajoki and its neighbouring municipalities". The engagement in the Finnish Research

Programme on Nuclear Waste Management, KYT2010 ([www.ydinjatutkimus.fi](http://www.ydinjatutkimus.fi)) gave us an opportunity to realize our research ambition.

First and foremost, during the research process we could always count on the sociological and statistical expertise of Senior Lecturer Pertti Jokivuori (University of Jyväskylä). Energy policy experts, Professor Ilkka Ruostetsaari (University of Tampere) and research fellow Miikka Salo (University of Jyväskylä) have been good debate partners. Researchers Anne Pylkkönen and Anna Nurmi (both University of Jyväskylä) conducted their individual research projects alongside this main project, and latter also helped in the editing of this report. We appreciate discussions with the mentor group set up by the KYT research programme. Members of the group, Jaana Avolahti (MEE), Timo Seppälä (Posiva), Esko Eloranta (STUK), Heikki Leinonen (Carrum Ltd) and Mauri Vieru (MEE), have been our first hand contacts to the KYT research programme. In the space of three years two mentor meetings were held.

Finally we want to express our deepest gratitude to the residents of Eurajoki and its neighbouring municipalities. People in this area have been in the spotlight of researchers for decades and they are still willing to assist academic research by completing questionnaires. We are truly grateful. Thank You!

Jyväskylä, 9 December 2010

Mika Kari, Matti Kojo and Tapio Litmanen

## 1 Introduction

The final disposal of spent nuclear fuel (SNF) is approaching one milestone in Finland as the nuclear waste management company Posiva Oy (Posiva) is preparing to submit an application to the Council of State for permission to build an SNF repository by 2012. Due to the approaching new stage of nuclear waste management, updated information regarding opinions of the local residents is needed for the use of authorities and decision-makers. Furthermore, the revival of nuclear power in Finland has raised new issues regarding Finnish nuclear waste policy. One of the questions is where to dispose of SNF generated by the newcomer, Fennovoima Oy (Fennovoima), in Finnish nuclear industry.

The main objectives of the SEURA<sup>1</sup> research project were to study residents' opinions in the municipality of Eurajoki and its neighbouring municipalities regarding

- 1) socio-economic and socio-political impacts of the final disposal facility and
- 2) information needs and ways of obtaining information regarding the final disposal plan.

The SEURA research project was launched in 2008 as a cooperation between the University of Jyväskylä (Department of Social Sciences and Philosophy) and the University of Tampere (Department of Political Science and International Relations). The project was funded by the Finnish Research Programme on Nuclear Waste Management (KYT2010, [www.ydinjatetutkimus.fi](http://www.ydinjatetutkimus.fi)) 2008–2009. In 2010 the funded project was called TEKY<sup>2</sup>. Assistant Professor Tapio Litmanen (University of Jyväskylä) acted as the project manager and Matti Kojo Lic.Soc.Sc. (University of Tampere) and Mika Kari M.Soc.Sc (University of Jyväskylä) worked as researchers in both projects. Furthermore, Anne Pylkkönen M.Soc.Sc. and Anna Nurmi B.Soc.Sc (both University of Jyväskylä) worked as research assistants.

The main objectives of this SEURA final report are:

- 1) to present the results of the 2008 survey in one research report
- 2) to compare the results of the 2008 survey to some earlier survey results
- 3) to examine some possible explanations for attitudes towards final disposal

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<sup>1</sup> SEURA stands for "Seurantahanke käytetyn ydinpolttoaineen loppusijoituslaitoksen sosio-ekonomisista vaikutuksista ja tiedonvälityksestä Eurajoen ja sen naapurikuntien asukkaiden näkökulmasta", in English "Follow-up research regarding the socio-economic effects and communication of final disposal facility of spent nuclear fuel in Eurajoki and its neighbouring municipalities".

<sup>2</sup> TEKY stands for "Teollisuustietoisuus ja käytetyn ydinpolttoaineen loppusijoituksen hyväksyttävyyys", in English "Industry awareness and acceptance of final disposal of spent nuclear fuel".



Before this report the results of the resident survey were presented at a number of international conferences (Kojo, Kari and Litmanen 2008; Kojo, Kari and Litmanen 2009a; Kojo, Kari and Litmanen 2009b<sup>3</sup>; Kari 2009; Kari 2010a; Kari 2010b; Kojo and Kari 2010<sup>4</sup>; Litmanen and Kari 2010). So far two conference papers have been partly rewritten and published as articles in international reviewed journals (Kojo, Kari and Litmanen 2010; Litmanen, Kojo and Kari 2010). Three separate working reports on public meetings in the field of nuclear issues were published in the project (Pylkkönen, Litmanen and Kojo 2008; Nurmi, Kojo and Litmanen 2009; Nurmi 2010).

Residents' opinions in the candidate municipalities for the SNF repository have been a subject of interest earlier in Finland. Finnish power companies have funded a follow-up study "Energy Attitudes of the Finns" annually since 1983. Currently, the survey is conducted by the Finnish Energy Industries and Yhdyskuntatutkimus Oy (Kiljunen 2009). According to the Finnish Energy Industries "the research series has been used to clarify and follow people's attitudes towards questions on energy policy". The study also covers a few questions regarding nuclear waste management and an independent sample consisting of residents of Eurajoki has been included in the survey since 1984. This is the only long-term follow-up survey available in Finland. Regrettably, as the number and also the wording of the statements in the survey have varied to some extent since the early 1980s, there is only one statement regarding nuclear waste which have been asked annually since 1983 and one which has been asked since 1984. In the energy attitude survey some 230 people represent the population of the specific municipalities of the study, namely Eurajoki and Loviisa. Since the survey of 2004 the sample size in these two municipalities was increased to 320 people.

Since 1994, when the first nuclear waste resident survey was conducted in Eurajoki (Kurki 1995) by the researcher Osmo Kurki (University of Jyväskylä<sup>5</sup>), four other resident surveys have been carried out before this one; one in 1996 as part of the Public Sector's Research Programme on Nuclear Waste Management 1994–1996 JYT2 (Harmaajärvi, Litmanen and Kaunismaa 1998), one in 1999 as a part of Posiva's application process for a Decision-in-Principle (DiP<sup>6</sup>) (Posiva 1999a), and two in 2007, one as part of land-use planning in Olkiluoto area and one as part of Johanna Aho's<sup>7</sup> master's thesis (Aho 2008). The results of these surveys were reported in Posiva's environmental impact assessment (EIA<sup>8</sup>) report on repository expansion (Posiva 2008). Our survey was conducted in June 2008 as a part of the KYT2010 research programme, as already mentioned.

Moreover, Posiva commissioned two surveys of Corporate Image Oy which focused on image, the first of these was done 1998 and the follow-up survey 2006 (Ala-Lipasti, Karjalainen and Pohjola 1999; Posiva 2007; Seppälä 2010). These surveys targeted four municipalities which were at the time of the first survey candidates for the final disposal (Eurajoki, Kuhmo, Loviisa and Äänekoski) and for purposes of comparison one additional municipality (Naantali). The Department of Political Science and International Relations, University of Tampere conducted a survey focusing on local policymakers (e.g. Ponnikas 1998; 2000) and the chairs of local associations (Kojo 1999) in the same four candidate

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<sup>5</sup> Later Osmo Kurki worked as a communications manager in Posiva in 1996–2000.

<sup>6</sup> See Abbreviations and terms.

<sup>7</sup> Aho worked as a project coordinator in the Posiva communications department.

<sup>8</sup> See Abbreviations and terms.

municipalities as part of the JYT2001<sup>9</sup> research programme in 1997. In 2007 the University of Tampere and the University of Jyväskylä conducted a nation-wide survey focusing on energy issues in Finland (Litmanen et al. 2010) which also included some questions on nuclear waste policy and uranium mining in Finland (Litmanen 2009; Jartti 2010).

The interests of the energy industry and public administration in researching local opinions can be understood by the fact that according to the Finnish Nuclear Energy Act of 1987 a host municipality of a nuclear facility is vested with the right of veto. The veto can be overruled neither by the government nor Parliament. According to the legislation the right of veto is in the hands of the municipal council of the candidate municipality. The possible use of veto is expressed when the municipal council gives the Ministry of Employment and the Economy (MEE) its statement on the DiP application. The favourable statement of the municipal council is also required in the case of expanding the SNF repository. Surveys can also be seen as part of the changed approach to nuclear waste management. A general change from a technical approach towards a more participatory approach has been identified in a number of European countries (Bergmans et al. 2008). Since the early 1980s the opinions of the residents living in the host municipalities have carried more weight.

In the report of the 1994 survey Kurki (1995, 4) described the situation faced by nuclear industry as follows:

"So that TVO [Teollisuuden Voima Oyj] could proceed in time schedule of nuclear waste management more than half of the local councillors have to be in favour of construction of final disposal facility in next decade. In practise this means that at least one out of two of residents have to be in favour of construction of final disposal facility."<sup>10</sup>

Thus resident surveys are a tool for monitoring local opinion and effectiveness of implemented communications activities in a political system based on representative democracy.

Although local decision-making is respected, it is interesting to note that in Finland the focus has been on monitoring local opinion and not so much in engaging the public and developing novel public participation approaches at local level. For example, in Sweden there are a number of examples of dialogue projects conducted in the field of nuclear waste management since the early 1990s. In some of the projects candidate municipalities have had an active role. (Elam et al. 2008, 30–41.) In Finland citizen engagement was discussed to some extent in the late 1990s before the implementation of the EIA procedure in 1997–99, but no real effort was ever made. One explanation for this may have been lack of funding instruments<sup>11</sup> for the candidate municipalities, but also a lack of competence in public participation arrangements and, furthermore, local decision-makers did not favour new approaches beside representative decision-making (Ponnikas 1998, 21–23, 26–29). In a survey focused on the policymakers of the candidate municipalities 79% of policymakers in Eurajoki agreed that the

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<sup>9</sup> See Abbreviations and terms.

<sup>10</sup> Original in Finnish. Translation by the authors.

<sup>11</sup> For example, in Sweden candidate municipalities could apply for funding from the Nuclear Waste Fund. In Finland candidate municipalities were offered a chance to propose social scientific research subjects as part of a publicly funded research programme (JYT2001) in the late 1990s, but the municipalities could not apply for funds for their own use.

final word in the local decision regarding the nuclear waste siting should be given by the municipal council (Ponnikas 1998, 27).

In the survey of 1994 a questionnaire (Kurki 1995, 11–12) was sent to 600 respondents in the municipalities of Kuhmo and Äänekoski and to 300 respondents in the municipality of Eurajoki. Respondents were selected by random sampling based on address information provided by the Population Register Centre. The survey was conducted in November 1994 and reminders were sent in December. The response rate in Äänekoski was 58% and in Eurajoki and Kuhmo 49%. The results of the survey were reported in several publications (Kurki 1995; Litmanen 1996; Harmaajärvi et al. 1997; Litmanen 1999; Lahtinen 1999).

In the survey of 1996 (Harmaajärvi, Litmanen and Kaunismaa 1998), the questionnaire was sent to 600 residents in Eurajoki, to 1,200 residents both in Kuhmo and Äänekoski corresponding to about 10% of the inhabitants in these three municipalities, and to a further 600 residents living elsewhere in Finland. The response rate of the survey was 51%. In Eurajoki the response rate was somewhat less than 50% but the exact figure was not given. The survey was conducted in December 1996 by VTT the Technical Research Centre of Finland, Communities and Infrastructure and the University of Jyväskylä with funding from the Public Sector's Research Programme on Nuclear Waste JYT2. The focus of the survey was on residents' opinions regarding the importance of certain environmental impacts of final disposal of SNF. (Harmaajärvi, Litmanen and Kaunismaa 1998.) The results of the survey were also reported in the Final Report of the JYT2 research programme (Vuori 1997).

In early 1999 an opinion poll by telephone was conducted by Suomen Gallup Oy in the municipalities of Eurajoki, Kuhmo, Loviisa and Äänekoski. All the municipalities were host candidates at that time. The focus of the opinion poll was on the general acceptability of the final disposal project among the inhabitants of the research area. The sample covered ten percent of the population in each host candidate municipality. (Posiva 1999a, 167.) The opinion poll was funded by Posiva, who submitted the DiP application to the Council of State in May 1999.

The survey conducted by Aho in autumn 2007 was carried out as a postal questionnaire. It was sent to 400 residents of Eurajoki. The response rate was 49%. (Aho 2008, 24.) The objective was to study the trust of the residents in safe final disposal, the generation of trust and division of trust into different trust types. Some of the results were also reported in Posiva's EIA report (Posiva 2008, 111).

As part of a partial master plan for land use in Olkiluoto area, the consultants Ramboll Finland Oy conducted a survey focused on neighbouring residents and workers of Olkiluoto site in 2006–2007 (Posiva 2008, 113). Residents of the municipality of Eurajoki at large and residents of the municipality of Rauma were, however, also targeted by the survey. Overall the questionnaire was sent to 1,500 recipients. The response rate was 52%. Some of the results were reported in Posiva's EIA report. (Posiva 2008, 95.) Despite requests to TVO the Ramboll Report was never delivered to the SEURA research group.

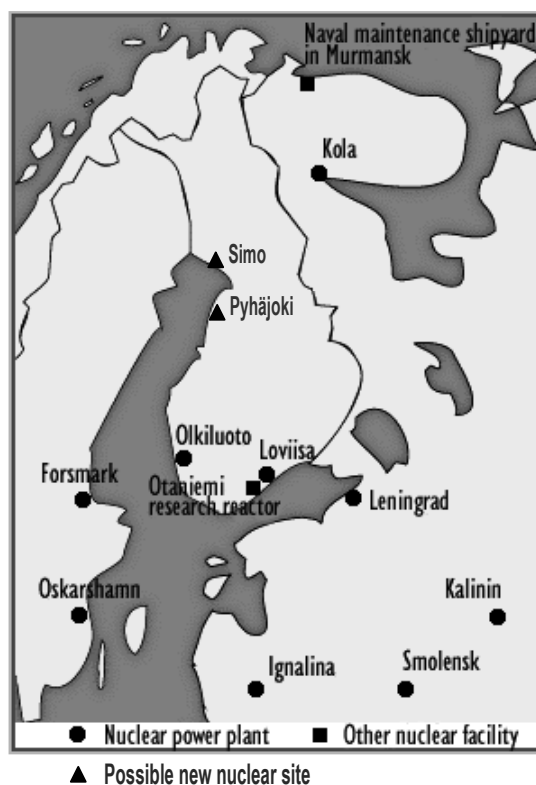
The structure of the report at hand is as follows. In Chapter 2 milestones of Finnish nuclear waste policy are introduced in brief. The chapter is partly based on an article published in the *Journal of Progress in Nuclear Energy* (Kojo, Kari and Litmanen 2010). The chapter was updated to cover the decisions regarding the nuclear power plant (NPP) applications in 2010. In Chapter 3 target population, sampling, the respondents of the survey and methods used in

the study are introduced. The non-response analysis is also introduced. In Chapter 4 the focus is on the sources people consult to obtain information on final disposal issues, how satisfied they are with the quantity and the reliability of the information provided by different actors and what kind of information needs they have in relation to these issues. In Chapter 5 the focus is on how people in the area perceive the effects of the construction of the final disposal facility and whether they feel that it poses some kind of threat. In Chapter 6 the main theme is to find out how willing or reluctant the respondents are to accept final disposal of SNF and its possible expansion for the needs of different nuclear power companies. In Chapter 7 the focus is only on respondents living in the municipality of Eurajoki. Chapter 7 is based on an article published in the International Journal of Nuclear Governance, Economy and Ecology (Litmanen, Kojo and Kari 2010) and a conference paper presented at the international "Managing Radioactive Waste" conference held in Gothenburg, Sweden, 15-17 December 2009 (Kari 2009). In Chapter 8 we conclude by pointing out some results which could be of general interest, characterizing the opinions from the point of view of the developments of the last decades and taking a look at rationality of nuclear community.

## 2 Milestones of nuclear waste policy in Finland

### 2.1 The nuclear power programme and the status quo

Currently in Finland there are four NPP units in operation. The NPP's are located at two sites, at Hästholmen in Loviisa some 100 kilometres east of the capital, Helsinki, and at Olkiluoto in Eurajoki, some 240 kilometres northwest of Helsinki (Figure 1).



**Figure 1.** Nuclear power plants and other reactors in Finland and nearby (STUK 2006)<sup>12</sup>. Possible sites for a new Finnish nuclear power plant facility added to the map.

<sup>12</sup> "Leningrad" (subsequently St.Petersburg) refers to Sosnovyi Bor NPP. Ignalina has been closed down.

All four reactors have been upgraded and their operating licences have been extended. In 2006 the four NPP units produced 22 TWh<sub>e</sub>, which was 28 percent of electricity production in Finland, making nuclear power the largest source of electricity nationally. By 2006 the four reactors had generated 1700 tU of spent fuel. In 1981–1996 spent nuclear fuel generated in the Loviisa NPP was shipped to the Soviet Union and Russia. The return was based on the agreement between the governments of Finland and the Soviet Union in 1969 regarding the use of nuclear energy in peacetime. The rest of the spent nuclear fuel is stored in interim storage at the reactor sites in Loviisa and in Eurajoki (Olkiluoto). The four units produce 35 tU of spent fuel annually.

In May 2002 Parliament ratified the DiP application of Teollisuuden Voima Oyj (TVO) regarding a new 1600 MW European Pressurized Reactor. This new NPP unit (Olkiluoto 3) is under construction in Olkiluoto, but it is over 36 months behind schedule. In 2007 the nuclear power utilities TVO and Fortum Power and Heat Ltd. (Fortum) announced their plans to construct new NPP units. TVO submitted a DiP application in April 2008 and Fortum in February 2009. TVO proposed Olkiluoto as the site for the new unit and Fortum proposed Loviisa.

A brand new company, Fennovoima, also submitted an application in January 2009. The new company, partly owned by E.ON AG (E.ON), had two site alternatives in the municipalities of Pyhäjoki and Simo in the northern part of Finland. Both sites are greenfield sites. When Fennovoima launched the site selection process for NPP in the summer 2007, the company had about 30 site alternatives. In October and December 2007 Fennovoima announced that it would start the EIA procedure in four municipalities. In June 2007 during the EIA procedure the company rejected the site in the municipality of Kristiinankaupunki (Pylkkönen, Litmanen and Kojo 2008, 15-18.) In December 2009 the company rejected the site in the municipality of Ruotsinpyhtää which was merged with the town of Loviisa. Thus there was a competition between the power companies for a favourable decision-in-principle regarding the new NPP unit.

However, the leading ministers had differing views on the number of new NPP units needed. During the debate on additional nuclear energy in 2008 and 2009 the ministers of the Centre Party of Finland, for example Prime Minister Matti Vanhanen and Minister of Economic Affairs Mauri Pekkarinen, seemed to be ready to accept one unit, whereas Minister of Finance Jyrki Katainen and the National Coalition Party called for approval for all three new applications (MTV3, 8 February 2008; Hufvudstadsbladet, 16 March 2009; MTV3, 19 March 2009; Kaleva, 17 August 2009; YLE, 17 August 2009; YLE, 10 September 2009). The Green League, which is the second minor party in the government, strongly opposed the expansion of nuclear power. In the government's new long-term climate and energy strategy for Finland, approved in November 2008, the nuclear option was left open by stating that the additional construction of nuclear energy generation would be necessary in the next few years, i.e. during the term of the present government. However, this was based on the premise that nuclear power would not be constructed in Finland for the purposes of permanent export of electricity (Government Report 2008). The nuclear option was mentioned in the government programme of 2007, too (Government Programme 2007, 40). In the negotiation on the government programme of 2007 the political parties agreed that the Green League could vote against a new build of nuclear power if the Government took a DiP on nuclear power.

Minister Pekkarinen introduced the Government's proposal on 21 April 2010. According to the proposal, the Government would make favourable decisions on the construction of additional nuclear power based on the DiP applications submitted by TVO and Fennovoima. The application by Fortum would be rejected. In the same context, a positive DiP would be made on Posiva's application regarding the management of SNF from TVO's new unit (Olkiluoto 4). The corresponding application by Fortum would meet with a negative decision. (MEE 2010a.) Furthermore, as a precondition of Fennovoima it was determined that the company should introduce either a co-operation agreement with Posiva on SNF management or an EIA programme of its own regarding a final disposal facility for SNF. The precondition must be fulfilled in six years after the ratification of the DiP by Parliament. The government took the decision on 6 May 2010 after a vote. The ministers of the Finnish Green League voted against approval of the applications (MEE 2010b). On 1 July 2010, Parliament voted 120-72 in favour of the DiP approving the construction of the Olkiluoto 4 unit by TVO. The favourable DiP regarding Fennovoima's application to construct a new NPP unit in Simo or Pyhäjoki was also approved, by 121 votes to 71. (MEE 2010c).

The nuclear waste management company Posiva submitted a DiP application to expand the final disposal repository at the same time as its main shareholder TVO in April 2008. Posiva's application covered the disposal capacity of a maximum of 9000 tU. Furthermore, Posiva implemented an EIA procedure for the further expansion of the repository in 2008 because of the NPP application of Fortum. A new DiP application was submitted by Posiva in March 2009. The aim was to expand the capacity of the repository to a maximum of 12,000 tU.

Fennovoima in its statement on the Posiva EIA programme of 2008 proposed that capacity should cover disposal of 18,000 tU. The contact authority of the EIA procedure, the Ministry of Employment and the Economy (MEE), however, did not require capacity of 18,000 tU in its statement on the Posiva EIA programme (MEE 2008). However, Posiva declared that the company would only take care of SNF produced by its owners, that is, TVO and Fortum. According to the managing director of TVO, Jarmo Tanhua, Fennovoima had to organise SNF management by it self (YLE, 17 September 2009). Thus Posiva rejected the idea of disposing of spent fuel produced by Fennovoima. Fennovoima based its NPP plan on joint nuclear waste management with Posiva, but the competing companies have not even been able to start negotiations on the issue. Posiva has even gone so far as to deny the very existence of national nuclear waste management (Satakunnan Kansa, 12 August 2008; see also Kojo 2010). According to the managing director of Posiva, Reijo Sundell, a second SNF repository will be needed in Finland in future as the disposal capacity of the one under construction at Olkiluoto will not be enough for more than the disposal of spent fuel generated by seven NPP units (YLE, 26 March 2010).

According to the Nuclear Energy Act, the nuclear waste producers, the utilities, are responsible for the management and all costs of nuclear waste management. The Finnish Radiation and Nuclear Safety Authority (STUK) is responsible for safety aspects. According to the Nuclear Energy Act the Government shall ascertain that the municipality where the nuclear facility is to be located is in favour of the facility and that no facts indicating a lack of sufficient prerequisites for constructing a nuclear facility have arisen. Thus the local council of a proposed site of a nuclear facility is vested with the right of veto. A preliminary safety assessment from STUK is also required. The Ministry of Employment and the Economy (MEE, until 31 December 2007 the Ministry of Trade and Industry, MTI) prepares the policy decisions regarding nuclear waste management.

## 2.2 Nuclear waste policy in brief

The four NPP units in operation were built in the 1970s. In 1978 the Atomic Energy Act, dating from 1957, was amended to take account of nuclear waste management. According to the amendments the licence holder of an NPP unit assumes responsibility for all measures and costs relating to nuclear waste management. Under the Atomic Energy Act, detailed regulations were incorporated into the licences issued to NPP units (Posiva, 1999a, 3).

Nuclear waste policy for waste generated in Loviisa NPP was based on returning the fuel to the Soviet Union, as mentioned in Chapter 2.1 above. TVO negotiated for a reprocessing contract with the British company British Nuclear Fuels and the French company COGEMA<sup>13</sup>. The board of TVO abandoned reprocessing plans in the early 1980s for purely financial reasons. Foreign policy has also been seen as a reason for change in nuclear waste policy (Suominen 1999). The economic viability of reprocessing was assessed in 1990, but neither the circumstances nor the costs had changed significantly (Posiva 1999a, 12–13). In February 2008 TVO argued on economic aspects as the company rejected the vision of reprocessing as a part of Finnish nuclear waste management in coming decades (Satakunnan Kansa, 20 February 2008). The return of reprocessing was proclaimed by Jukka Laaksonen, the director general of the Radiation and Nuclear Safety Authority, in an interview (Loviisan Sanomat, 15 February 2008; see also Virtanen 2009; Satakunnan Kansa, 23 April 2010). Thus the possible revival of nuclear power programmes in Europe and elsewhere and rising uranium prices might pose new challenges for Finnish nuclear waste policy in the form of a global nuclear fuel cycle.

Although the utilities have each had their own nuclear waste policies since the early days of nuclear power production in Finland, there has been some co-operation, too. In 1978 the companies set up the Nuclear Waste Commission of Finnish Power Companies (Ydinjätetoimikunta, YJT) to coordinate research and development activities. Due to the cooperation the first nuclear waste management programme was completed in September 1978. However, it took until 1995 before the utilities established a joint company, Posiva, for spent nuclear fuel management.

The main input for closer cooperation was the amendment in 1994 to the Nuclear Energy Act of 1987. According to this amendment nuclear waste produced in Finland "shall be handled, stored and permanently disposed of in Finland" (Nuclear Energy Act 990/1987). Thus the spent fuel policy of Loviisa NPP was changed. In 1983 the Council of State took the decision-in-principle on the aims and schedules relating to the implementation of nuclear waste management and associated research and planning. The decision of 1983 also included the overall schedule for nuclear waste management in Finland. The Government's timetable was based on the schedule presented in the TVO programme (Raumolin 1982, 5,7) for the final disposal of spent fuel (Table 1).

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<sup>13</sup> See Abbreviations and terms.



**Table 1.**Timetable of 1982 for spent fuel final disposal by TVO<sup>14</sup>.

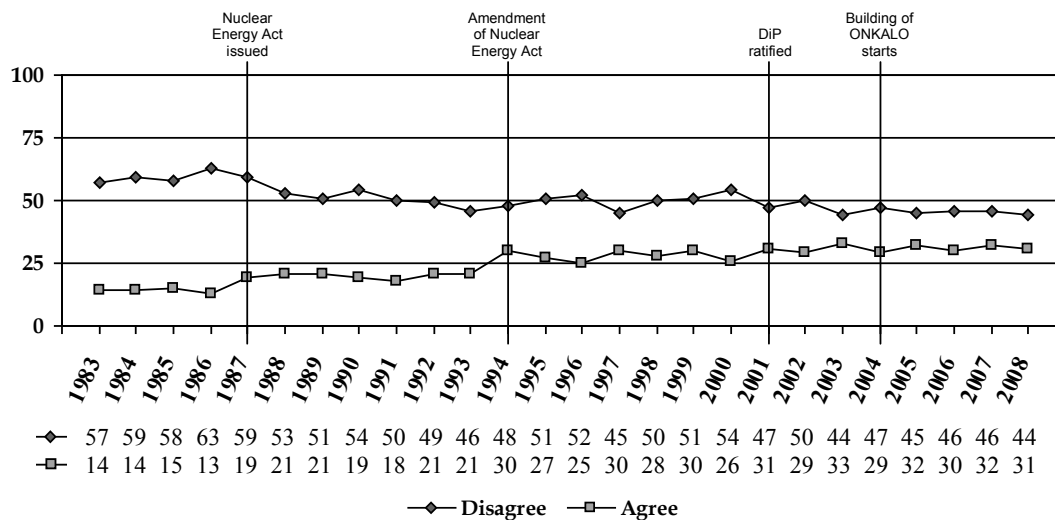
<b>1980 – 1982</b>	Suitability study with safety analyses
<b>1983 – 1985</b>	Preparation for the preliminary site characterization
<b>1986 – 1992</b>	Preliminary site characterization in chosen areas (5–10 sites)
<b>1993 – 2000</b>	Additional siting studies (2–3 sites)
<b>2001 – 2010</b>	Detailed studies of chosen disposal site and preplanning of the siting and the encapsulation plant
<b>2011 – 2020</b>	Planning and construction of the disposal site and the encapsulation plant
<b>2021 – 2050</b>	Final disposal facility is operational
<b>2050 – 2060</b>	Closing of disposal site

Posiva submitted the application for the repository for SNF in May 1999. The amount of waste applied for was a maximum of 9000 tU. This amount covered the SNF produced in six NPP units. However, due to the TVO application of 2000 regarding the new NPP unit (Olkiluoto 3, which is currently under construction) Posiva changed its application in November 2000. The company asked the Council of State to decide on the disposal of SNF produced in TVO's new unit, approximately 2500 tU, at the same time as TVO's reactor application. Disposal capacity was also decreased as the updated application covered only SNF produced by four NPP units in operation, approximately 4000 tU. The Council of State made the DiP in December 2000. Parliament ratified the decision in May 2001. The favourable DiP regarding the expansion was taken in January 2001. The expansion of the repository was approved by Parliament in May 2002 when Parliament voted for the construction of the new NPP unit.

According to the survey by Finnish Energy Industries, Finns' attitudes towards the statement "Nuclear waste can be disposed of safely in the Finnish bedrock" have become more confident in 25 years (Figure 2). In 1983, when the survey was conducted for the first time, 57% of respondents disagreed with the statement and only 14% agreed. It was only in the year 1992 that the number of those respondents disagreeing was under 50%. It is noteworthy that at nearly the same time, between 1993 and 1994, the number of those agreeing increased by nine percentage points. In September 1993 Parliament rejected the application for further construction of nuclear power and in 1994 the amendment to the Nuclear Energy Act of 1987 was enacted. According to the amendment, import and export of nuclear waste were prohibited and power companies were obliged to dispose of nuclear waste in a permanent manner in Finland. Thus the idea of national nuclear waste model was introduced.

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<sup>14</sup> Source: Raumolin (1982, 7).

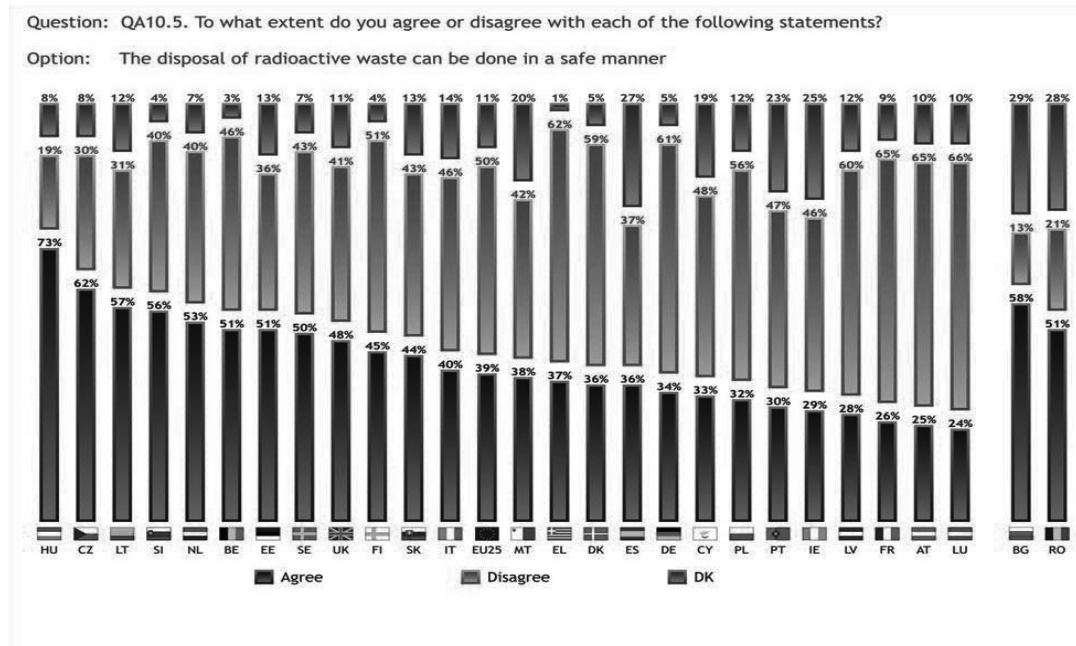


**Figure 2.** Finns disagreeing and agreeing with the view that final disposal in the Finnish bedrock is safe (%). Based on data from the annual Energy Attitudes of the Finns (1983-2008) study<sup>15</sup>.

The debate on new build of nuclear power in 1997–2000 seems to have increased the feeling of mistrust regarding safe disposal as in 2000 the number of those respondents disagreeing with the statement "Nuclear waste can be disposed of safely in the Finnish bedrock" was again over 50%. However, the number of those agreeing decreased only a few percentage points. Since the approval by Parliament of Posiva's DiP application for final disposal of spent nuclear fuel in May 2001 the numbers of those disagreeing and agreeing remained more or less constant. After more than two decades of investigations and national as well as local decisions on final disposal, 44% of Finns disagreed with the statement and 31% agreed. The number of those disagreeing decreased 13 percentage points and those agreeing increased 17 percentage points. The number of those who did not know was 25% in 2008, whereas in 1983 the figure was 29%.

Despite of the fact that Finns tend to have positive perceptions of the value of nuclear energy and that Finns' trust in nuclear safety authorities and nuclear power industry is very high in the European context, the trust in the safety of the disposal of radioactive waste is not, however, at the same level (Eurobarometer 2007). Surprisingly, the share of those who agreed with the statement "The disposal of radioactive waste can be done in a safe manner" was 45% while 51% disagreed. The question was asked as part of the section eliciting perceptions of the risks associated with nuclear energy. Among the 27 European countries Finns' trust in the safety of disposal was neither among the highest nor the lowest when the shares of those agreeing with the statement were compared. (Eurobarometer 2007, 29; see Figure 3.)

<sup>15</sup> More on the study in Chapter 1.



**Figure 3.** Europeans disagreeing and agreeing with the view that disposal of radioactive waste can be done safely. According to Eurobarometer 2007.

The timetable of 1983 set by the Council of State has so far been changed only once. In 2003 the Ministry of Trade and Industry (MTI) decided that the companies must submit the final applications for the construction licence by 2012 at the latest. As shown in Table 1, originally the aim was to submit the application in 2010. The change in the timetable was argued for by ensuring the safety of the repository. The DiP of 2000 is valid until 2016. (Kojó 2004, 232.)

Since 2003 Posiva has prepared three three-year plans for the nuclear waste management of the Olkiluoto and Loviisa nuclear power plants. These TKS reports<sup>16</sup> have included plans for future research, technical design and development work as well as assessments of the state of nuclear waste management, with particular regard to the preparations for the disposal of SNF. TKS-2003 covered the research period extending from 2004 to 2006, TKS-2006 covered the period extending from 2007 to 2009 and TKS-2009 covered a detailed plan extending from 2010 to 2012 and a general plan covering the subsequent three-year period from 2013 to 2015. The latest report (TKS-2009) also provided a direct response to the requirements concerning the report to be submitted to MEE as stated in Section 28 of the Nuclear Energy Act. (Posiva 2010a, 3.) At the same time as the TKS-2009 programme MEE was provided with a construction licence readiness report, the final disposal facility's pre-licence material for the construction licence application. The material shows the current readiness of the reports required for the licence application, and specifies what parts of the material required for the licence still need to be supplemented. (Posiva, 30 October 2009.)

Posiva is obliged to submit the construction licence application for the SNF repository by 2012 and the operating licence application by 2018. The final disposal is scheduled to start in

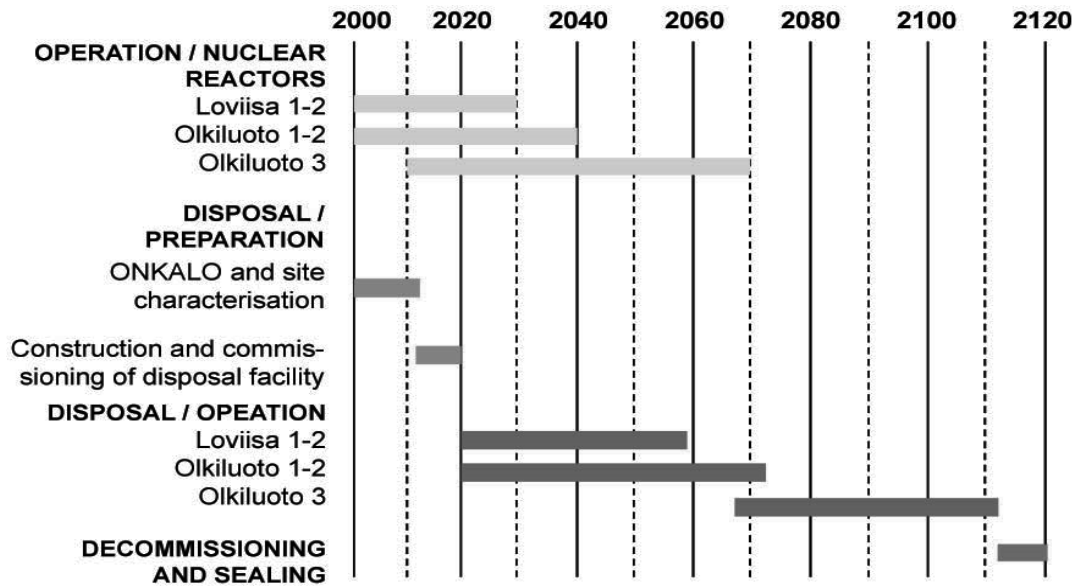
<sup>16</sup> See Abbreviations and terms.

2020. According to Posiva's current plans, the final disposal would end in 2112 and the repository would be sealed up by 2120. (Posiva 2010b; see Figure 4.) As Parliament agreed to the granting of the new NPP licences in July 2010, the schedule will be changed.

The Finnish legislation concerning nuclear energy was reformed in 2008. Parliament approved the Government's legislative proposal for amending the Nuclear Energy Act (Government Bill 117/2007) on 7 May 2005, and the amended Act entered into force on 1 June 2008. As part of the legislative reform, a number of the relevant Government decisions were replaced with Government decrees. The decrees entered into force on 1 December 2008. For example, the Government Decision 478/1999 regarding the safety of disposal of SNF was replaced with Government Decree 736/2008, issued 27 November 2008. (See Posiva 2010a, 10.)

The passing of the amendment to the Nuclear Energy Act and Government Decree 736/2008 saw a partial redefinition of the relevant terminology. According to the Nuclear Energy Act, the term *nuclear facility* refers to facilities necessary for obtaining nuclear energy, including research reactors, facilities performing extensive disposal of nuclear waste, and facilities used for extensive fabrication, production, use, handling or storage of nuclear material or nuclear waste. Section 2 of Government Decree 736/2008 divides the facilities and buildings required for the disposal of spent nuclear fuel into two separate nuclear facilities – the encapsulation plant and the actual disposal facility. The term *disposal facility* refers to an entirety comprising the rooms for disposal of the waste packages (*repository facilities*) and the adjoining underground and aboveground auxiliary facilities. (Posiva 2010a, 10.) For our use of various terms used in this report please refer to Abbreviations and terms section at the beginning of the report.

During the last few years the option of reprocessing SNF has been repeatedly taken into the discussion by STUK (e.g. Loviisan Sanomat, 15 February 2008; Virtanen 2009; Satakunnan Kansa, 23 April 2010). According to STUK director general Jukka Laaksonen, (Satakunnan Kansa, 23 April 2010) technology could develop so that the direct final disposal of SNF would be abandoned and fuel would be recycled over time.



**Figure 4.**  
Timetable of final disposal. According to Posiva (2010b).

The nuclear waste management company Posiva submitted a DiP application for expanding the final disposal repository at the same time as its main shareholder, TVO, in April 2008. Posiva's application covers the disposal capacity of a maximum of 9000 tU. Furthermore, Posiva implemented an EIA procedure for the further expansion of the repository in 2008 because of the NPP application of Fortum. A new DiP application was submitted by Posiva in March 2009. However, as the DiP application for a new NPP unit by Fortum was rejected by the government, Parliament approved only the expansion of the final disposal repository for SNF arising from TVO's Olkiluoto 4 project. The DiP in favour of Posiva's plan was ratified by 159 – 35 votes (MEE 2010c).

A whole new chapter in Finnish nuclear waste policy will begin if Fennovoima decides to apply for a DiP for a second SNF repository. As mentioned earlier, this option was introduced in the government's prerequisite to Fennovoima in May 2010. In practice a second repository would provide additional disposal capacity of thousands of tons of uranium. According to STUK director general Laaksonen the safety of the repository would not be a concern. Furthermore, it was noted by a STUK director that hundreds of candidate sites had already been identified in the 1980s. Those sites just needed to be further investigated. (Satakunnan Kansa, 23 and 24 April 2010).

### 2.3 The site selection process

The concept of site selection strategy partly helps to understand why the siting process of a final repository for SNF was so smooth in Finland. The formation of nuclear waste policy was described in brief in Chapter 2.2. There we explained how the policy setting changed and how the utilities started to cooperate in SNF management based on direct geological disposal. The reprocessing alternative was finally rejected in the mid 1990s. Chapters 2.3 and 2.4 focus on

explaining the chain of events by which the municipality of Eurajoki became the site of the final disposal repository. Firstly, the siting programme is analysed with the help of the concept of site selection strategy in 2.3 and secondly, the local decision-making process is introduced in 2.4.

According to Sundqvist (2002, 110)

"...a site selection strategy is the base from which the surrounding world is interpreted, and also identifies the tasks that have to be carried out. The strategy is used as a tool for understanding, interpreting and manipulating reality, and will therefore shape the identity of the organization as well as its view of the external world."

While analysing Swedish nuclear waste policy Sundqvist has identified two different kinds of siting strategies: systematic, referring to a strategy based on the use of specific criteria and systematic comparisons between different regions, areas and sites, in a sequential order of distinct siting phases and flexible, referring to voluntariness and local acceptance by a municipality. The latter strategy is characterized by the possibility of "muddling through" without being constrained by excessively detailed requirements (Sundqvist 2002, 125).

The site selection strategy in Finland gradually changed from systematic to more flexible in the 1980s–1990s (see Kojo 2009, 168–174). According to Anttila (1995, 7) the elimination of potential sites was based on purely geological criteria in Finland. Thus siting followed a classic elimination process (Richardson 1998, 10). The site selection strategy was thus initially systematic. Litmanen (1994, 23, 139–141) and Anttila (1995), however, already concluded in the mid 1990s that the purely geological elimination process was in a state of change in Finland and that environmental and social criteria were being emphasised instead of purely geological criteria. For example, Litmanen (1994) was the first scholar to pay attention to local siting conflicts in Finland. Although the nature of the local conflicts and their feedback on the siting process were not as dramatic as in some other countries, the local conflicts did indeed affect the site selection strategy applied. Gradually the informing and involvement activities of local residents were emphasized (Kojo 2005; Hokkanen, 2007) and the nuclear industry negotiated in closer partnership with the local politicians regarding the siting of the repository.

Deviation from the systematic siting strategy occurred in the early stages of the research. Litmanen (1994, 23) notes that geological criteria were applied to the selection of the areas, but that investigation sites were not chosen on strictly geological principles. Anttila (1995) makes the same comment as Litmanen on the site selection. Anttila states that in recent years the selection of the final disposal site the importance of environmental and social factors clearly exceeded geological criteria. In the mid 1980s STUK emphasised the importance of selecting different geological environments (McEwen and Äikäs 2000, 48), but at the end of the 1990s no ranking of the four candidate sites in the municipalities of Eurajoki, Kuhmo, Loviisa and Äänekoski was required by the authorities. Posiva concluded in its DiP application that in all four areas researched it was possible

"...to show sufficiently large and sufficiently integrated rock capacities, where the conditions are chemically and mechanically sufficiently suitable and stable to provide a sufficient barrier to prevent the release of radioactive substances, and which are suitable for the construction of final disposal facilities." (Posiva 1999b, App. 5 p.28).

Posiva (1999b, App. 5 p.35) also stated that the containment capacity of the final disposal facility would be effective without the influence of the bedrock and Nature. The conclusion of the safety analysis was that "no surveyed area can be regarded as clearly safer than the others, neither does the safety analysis give any reason to discard any of the alternatives" (Posiva 1999b, App. 5 p.40). Thus the conclusions of Posiva were in line with the recommendation of an international expert group who had proposed in 1993 that "choice of a site should not aim at finding the "best possible site", but a "suitable" site that complies with the safety criteria of a final disposal facility built in line with multi barrier principle." (Posiva 1999b, 8.) The strategy applied called for a more sensitive approach on local level, too.

## **2.4 Local decision-making in Eurajoki**

In the 1970s Eurajoki became a nuclear community, that is, a municipality where nuclear facilities, like NPP units and waste storage facilities, are located. Until 1993 the municipal report included a sentence forbidding the disposal of nuclear waste in Eurajoki. In the early days of TVO's nuclear power production spent nuclear fuel management was based on the plan to reprocess waste using a foreign reprocessing service. Indeed, under some pressure, TVO in 1980 gave a written undertaking not to dispose of spent nuclear fuel in the Olkiluoto area. The company, however, needed to reconsider its nuclear waste policy towards the end of 1980s. As explained in Chapter 2.2 the reprocessing option was assessed to be too expensive. Later on the reprocessing option became illegal in Finland because of the 1994 amendment to the Nuclear Energy Act. Thus TVO was in search of a site for a repository.

The siting process was launched in the early 1980s (McEwen and Äikäs 2000; Kojo 2009). In 1985 TVO announced a list of 102 sites suitable for further investigation. Of these 101 were "a result of the systematic selection and elimination process" (Vieno et al. 1992, 22). The Olkiluoto site in Eurajoki was included in the list as an exception. According to the company's safety analysis, the site of the NPP was in a special position because of its short transport distance. The other reason given was that because of the rock block identification method, coastal areas were sparsely represented as the method used was not suitable for coastal areas. (McEwen and Äikäs 2000, 9,46.) One screening phase took place in 1992–93. As the local opponents knew this, they tried to push the company by sharpening the forbidding sentence in the municipal report. At first the opponents were successful, but in 1994 the local council after a vote removed the sentence and neutralized the stance of the municipality regarding the siting. In 1995 the municipality signed a cooperation agreement with TVO. One aim of TVO was to safeguard the development of nuclear waste management in Olkiluoto. The main interest of the municipality in signing was to safeguard its level of tax revenue as the taxation system was reformed in the early 1990s. The idea of compensation was also introduced in the agreement.

The cooperation between the municipality and TVO was further developed during the late 1990s. Some time around 1996–97 TVO raised the siting issue. A series of discussions and negotiations was launched which resulted in a new municipal strategy, including the Olkiluoto vision, and signing of the Vuojoki Agreement in 1999. In the Olkiluoto vision the municipality issued a positive statement on both the further construction of nuclear power and on siting the repository in Olkiluoto. In 1999–2000 the municipality negotiated a package of economic benefits with TVO and Posiva which helped the municipality to overcome the liquidity problems it faced due to the reimbursement of the real estate tax of the TVO nuclear facilities granted in 1993–94. (Kojo 2009, 177–185). Thus, in a relatively short period, 1994–

1998, the municipality of Eurajoki experienced a total change in its stand regarding the siting of a repository. The negative statement was neutralized and finally a positive signal was given. The local council of Eurajoki approved a positive statement on Posiva's DiP application in January 2000. As a precondition it was stipulated that only nuclear waste generated in Finland should be disposed of in Olkiluoto. Another precondition, not written in the statement, but stated in the compensation negotiations, was the requirement for compensation regarding the real estate tax of the TVO nuclear facilities of 1994 (Kojo 2009, 184).

The Council of the State granted the DiP in December 2000 after rejecting of appeals against the positive statement of the municipality by the Supreme Administrative Court. Two appeals were first submitted to the Administrative Court in February 2000 and later in May 2000 to the Supreme Administrative Court. Parliament ratified the DiP in June 2001 by 159–3 votes (Raittila and Suominen 2002). What then happened in Eurajoki in the post site-selection phase, that is, after the political decisions to approve the site selection? A year later, in May 2002, Parliament approved the expansion of repository capacity as TVO's DiP application regarding the new NPP unit was approved. A new procedure for repository expansion was launched in 2008 as mentioned in Chapter 2.1 due to the new NPP applications (see also Nurmi, Kojo and Litmanen 2009).

New build has been under construction at Olkiluoto since 2005 as TVO selected the Olkiluoto site for the new NPP unit, Olkiluoto 3, in October 2003. According to the latest estimations the Olkiluoto 3 unit should be operational by 2012, more than three years behind schedule (Lampinen 2009). For the municipality the delay yielded more tax revenue. The total tax revenue of 32 M€ for the fiscal year 2009 included 10 M€ of real estate tax and roughly 5 M€ of income tax paid by the construction workers of the Olkiluoto 3 unit. A surplus of roughly 12 M€ is extremely high and exceptional, yet for 2010 a surplus of 5.6 M€ is expected (Satakunnan Kansa, 2 December 2009). Due to the new build at Olkiluoto the share of real estate tax has increased as in the early 2000s it was around 20% of total municipal tax revenue. The annual real estate tax of the repository is estimated to be 3.5 M€ in 2020.

Posiva moved its headquarters to Eurajoki in 2002. In 2002, 15 actors, the municipality of Eurajoki and Posiva among them, established the Vuojoki Foundation to develop the use of the Vuojoki Mansion. The mansion, which was used as old people's home until 2003 and owned by the municipality was in a central role in the compensation negotiations between the company and the municipality in the late 1990s. The new health and social service centre was built in Eurajoki on the funding compensation by Posiva. (Kojo 2009.) Renovation of the Vuojoki Mansion was started in 2004. The budget was 4.3 M€ including the financing from the municipality of 660,000 € and public funding (European union and the State of Finland). Posiva paid the rest of the costs, roughly 2.6 M€. The opening of the renovated mansion was in November 2005. In 2006–2007 the west annex (the orangery) of the manor was renovated as conference facilities. Funding of the European Fund for Regional Development covered one third of the costs of 0.95 M€, and the municipality and Posiva the rest.

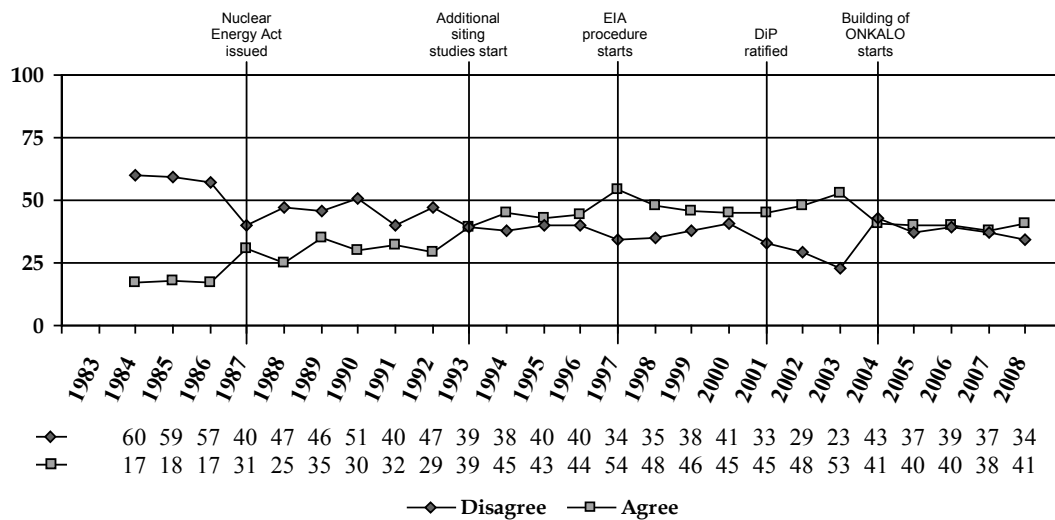
In May 2003 Posiva submitted the construction licence for ONKALO to the municipality of Eurajoki (on land use planning see Posiva 2008, 77–80). ONKALO is a rock characterization facility which consists of one access tunnel, a personnel shaft and two ventilation shafts. In it bedrock is studied with methods from geology, hydrology and geochemistry, but it is not solely a rock laboratory, as ONKALO is planned to be part of the future SNF repository. The licence for ONKALO was granted in August 2003. STUK reviewed the plans, issued a



positive statement in 2004 and the construction work started in summer 2004. At the time of writing this report excavations at Olkiluoto have advanced four kilometres to a depth of almost 407 metres. Also the expansion of the interim storage for spent nuclear fuel (KPA storage) at the Olkiluoto is currently under construction (TVO 2010). According to Posiva planned final disposal depth - 420 metres - will be reached this year. According to the current timetable, Posiva should submit application for the construction licence for the repository by 2012 and for the operation licence by 2018 to the Council of State.

The expansion of the SNF repository was approved by the local council of the Municipality of Eurajoki without a vote in connection with the TVO NPP project (Olkiluoto 4) in December 2008 (one dissenting opinion), and again in August 2009 by 22 votes to 4 in connection with the Fortum NPP project (Loviisa 3 unit). Although the local council of Eurajoki approved the repository expansion for the needs of Posiva's shareholders, in March 2010 the local government reported to the Minister of Economic Affairs, Mauri Pekkarinen (Finnish Centre Party), who is in charge of nuclear energy policy that the municipality was concerned about the way issues related to municipal decision-making in accordance to the Nuclear Energy Act were handled in the case of Fennovoima. The municipality was especially concerned that the municipality was not given a chance to issue its statements although the Fennovoima application for a DiP gave the impression that SNF generated by company would be disposed of in Olkiluoto. The local government noted that the municipal council have the right of veto which cannot be overruled by either Government or Parliament. According to the municipality the procedure is also of great importance in building and strengthening openness and confidence between the applicant, the municipality and the residents. (Local government of Eurajoki 2010.)

Local opinion in Eurajoki has also gradually become more positive towards the final disposal of nuclear waste in the Finnish bedrock as shown in Figure 5 illustrating residents' perceptions regarding the safety of final disposal. Although the statement in Figure 5 is not directly about the acceptance of siting at Olkiluoto (see Kojo 2006, 67; see also Chapter 6) the figure reflects how nuclear energy and waste policy-making, site selection strategy, local decisions and implementation influenced the local opinions 1984–2008. As Olkiluoto was selected among the five candidate sites for preliminary site characterization in 1987, the local reaction was not rejection, but greater confidence in safe bedrock disposal. Neither does the Chernobyl accident of 1986 seem to have caused feelings of rejection at local level towards final disposal. Due to the Chernobyl accident the application for the construction of a new NPP unit was withdrawn by the industry in 1986.



**Figure 5.** Residents of Eurajoki disagreeing and agreeing with the view that final disposal in the Finnish bedrock is safe (%). Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.

When the next phase of site selection process – additional siting studies – started in 1993, the number of those disagreeing and agreeing with the view that final disposal in the Finnish bedrock was safe were already nearly equal among residents of Eurajoki. In 1993 Parliament rejected the DiP application for further construction of nuclear power and in 1994 the Nuclear Energy Act was amended with a prohibition to import and export nuclear waste. At the same time the local council of Eurajoki changed its attitude on siting the repository at Olkiluoto. The decision was influenced by the economic dependence of the municipality on the tax revenue from TVO (Kojo 2009). For the first time the majority of residents of Eurajoki agreed in the mid 1990s with the statement regarding safe final disposal.

The next major change in opinion took place in 1997. The establishment of Posiva was promoted with nation-wide newspaper advertisements in 1996 and the EIA procedure for final disposal was launched in 1997 (Kojo 2005; Hokkanen 2007). In 1997 Posiva also announced that it had chosen Loviisa as a new candidate site. Public engagement in the EIA procedure and competition over the repository and benefits offered by nuclear industry (see Kojo 2009) maintained the very positive opinions towards final disposal. In 2003, after the ratification of the Decisions-in-Principle concerning final disposal and the new NPP unit (Olkiluoto 3), the number of those disagreeing with the statement was at its lowest. Only one out of four (23%) disagreed with the statement "Nuclear waste can be disposed of safely in the Finnish bedrock". Twenty years earlier the figure had been 60%. However, after 2003 something happened and local opinions became more critical. One explanation could be the fact that the excavation for the rock characterization facility ONKALO was launched in summer 2004 at Olkiluoto and thus the project came out of the Posiva drawing boards.

### 3 Survey and methods used

#### 3.1 The target population, sampling and the respondents<sup>17</sup>

The target population of the survey consisted of 16 to 75 year-old residents of Eurajoki and neighbouring municipalities whose native language is Finnish. Age wise, the aim in dropping the lower limit a few years under 18 was to be able to some extent compare the opinions of the rising generation to those of the older generations. The survey was limited to those with Finnish as their first language as the questionnaire was to be implemented only in Finnish. The main focus of the survey was the municipality of Eurajoki, which was selected as the site for the repository but the neighbouring municipalities were also covered as they have a role in the EIA and the DiP processes.

The survey was carried out as postal survey. Three thousand recipients were chosen by stratified sampling conducted by Population Register Centre<sup>18</sup>, which supplied the addresses. The reason for stratified sampling was pragmatic. Postal survey response rates tend to be low without several postings and/or some sort of additional incentive to respond. Moreover, as a nuclear community Eurajoki is an especially heavily studied area. On that account it made good sense to be prepared for possible survey fatigue and a low response rate. The aim was to allocate resources efficiently to ensure that there would be at least an adequate number of respondents from Eurajoki and decent representation from all neighbouring municipalities (Eura, Kiukainen, Lappi, Luvia, Nakkila and Rauma).

The four-page questionnaire was sent to recipients on June 2008. Questionnaires returned in time for data entry amounted to 616 and of those 606 qualified for analysis. As 3,000 questionnaires was sent this gives us a return rate of 21% and a response rate of 20%. Those reporting that they were residents of Eurajoki numbered 245, which is 20% of strata used in sampling. Table 2 shows that the number of respondents from each municipality corresponded well with the stratified sample sizes. As anticipated above, the response rate was not very high but satisfied our preset conditions (see 3.3.1).

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<sup>17</sup> These have been reported earlier by the authors on a number of occasions (for more information about presentations, papers and articles see Chapter 1).

<sup>18</sup> Due to an error in translation earlier papers indicate that sampling would have been conducted and addresses supplied by Statistics Finland.

**Table 2.**  
Sample sizes and respondents (n,%).

	Sample sizes		Respondents		
	n	%	n	%	Valid %
<b>Eurajoki</b>	1200	40	245	40	41
<b>Other municipalities</b>	1800	60	353	58	59
<b>Eura</b>	300	10	51	08	09
<b>Kiukainen</b>	300	10	59	10	10
<b>Lappi</b>	300	10	61	10	10
<b>Luvia</b>	300	10	55	09	09
<b>Nakkila</b>	300	10	60	10	10
<b>Rauma</b>	300	10	67	11	11
<b>Missing</b>			8	1	
<b>Total</b>	3000	100	606	100	100

### 3.2 Socio-demographic background and non-response analysis

In addition to the location of residency covered in the previous chapter (Table 2) respondents were asked a number of background questions relating to gender, age, relationship status, children, level of education, type of education, socio-economic group, line of work, political affiliation and income. A non-response analysis was performed on the acquired data by comparing categorized frequency distributions of responses to these questions with information obtained from the Official Statistics of Finland, Statistics Finland, the Finnish National Board of Education and municipality of Eurajoki. (Tables 3-12.)

**Table 3.**  
Respondents by gender (n,%) and population in the area by gender (n,%)<sup>19</sup>.

	Respondents		Area	
	n	%	n	%
<b>Men</b>	279	47	33435	49
<b>Women</b>	315	53	34227	51
<b>Total</b>	594	100	67662	100

<sup>19</sup> Source of comparison data: Statistics Finland's PX-Web database - Väkiluku sukupuolen mukaan alueittain sekä väestömäärän muutos 31.12.2007 (Population by gender and area 31.12.2007 and increase of population).

**Table 4.**

Respondents by birth cohort (n,%) and 15-75 year old population in the area by birth cohort (n,%)<sup>20</sup>.

	Respondents		Area	
	n	%	n	%
– 1935	32	05	2229	04.4
1936 – 1940	39	07	3496	06.8
1941 – 1945	71	12	4165	08.2
1946 – 1950	85	15	5927	11.6
1951 – 1955	66	11	5331	10.4
1956 – 1960	48	08	4588	09.0
1961 – 1965	53	09	4568	08.9
1966 – 1970	38	07	4215	08.3
1971 – 1975	32	05	3578	07.0
1976 – 1980	35	06	3751	07.3
1981 – 1985	27	05	3745	07.3
1986 – 1990	37	06	3792	07.4
1991–	21	04	1678	03.3
<b>Total</b>	<b>584</b>	<b>100</b>	<b>51063</b>	<b>100</b>

**Table 5.**

Respondents by relationship status (n,%) and 15-75 year old population by marital status (n,%)<sup>21</sup>.

	Respondents		Population	
	n	%	n	%
Unmarried	96	16	1579170	39.2
Common-law marriage	114	19	–	– <sup>1</sup>
Marriage / registered relationship	377	56	1855599	46.0
Divorced, separated or widowed	55	09	596761	14.8 <sup>2</sup>
<b>Total</b>	<b>594</b>	<b>100</b>	<b>4031530</b>	<b>100</b>

<sup>1</sup> Common-law marriage is not an official marital status, classified as unmarried

<sup>2</sup> Separated are nowadays classified as being married or in registered relationship

**Table 6.**

Respondents by under-aged children (n,%).

	n	%
Under-aged children	164	29
No under-aged children	406	71
<b>Total</b>	<b>570</b>	<b>100</b>

<sup>20</sup> Source of comparison data: Statistics Finland's PX-Web database - Väestö iän (1-v.) ja sukupuolen mukaan alueittain 1980 – 2007 (Population according to age (1-year) and gender by area 1980 – 2007).

<sup>21</sup> Source of comparison data: Statistics Finland's PX-Web database - Väestö iän (1-v.), siviilisäädyn ja sukupuolen mukaan 1990 – 2007 (Population according to age (1-year), marital status and gender 1990 – 2007).

**Table 7.**

Respondents by level of education (n,%) and population aged 15 or over by level of education in Satakunta region (n,%)<sup>22</sup>.

	Respondents		Satakunta	
	n	%	n	%
<b>No qualification after basic education</b>	133	22	74736	39
<b>Upper-secondary school</b>	42	07	9649	05
<b>Vocational qualification</b>	200	34	66156	34
<b>College-level qualification</b>	110	18	21135	11
<b>Polytechnic degree</b>	48	08	12822	07 <sup>1</sup>
<b>University degree</b>	60	10	7958	04 <sup>2</sup>
<b>Total</b>	593	100	192456	100

<sup>1,2</sup> Lower level university degrees are combined with polytechnic degrees in official statistics

**Table 8.**

Respondents by type of primary education (n,%) and population aged 15 or over with degree after basic education by type of education (n,%)<sup>23</sup>.

	Respondents		Population	
	n	%	n	%
<b>General education</b>	90	18	337877	12
<b>Education and teaching</b>	21	04	85059	03
<b>Humanities, arts and culture</b>	22	04	125072	04
<b>Business, administration and social sciences</b>	72	15	531726	19
<b>Natural sciences and computing</b>	11	02	61324	02
<b>Technology and transport</b>	128	26	862534	30
<b>Agriculture and forestry</b>	35	07	133486	05
<b>Health and welfare</b>	71	14	369483	13
<b>Services and security</b>	29	06	346346	12
<b>Other</b>	12	02	1454	00 <sup>2</sup>
<b>Total</b>	491 <sup>1</sup>	100	2854361	100

<sup>1</sup> Those who selected more than one primary type of education are counted missing

<sup>2</sup> "Some other or unknown" in official statistics

<sup>22</sup> Source of comparison data: Finnish National Board of Education WERA web information service - Väestön koulutus rakenne 10-vuotiskäryhmittäin 2007 (Educational structure of population by 10-year age groups 2007).

<sup>23</sup> Source of comparison data: Statistics Finland's web page - Perusasteen jälkeisiä tutkintoja suorittanut väestö koulutusalan ja -asteen mukaan 2007 (Population's post-comprehensive school educational qualifications and degrees 2007).

**Table 9.**

Respondents by socio-economic group (n,%) and 15-75 year old population by socio-economic group, in thousands (n,%)<sup>24</sup>.

	Respondents		Population	
	n	%	n	%
Senior executives	15	03	129	03
White-collar workers etc.	60	10	465	12
Pink-collar workers etc.	50	08	819	21
Blue-collar workers	177	30	761	20
Self-employed / employers	38	06	314	08
Farmers	18	03		
Students	56	09	318	08
Retirees	160	27	781	20
Doing domestic work	10	02	91	02
Unemployed	13	02	183	05
<b>Total</b>	<b>597</b>	<b>100</b>	<b>3861</b> <sup>†</sup>	<b>100</b>

<sup>†</sup>Categories 'conscripts', 'others' and 'unknown' from official statistics are excluded from these figures

**Table 10.**

Respondents by line of work (n,%) and 15-75 year old population by line of work, in thousands (n,%)<sup>25</sup>.

	Respondents		Population	
	n	%	n	%
Agriculture, forestry etc.	35	06	113	03
Manufacturing and mining	82	14	466	12
Energy, heat and water supply	29	05		
Construction	31	05	174	04
Wholesale and retail trade	27	05	311	08
Accommodation and food services	11	02	84	02
Transport, storage and communication	23	04	175	04
Finance, real estate and business support services	22	04	359	09
Public administration and defence	10	02	117	03
Education, health and social services	84	15	539	14
Other civil and personal services	27	05	150	04
<b>Not currently in the working life</b>	<b>185</b>	<b>33</b>	<b>1489</b>	<b>37</b>
<b>Total</b>	<b>566</b> <sup>†</sup>	<b>100</b>	<b>3977</b>	<b>100</b>

<sup>†</sup>Those who selected more than one primary line of work are counted missing

<sup>24</sup> Source of comparison data: Official Statistics of Finland -Työvoimatilasto 2007 (Labour force statistics 2007). Helsinki: Statistics Finland, 2008.

<sup>25</sup> Sources of comparison data: Statistics Finland's PX-Web database - Työvoima ja työvoimaan kuulumaton väestö 1989 – 2007 (Labour force and persons not in labour force 1989 – 2007) and Työlliset toimialoittain 1990 – 2007 (Employed persons by industry 1990 – 2007).

**Table 11.**

Respondents by political affiliation (n,%) and support for parties in the area in parliamentary elections 2007 (n,%)<sup>26</sup> and support for parties corrected according to sampling (%).<sup>27</sup>

	Respondents		Area		Corrected
	n	%	n	%	%
<b>Finnish Centre Party</b>	90	15	8417	15	23
<b>National Coalition Party</b>	68	12	7334	13	11
<b>Finnish Social Democratic Party</b>	107	18	12839	23	22
<b>Left Alliance</b>	23	04	3251	06	06
<b>Green League of Finland</b>	19	03	1401	03	02
<b>Finnish Christian Democrats</b>	14	02	1032	02	01
<b>Swedish People's Party</b>	0	00	00	00	00
<b>True Finns Party</b>	32	05	1340	02	02
<b>Some other</b>	7	01	362	01	01
<b>Not able to say</b>	110	19			
<b>Do not want to say</b>	69	12			
<b>Would not vote - Did not vote</b>	51	9	19339	35	32
<b>Total</b>	590	100	55315	100	100

**Table 12.**

Respondents by personal income (n, %) and income earners by income group (n, %)<sup>28</sup>.

	Respondents		Income earners	
	n	%	n	%
<b>Under 10000€</b>	99	19	1144779	26
<b>10000 - 19999€</b>	116	22	1141202	26
<b>20000 - 29999€</b>	131	25	989281	22
<b>30000 - 39999€</b>	97	18	576976	13
<b>40000 - 59999€</b>	56	11	399899	09
<b>60000€ or over</b>	29	05	190620	04
<b>Total</b>	528	100	4442757	100

Overall, based on the comparison, the survey data represents the target population fairly well. However, three biases were observed that should be taken into consideration. Firstly, those who were married or in registered relationships were overrepresented by 10 percentage points. Secondly, supporters of the Centre Party were underrepresented by 8 percentage points. Thirdly, respondents were better educated than the inhabitants of the Satakunta region as a whole. In addition, it seems that those in the low income group were somewhat underrepresented, although the extent of underrepresentation is difficult to assess; as many as 13% of respondents declined to report their income.

<sup>26</sup> Source of comparison data: Statistics Finland's PX-Web database - Eduskuntavaalit 2007, äänestystiedot (Parliamentary elections 2007, data on voting) and Eduskuntavaalit 2007, puolueiden kannatus (Parliamentary elections 2007, support for parties).

<sup>27</sup> For more on the Finnish parliamentary parties see Chapter 3.3.2.

<sup>28</sup> Source of comparison data: Statistics Finland's PX-Web database - Tulonsaajien luku, veronalaiset tulot ja verot iän, sukupuolen ja veronalaisten tulojen mukaan 2007 (Number of income recipients, taxable income and taxes by age, gender and taxable income 2007).



Regarding the deviation observed in the case of socio-economic groups, it seems plausible that a high share of those working in pink-collar etc. occupations do not identify themselves as such workers as difference between categories used in Finland 'alempi toimihenkilö'<sup>29</sup> translated here roughly as 'pink-collar worker etc.' and 'työntekijä' translated here as 'blue-collar worker' is rather vague and not so easy to discern. People identify them selves readily as 'työntekijä' meaning 'just a regular worker' without any special status, "just a regular working guy [or girl]". The experience of the authors is that, for example, office workers and salespersons often feel that they are such "regular workers", whereas in official classifications they are classified as 'alempi toimihenkilö' (i.e. 'pink-collar worker etc.').

### 3.3 Methods used

#### 3.3.1 Sampling and examining respondents' socio-demographic background

Stratified sampling was used as sampling method for the survey. In stratified sampling a random sample of specified size is drawn from each stratum of a population. As mentioned earlier (Chapter 3.1), the aim was to ensure an adequate number of respondents from Eurajoki and a decent representation from all neighbouring municipalities. The size of each sample was determined according to the following procedure; to the number of respondents deemed acceptable by the research group was added the number of recipients estimated to cover a normal share of non-respondents and an appropriate safety margin, after which the number was rounded up to a suitable round number. In the case of Eurajoki the acceptable number of respondents was set at 200 and in the case of neighbouring municipalities at 40 per municipality, which were also reached (see Table 2).

This way each individual strata formed a simple random sample of residents of one municipality included in the target population. Regarding Eurajoki the number of respondents in the data is large enough to allow its thorough analysis, also as an individual sample which, in turn, allows us to draw conclusions concerning the opinions of residents of Eurajoki (as defined in Chapter 4.1). Regarding the neighbouring municipalities of Eurajoki no such analysis is possible as the number of respondents in each individual municipality is so small. Instead the data are combined so as to form a non-probability sample of neighbouring municipalities as one bloc. This procedure allows an analysis of opinion climate around the municipality of Eurajoki without the largest municipalities (Rauma and Eura) dominating the view. By comparing these two samples it is in turn possible to examine differences between the opinions of Eurajoki residents and those of neighbouring municipalities.

The socio-demographic backgrounds of the respondents are described in Chapters 3.1 and 3.2 through frequency tables (Tables 2-12). The tables include frequency and percentage frequency of respondents belonging to each category and in addition frequency and percentage frequency figures from appropriate comparison data, when available. The comparison information used in the tables was obtained from the Official Statistics of

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<sup>29</sup> Statistics Finland defines 'alemmat toimihenkilöt' (plural of 'alempi toimihenkilö') as lower-level employees with administrative and clerical occupations. The class contains following subcategories: 1 supervisors, 2 clerical and sales workers, independent work, 3 clerical and sales workers, routine work, 4 other lower-level employees with administrative and clerical occupations and 5 lower-level employees, unspecified.

Finland, Statistics Finland, the Finnish National Board of Education and the municipality of Eurajoki.

Overall frequency tables are used in research to summarise categorical, nominal, and ordinal data or continuous data divided up into groups. This is one of the easiest ways to analyse categorical data. In this case the tables illustrate the proportion of respondents belonging to each background category and the proportions of those belonging to each background category in the comparison data, which in turn provides a convenient and explicit way to assess differences between the respondents and the target population.

### 3.3.2 Data analysis

Because the research is descriptive and comparative in nature, that is, the purpose is to form a picture of Eurajoki as a community from a certain viewpoint, and analyse how well the data fits to the predetermined theoretical standpoints, the analysis methods are kept straightforward.

**Frequency analysis and frequency tables** are used throughout Chapters 4-6 to illustrate the distribution of opinions among all respondents, respondents living in Eurajoki and respondents living in neighbouring municipalities. This allows us both to examine opinion climate in the whole surveyed area and assess differences in opinions between those living in the municipality of Eurajoki and those living in neighbouring municipalities.

**Cross tabulations** are used throughout Chapters 4-6 to produce figures on the attitudes of different respondent groups and to examine differences between those groups. The groups are formed on the basis of background questions and statistical significances of the differences between the groups are tested. The background groupings formed on the basis of gender, age, relationship status, number of children, level of education, type of education, socio-economic group, line of work, political affiliation and personal income are systemically tested and statistically highly significant ( $p \leq .001$ ) and statistically significant ( $.001 < p \leq .010$ ) differences between groups are reported. Cross tabulations based on age are a special case because calculations were made with two different groupings 'age group' and 'generation group'. Differences between the groups are reported for the grouping revealing more statistically highly significant or significant differences, and then if there is additional statistically highly significant or significant differences revealed by the another grouping these are reported in addition. Otherwise group differences for the grouping with fewer statistically highly significant or significant differences are not reported.

Generation groups used in analysis are based on classification by Statistics Finland, which in turn is partly based on the classification by J.P. Roos<sup>30</sup>. First four generations 1) the Generation of war and depression ( -1939), 2) the generation of the transformation (1940-1949), 3) the suburban generation (1950-1959) and 4) the welfare generation (1960-1969) are from Roos, 5<sup>th</sup> the media generation (1970-1979) and 6<sup>th</sup> the new generation (1980-[1989]) were added by Statistics Finland and 7<sup>th</sup> the rising generation (1990- ) was added by us. Age groups used in analysis are: 24 or under, 25-34, 35-44, 45-54, 55-64 and 65 or over. Other groups used in analysis were formed according to the classifications used in Chapter 3.2 to examine respondents' socio-economic backgrounds (see Tables 3,5-12). No results are

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<sup>30</sup> See (in Finnish) <http://tilastokeskus.fi/meta/luokitukset/sukupolvi/index.html> and <http://tilastokeskus.fi/meta/luokitukset/sukupolvi/001-2002/kuvaus.html>.

reported for the groups based on number of children because there were no statistically highly significant or statistically significant differences between those who had children and those who did not in the cases examined in this context. In the case of political affiliation the reported results focus on those groups oriented towards parliamentary parties but other groups (see Table 11) were also included in analysis.

Finnish parliamentary parties in order of support in 2007 elections<sup>31</sup>.

- 1) *Finnish Centre Party*. Liberal-conservative centrist party which political influence is greatest in small and rural municipalities. (Originally an agrarian party the Agrarian League.)
- 2) *National Coalition Party*. Liberal conservative political party which has strongest support in cities in Southern Finland. (Founded on the basis of the Old-Finnish party.)
- 3) *Finnish Social Democratic Party*. Moderate social democratic party which has a close relationship with the Finnish Trade Unions. (Founded as the Finnish Labour Party.)
- 4) *Left Alliance*. Left-wing party which wants to be associated with the 'New Left' and Green socialism. (Founded by merging the Democratic League for the Finnish People, the Finnish Communist Party and the Democratic League of Finnish Women.)
- 5) *Green League of Finland*. Environmentalist party whose ideology is a mixture of green politics, traditional centre-left ideology and criticism of conventional political thinking with the rejection of the classification "left" or "right".
- 6) *Finnish Christian Democrats*. Traditional Christian-democratic conservative party whose roots are in the Christian faction of the conservative National Coalition Party. (Originally Finnish Christian League.)
- 7) *Swedish People's Party*. Liberal party which represents the Swedish-speaking minority in Finland and thus draws support mainly from the Swedish-speaking minority. (In the 2007 elections no one in Eurajoki or in the neighbouring municipalities voted for this party.)
- 8) *True Finns Party*. A populist party with the ideology of nationalism and Euroscepticism. (Founded on the basis of the Finnish Agrarian Party, an offshoot of the Finnish Centre Party.)

**Chi-square test** (Pearson's chi-square,  $\chi^2$ ) is used to test statistical significance of observed group differences in cross tabulations. The chi-square test is a widely used nonparametric test to test differences between two samples or groups. The test compares expected values to observed values and calculates probability ( $p$ ) to that to which one variable is unrelated (or only randomly related) to the second variable. Advantages of this test are that it also detects non-linear associations and the variables used can be nominal.

**Kendall's correlation test** (Kendall's tau-b,  $\tau_{\text{Ken,b}}$ ) is used in Chapter 7 to explore the relationship between different variables presumably related to the acceptance of final disposal and variables actually measuring acceptance of final disposal. Kendall's tau-b is a non-parametric measure of association which measures rank correlation and takes ties into account. For the most part only the highest correlation coefficients are reported. The focus in the chapter is exclusively on those respondents residing in the municipality of Eurajoki.

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<sup>31</sup> Members of the Finnish Parliament are elected every four years in general elections.

## 4 Obtaining information regarding the final disposal

When we make assessments or form opinions about something we essentially interpret the information we have gathered from various sources. In first part of this research we asked about the sources people consult to obtain information on final disposal issues, how satisfied they are with the quantity and reliability of information provided by various actors and what kind of information needs they have in relation to these issues.

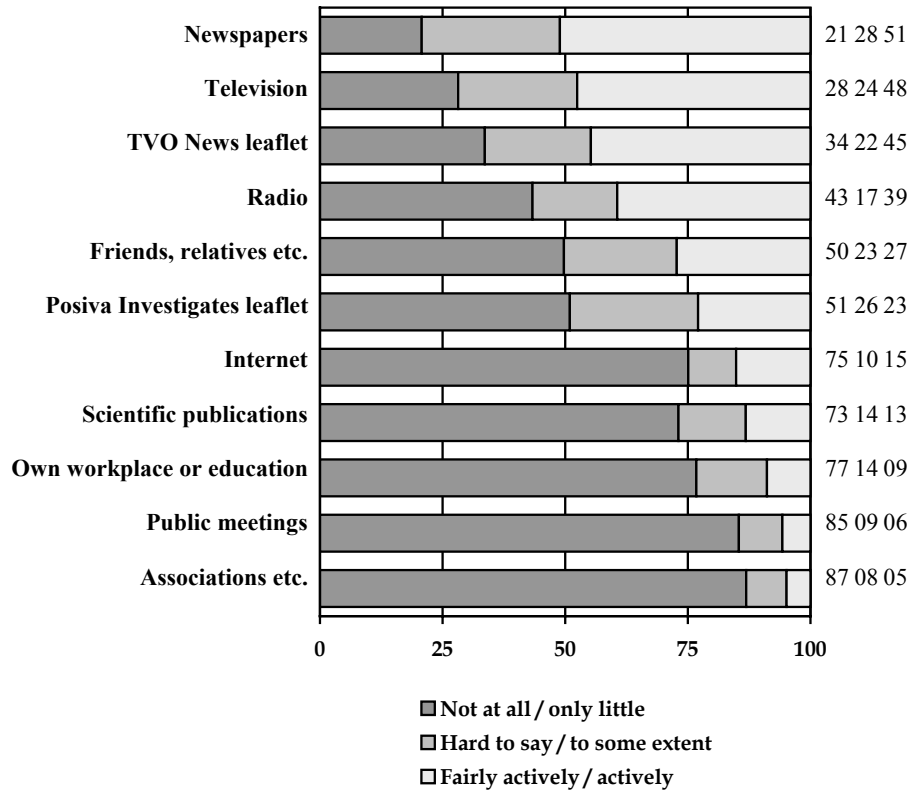
### 4.1 Obtaining information

The first aim of this research was to update knowledge of the sources local residents use to obtain information concerning the final disposal of SNF. The question used in the survey was: "Information of the final disposal can be obtained different ways. To what extent do you consult different sources of information to obtain this knowledge?" Eleven different information sources were listed and respondents were asked to indicate how actively they consult them on a five-step scale from "I do not consult at all" to "I consult actively". In addition the respondents were asked specifically about their overall "Internet usage in matters related to the final disposal project". Respondents were presented with seven types of Internet activities and asked to indicate how frequently they engage in these activities in relation to the final disposal project on the six step scale from "Not at all" to "Several times in a week". (For the questionnaire [in Finnish], see Appendix.)

As Figure 6 demonstrates the most consulted information sources were *newspapers*, *television* and *TVO News leaflet*. Around 45–50% of respondents consulted these fairly actively or actively in relation to the final disposal. The number of respondents consulting *radio* at least fairly actively was also close to 40%, and the percentage consulting *friends, relatives etc.* and the *Posiva Investigates leaflet* this way was roughly 25%. Other sources were consulted at least fairly actively only by 15% or under.

Table 13 shows percentage share of those respondents who consult each information source actively. The most intently consulted information sources were the *TVO News leaflet*, *newspapers* and the *Posiva Investigates leaflet*, which were consulted actively by 15–18% of the respondents. *Television* was consulted actively by 12%, and *friends, relatives etc.*, *radio* and *own workplace or education* was actively used as an information source by 6–8% of respondents. Other sources were consulted actively only by 3% or under. Even if these figures are quite modest, it is noteworthy that the information sources which are most intently

followed have in fact a larger share of respondents consulting them actively than many information sources have fairly active and active followers combined.



**Figure 6.** Consulting different information sources to obtain information on final disposal (%).

**Table 13.** Consulting different information sources actively to obtain information on final disposal (%).

TVO News leaflet	18
Newspapers	16
Posiva Investigates leaflet	15
Television	12
Friends, relatives etc.	08
Radio	07
Own workplace or education	06
Internet	03
Public meetings	02
Scientific publications	02
Associations etc.	01

According to our survey the "TVO News" information leaflet is the most frequently actively consulted source of information on the final disposal issue among the respondents in Eurajoki and neighbouring municipalities, surpassing even newspapers (Table 13). TVO has published

the TVO News (prior to 2000 Olkiluoto News) four times a year since the late 1970s. The leaflet is delivered free of charge to every household in Eurajoki and all neighbouring municipalities. The "Posiva Investigates" information leaflet has also gathered quite many active readers but on the other hand more than half of the respondents indicate that they do not consult Posiva's leaflet at all or only little. However, this is largely explained by the fact that the leaflet is not delivered directly to households in the municipalities of Kiukainen and Nakkila. Almost half of the respondents from these municipalities do not read the leaflet at all. Overall, the information leaflets of the nuclear industry seem to have gained their places as channels of information over the years. Informal social networks are also quite an important source of information. Almost one out of ten respondents reported that friends, workmates and relatives were an actively consulted source of information in nuclear waste issues. The importance of Posiva personnel was also emphasized by Aho (2008) in her master's thesis on the building of trust in the safety of final disposal. Aho concluded that trust of the inhabitants of Eurajoki is mainly based on an image of the expertise of Posiva and its personnel, likewise their capabilities, honesty and the predictability of operations. The inhabitants assess disposal through the reputation of individuals and the company.

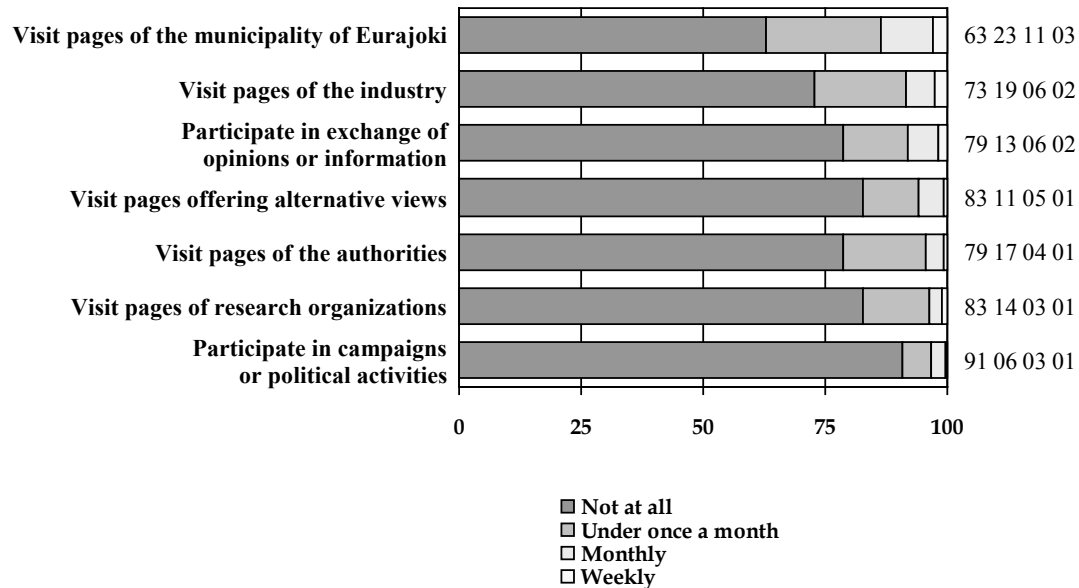
Regarding coverage, however, the mass media, namely newspapers and television, are still unsurpassable. Only 6% of respondents reported not consulting newspapers at all for information on final disposal, and with television the same figure was still only 11% (no tables). Thus these cover the local population very well.

The survey results show how certain sources of information are rarely used fairly actively or actively. The top 5 list of sources not used includes associations, organisations etc., public meetings, workplace or education, scientific publications and Internet. Of these public meetings have experienced a lack of participants since the early 1990s, when the public hearing of the Perusvoima NPP application was organised in Eurajoki (Säynäsalo and Borg 1992). The number of participants observed in the EIA meetings of Posiva in the late 1990s and in 2008 shows a declining trend (Hokkanen 2007, 171,179; Nurmi, Kojo and Litmanen 2009). Nevertheless, the public meetings certainly have their role in interaction in the future, too, as the meetings are the only arenas in which the different stakeholders can exchange views face to face.

The figures regarding the use of Internet are interesting. As popular as Internet is at present, it seems that as an information source on final disposal it is not very popular. Two thirds of the respondents reported using Internet "only little" or "not at all". "Heavy users" are also quite rare in this context as only 3% of respondents reported using Internet actively as an information source. The previous survey on information acquisition was carried out in 1994, over ten years ago (Kurki 1995). At that time Internet was not even mentioned as a possible source of information. Because the popularity of Internet as a media and of its growing importance as an information source today we, however, took a special interest in the issue. The survey therefore included one question devoted exclusively to Internet usage in relation to the final disposal, as described at the beginning of the chapter.

Figure 7 clearly shows that the great majority of respondents (63% to 91% depending on activity) did not use Internet at all for activities related to final disposal. In addition, only a very small minority (1% to 3% depending on activity) used Internet actively, that is weekly, for the activities in question. It is fairly obvious that a large proportion of such people probably have some kind of role in either in decision-making regarding nuclear waste management and/or their job is some other way related to SNF management. Judging by the

percentage of those respondents using Internet for each activity at least monthly, the most frequent uses of Internet were visiting the *pages of the municipality of Eurajoki* (14%) and the *pages of the industry* (TVO, Fortum, Posiva) (9%), and *exchange of opinions or information* (8%).



**Figure 7.** Frequency of certain Internet activities in relation to nuclear waste disposal issues. (%)

Comparison between the residents of Eurajoki and the residents of neighbouring municipalities (Table 14) revealed rather unsurprisingly that the residents of Eurajoki tend to follow information sources more actively than those of neighbouring municipalities in relation to final disposal. With all eleven information sources the percentage of those consulting "Not at all / only little" was smaller and the percentage of those consulting "Fairly actively / actively" was larger among the residents of Eurajoki, even if, with four information sources, *scientific publications* ( $p = .441$ ) *Internet* ( $p = .378$ ) *television* ( $p = .220$ ) and *newspapers* ( $p = .137$ ) the difference was statistically non-significant. Differences between the groups were clearest for consulting *Posiva Investigates leaflet* ( $\chi^2 (2, N=576) = 30.67, p = .000$ ), *TVO News leaflet* ( $\chi^2 (2, N=585) = 21.56, p = .000$ ) and using *friends, relatives etc.* ( $\chi^2 (2, N=578) = 13.08, p = .001$ ) as information source.

**Table 14.**

Six most "fairly actively or actively" consulted information sources (%). Comparison between Eurajoki and neighbouring municipalities.

		Not at all / only little	Hard to say / to some extent	Fairly actively / actively
Eurajoki	TVO News leaflet	27	17	56
	Newspapers	17	28	55
	Posiva Investigates leaflet	31	17	52
	Television	25	24	51
	Radio	48	18	34
	Friends, relatives etc.	43	27	30
Neighbours	Newspapers	23	29	48
	Television	30	25	45
	TVO News leaflet	38	25	37
	Posiva Investigates leaflet	52	17	31
	Radio	51	27	22
	Friends, relatives etc.	56	26	18

Table 14 illustrates how residents of Eurajoki rely relatively more in the industry's leaflets as an information source than do people in neighbouring municipalities, who in turn placed relatively more emphasis on newspapers and television when measured by source consulted fairly actively or actively. As noted earlier in this chapter (p. 31) industry leaflets are more efficiently distributed in Eurajoki than in the neighbouring municipalities as a whole, however.

When the survey data was examined in relation to other socio-demographic background variables, a number of statistically highly significant ( $p \leq .001$ ) and statistically significant ( $.001 < p \leq .010$ ) differences were observed.

The difference between men and women was statistically highly significant for using *Posiva Investigates leaflet* ( $\chi^2 (2, N=575) = 16.21, p = .000$ ) as an information source. 48% of men and 32% of women consulted the leaflet fairly actively or actively.

There were statistically highly significant differences between different generations<sup>32</sup> in consulting the *TVO News leaflet* ( $\chi^2 (12, N=572) = 97.60, p = .000$ ), *radio* ( $\chi^2 (12, N=563) = 64.74, p = .000$ ), *Posiva Investigates leaflet* ( $\chi^2 (12, N=565) = 61.97, p = .000$ ) and *Internet* ( $\chi^2 (12, N=542) = 58.07, p = .000$ ). The rising generation and the new generation included a high percentage (86%/65%) of those who consult the TVO leaflet not at all or little, whereas among the generation of war and depression and the generation of the transformation the percentage was low (13%/19%). Of the rising generation only 8% and of the new generation 20% consult TVO's leaflet fairly actively or actively. With other generations percentages were between 43% and 58%. For Posiva's leaflet the percentage share of those who do not consult at all or only little remained the same (86%) among the rising generation and with the new generation (69%) it even rose a little, but the difference was not so great, because even the lowest percentage among the generations was as high as 28%. The share of those who consulted the Posiva leaflet fairly actively or actively among the new generation (21%), was again essentially the same as in the case of the TVO leaflet but in the rising generation the

<sup>32</sup> For used classification see Chapter 3.3.2.



share dropped very low (3%). Radio is more popular among the generations born before 1960; the share of respondents consulting radio fairly actively or actively being from 32% to 40% while with the generations from 1960 onwards, the share of respondents consulting radio fairly actively or actively ranged from 12% to 18%. Internet on other hand was quite expectedly more popular among the younger generations than the older generations. Of the younger generations 18% of the media generation, 29% of the new generation and 36% of the rising generation consulted Internet fairly actively or actively. Of the older generations, 6 % of the generation of war and depression, 6% of the generation of the transformation, 13% of the suburban generation and 7% of the welfare generation consulted Internet fairly actively or actively.

Relationship status related to statistically highly significant differences in consulting *TVO News leaflet* ( $\chi^2$  (6, N=589) = 44.88,  $p= .000$ ), *Posiva Investigates leaflet* ( $\chi^2$  (6, N=581) = 31.58,  $p= .000$ ) and *Internet* ( $\chi^2$  (6, N=558) = 28.47,  $p= .000$ ). For leaflets the percentage of those consulting them fairly actively or actively increased gradually, moving from those who were single (with 30% consulting TVO's and 22% consulting Posiva's leaflet this way), to those living in a common-law marriage (38%/37%), to those who were married or living in a registered relationship (49%/44%), and finally to those who were divorced, separated or widowed (55%/47%). In the case of Internet the trend was exactly the opposite, between the divorced, separated or widowed (6%) and the married or those living in a registered relationship (11%) and those living in a common-law marriage (13%) and finally to those who were single (26%).

Level of education was related to statistically highly significant differences in using *own workplace or education* ( $\chi^2$  (10, N=568) = 43.60,  $p= .000$ ) and *Internet* ( $\chi^2$  (10, N=558) = 28.65,  $p= .001$ ) as an information source. In addition, there was a statistically significant difference in consulting the *TVO News leaflet* ( $\chi^2$  (10, N=584) = 27.71,  $p= .002$ ). The number of those using their own workplace or education as an information source fairly actively or actively was highest among those with polytechnic (31%), university (30%) and upper-secondary school (24%) education and lowest among those with no qualification after basic education (8%) and with vocational training (9%). For Internet the highest usage percentages were among those with upper-secondary school (26%) or polytechnic (25%) education and lowest again among those with no qualification after basic education (8%). The TVO leaflet is fairly evenly used as an information source across the education groups, depending on the group 43% to 53% used it fairly actively or actively – except in the case of group with upper-secondary education, where the percentage was considerably lower 24%.

Type of education was also related to a statistically significant difference in using *own workplace or education* ( $\chi^2$  (18, N=476) = 36.41,  $p= .006$ ) as an information source. Those whose education was in education and teaching, health and welfare, and agriculture and forestry reported the lowest level of using own workplace or education fairly actively or actively as an information source (5%/6%/6%) whereas those with education in natural sciences and computing, and technology and transport reported the greatest amount of those using own workplace or education as information source this way (36%/28%).

Socio-economic group related to numerous statistically highly significant differences in using *TVO News leaflet* ( $\chi^2$  (16, N=584) = 103.79,  $p= .000$ ), *Posiva Investigates leaflet* ( $\chi^2$  (16, N=576) = 81.15,  $p= .000$ ), *own workplace or education* ( $\chi^2$  (16, N=567) = 71.57,  $p= .000$ ), *Internet* ( $\chi^2$  (16, N=554) = 67.87,  $p= .000$ ) and *radio* ( $\chi^2$  (16, N=575) = 56.94,  $p= .000$ ) as information source. There was also a statistically significant difference in consulting

*newspapers* ( $\chi^2$  (16, N=585) = 35.61,  $p = .003$ ). Only 5% of those unemployed or doing domestic work consulted TVO's and 9% Posiva's leaflets fairly actively or actively to obtain information on final disposal. Among students 9% consulted TVO news and 7% Posiva investigates fairly actively or actively. In both cases those consulting most actively were farmers, 72% of them consulted the TVO and 61% the Posiva leaflets fairly actively or actively. Otherwise the share of those consulting TVO news fairly actively or actively in different socio-economic groups were from 40% to 54% and of those consulting Posiva investigate from 41% to 50%. By own workplace or education, 37% white-collar workers etc, 27% of senior executives, 25% of students and 24% of pink-collar workers etc. consulted information sources in this category fairly actively or actively. In other socio-economic groups the share of those using own workplace or education fairly actively or actively as in information source was between 2% and 11%. Internet was consulted fairly actively or actively for information by 33% of students and 27% of senior executives, otherwise percentages varied from 6% (farmers) to 19% (white-collar workers etc). Radio was used fairly actively or actively as an information source mostly by retirees (42%) and farmers (39%) while those unemployed or doing domestic work, and also students used radio very little for this purpose (5%/11%). With other socio-economic groups the share was from around one fourth (22%) to one third (33%). Among those unemployed or doing domestic work almost half (45%) do not consult newspapers at all or only little to obtain information on final disposal, whereas generally among other socio-economic groups around half or even more (46% to 66%) consulted newspapers fairly actively or actively to obtain information with the exception of students, of whom around third (34%) consulted newspapers that way.

Line of occupation was related to statistically highly significant differences in using *own workplace or education* ( $\chi^2$  (22, N=539) = 92.23,  $p = .000$ ) and *Internet* ( $\chi^2$  (22, N=525) = 54.43,  $p = .000$ ) as an information source. Those with energy, heat and water supply, public administration and defence, and finance, real estate and business support services as their occupation were among the heaviest users of own workplace or education as information source (62%/40%/32% using fairly actively or actively) whereas those working in the wholesale and retail trades, agriculture, forestry etc., and construction were among the lightest users of own workplace or education as information source (4%/6%/7% using fairly actively or actively), those whose line of occupation was in education, health and social services, and those not currently in the working life came close to them (10%/10% using fairly actively or actively). Those working in energy, heat and water supply were also the heaviest users of Internet as an information source (31% using fairly actively or actively), followed by those working in public administration and defence, and accommodation and food services (20%/20% using fairly actively or actively). Those working in agriculture, forestry etc., and construction were the lightest users of Internet as an information source (3%/3% using fairly actively or actively).

Political affiliation was related to two statistically significant differences, in using the *TVO News leaflet* ( $\chi^2$  (20, N=577) = 41.72,  $p = .003$ ) and *own workplace or education* ( $\chi^2$  (20, N=560) = 38.74,  $p = .007$ ) as an information source. The number of those consulting TVO News fairly actively or actively was highest among those oriented towards the National Coalition Party (57%) and the Finnish Centre Party (56%) and lowest among those oriented towards the Finnish Christian Democrats (14%) and the Green League of Finland (28%). Regarding own workplace or education, those oriented towards the National Coalition Party were also the heaviest users of these as an information source (32% using fairly actively or actively). Those oriented towards the Green League of Finland were the lightest users (6% using fairly actively or actively) of own workplace or education as an information source,

those oriented towards other parliamentary parties having only little higher shares than that (9% to 14% using fairly actively or actively).

Personal income related to four statistically highly significant differences, in using the *TVO News leaflet* ( $\chi^2$  (10, N=518) = 35.18,  $p = .000$ ), *Posiva Investigates leaflet* ( $\chi^2$  (10, N=513) = 33.67,  $p = .000$ ), *own workplace or education* ( $\chi^2$  (10, N=506) = 38.95,  $p = .000$ ) and *Internet* ( $\chi^2$  (10, N=496) = 33.25,  $p = .000$ ) as an information source. There was also one statistically significant difference, in consulting *newspapers* ( $\chi^2$  (10, N=516) = 26.13,  $p = .004$ ). With leaflets the percentage of those consulting them fairly actively or actively consulting them was highest among those with personal income between 40,000 and 59,999 euros a year, with 62% consulting TVO's and 56% consulting Posiva's leaflets fairly actively or actively. Those with personal income under 10,000 euros a year were much less active, 26% in this income group consulted TVO's and 19% Posiva's leaflets fairly actively or actively. Using own workplace or education as an information source was more frequent in groups with incomes higher than 40,000 euros a year, the percentage being 32% in the income group earning 40,000 to 59,999 euros and 38% in the income group earning 60,000 euros or more a year, while in groups with lower incomes the percentage varied from 8% to 16%. Internet on other hand was used fairly actively or actively as an information source by 21% of those in the lowest income group earning under 10,000 euros a year while the percentage varied between 6% and 11% with other income groups earning under 40,000 euros a year. Those earning 60,000 euros or more a year were the most active users of Internet, as 28% of this income group consulted Internet to obtain information on final disposal issues. In the group earning 40,000 to 59,999 euros a year the percentage share of those using Internet fairly actively or actively (19%) was approximately on the same level as for those earning less than 10,000 euros a year. Looking at the extent of consulting newspapers, the percentage of those consulting them fairly actively or actively was highest among those with personal income between 40,000 and 59,999 euros a year (70%) and lowest in the lowest income groups earning under 10,000 euros and 10,000 to 19,999 euros a year (41%/43%). In other income groups around half (53% to 55%) consulted newspapers fairly actively or actively.

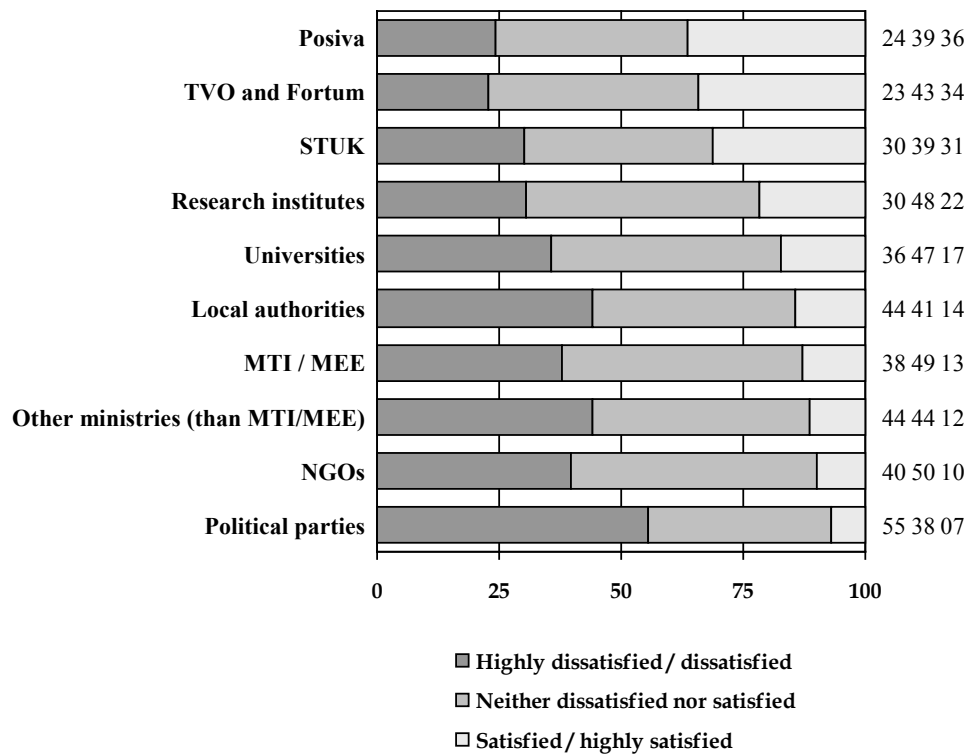
#### 4.2 Quantity of information provided by different actors

After ascertaining the use of information sources, the second aim of the research was to determine how local people perceive the information provided by different actors in the field. The question used in the survey consisted of two parts. In the first part, which is addressed in this chapter, respondents were asked about the quantity of information: "How satisfied or dissatisfied are you regarding quantity [...] of information disseminated by different parties concerning final disposal?" Ten different information providers were listed and respondents were asked to indicate level of their satisfaction to them on a five-step scale from "Highly dissatisfied" to "Highly satisfied". (For the questionnaire [in Finnish], see Appendix.)

As Figure 8 demonstrates, residents were most satisfied with the quantity of information disseminated by *Posiva*, *TVO*, *Fortum*, and *STUK*. Around one third of respondents (31% to 36%) were satisfied or highly satisfied with information provided by these nuclear waste management actors in relation to final disposal. Only these actors had more satisfied or highly satisfied respondents than highly dissatisfied or dissatisfied with the quantity of information disseminated by them. 22% were satisfied or highly satisfied with quantity of information provided by *research institutes* and 17% with that provided by *universities*. Less than 15%

were satisfied or highly satisfied with the information provided by other nuclear waste management actors. In addition, over half (55%) were dissatisfied or highly dissatisfied with quantity of information disseminated by *political parties* and more than two out of five with information disseminated by *local authorities* (44%) and *other ministries (than MTI/MEE)* (44%).

Table 15 shows the percentage share of those respondents highly dissatisfied with the quantity of information from different nuclear waste management actors. As can be seen, the share of those highly dissatisfied with the quantity of information provided by the *political parties* is high; more than quarter of respondents (28%) were highly dissatisfied with it. This is more than there were dissatisfied and highly dissatisfied combined in the cases of information provided by *Posiva* and by *TVO and Fortum* (Figure 8). Furthermore, quite a few were also highly dissatisfied with the quantity of information presented by *local authorities* (18%) and *NGOs* (17%). At first sight these figures do not look very high but given that six out of ten actors did not get this many satisfied and highly satisfied respondents combined (Figure 8) they seem pretty high.



**Figure 8.** Satisfaction regarding quantity of information disseminated by certain main actors in Finnish nuclear waste management (%).

**Table 15.**

Those highly dissatisfied with the quantity of information disseminated by certain main actors in Finnish nuclear waste management (%).

<b>Political parties</b>	28
<b>Local authorities</b>	18
<b>NGOs</b>	17
<b>Other ministries (than MTI/MEE)</b>	15
<b>Universities</b>	13
<b>MTI / MEE</b>	12
<b>STUK</b>	10
<b>Research institutes</b>	10
<b>TVO and Fortum</b>	09
<b>Posiva</b>	08

Comparison between the residents of Eurajoki and those of neighbouring municipalities (Table 16) reveals that, in line with Figure 8, regarding the quantity of information, in both groups there are only three information providers with whom the residents are more satisfied than dissatisfied (the share of those "satisfied / highly satisfied" is greater than of those "highly dissatisfied / dissatisfied"). These are TVO and Fortum, Posiva, and STUK. While satisfaction with quantity of information for all three of them is on the same level (30–31%) in neighbouring municipalities, in Eurajoki the residents are clearly most satisfied with Posiva as an information provider, as almost half (46%) of respondents are either satisfied or highly satisfied with quantity of information disseminated by Posiva. (Table 16.) The difference in satisfaction with quantity of information disseminated by *Posiva* between Eurajoki and its neighbouring municipalities is statistically highly significant ( $\chi^2$  (2, N=566) = 16.99,  $p$  = .000).

**Table 16.**

Four information providers found most satisfactory ("satisfied / highly satisfied" > 20%) quantity wise among certain main actors in Finnish nuclear waste management (%). Comparison between Eurajoki and neighbouring municipalities.

		<b>Highly dissatisfied / dissatisfied</b>	<b>Neither dissatisfied nor satisfied</b>	<b>Satisfied / highly satisfied</b>
<b>Eurajoki</b>	<b>Posiva</b>	22	32	46
	<b>TVO and Fortum</b>	24	38	38
	<b>STUK</b>	31	37	32
	<b>Research institutes</b>	33	46	21
<b>Neighbours</b>	<b>TVO and Fortum</b>	22	47	31
	<b>STUK</b>	29	40	30
	<b>Posiva</b>	26	44	30
	<b>Research institutes</b>	29	50	21

When the survey data was examined in relation to other socio-demographic background variables, a number of statistically highly significant ( $p \leq .001$ ) and statistically significant ( $.001 < p \leq .010$ ) differences were observed.

The difference between men and women was statistically highly significant in the case of *Posiva* ( $\chi^2$  (2, N=560) = 13.52,  $p$ = .001) and statistically significant in the cases of *TVO and Fortum* ( $\chi^2$  (2, N=567) = 10.32,  $p$ = .006) and *STUK* ( $\chi^2$  (2, N=564) = 9.30,  $p$ = .010). In all these cases men were more satisfied with the quantity of disseminated information. 44% of men but only 29% of women were highly satisfied or satisfied with quantity of information provided by Posiva. For TVO and Fortum the shares were 41% of men and 28% of women and for STUK 37% of men and 25% of women.

There was a statistically highly significant difference between age groups in satisfaction with the quantity of information provided by *political parties* ( $\chi^2$  (10, N=554) = 31.86,  $p$ = .000). Those aged 35–44 and 45–54 were less satisfied with the quantity of information provided (0%/3% "satisfied / highly satisfied") by political parties than others (7% to 13% "satisfied / highly satisfied"), with those aged 24 or under being most satisfied.

Level of education, however, was again related to statistically highly significant differences in satisfaction with quantity *political parties* ( $\chi^2$  (10, N=564) = 31.51,  $p$ = .000). The share of those satisfied or highly satisfied with the quantity of information was higher among those with upper-secondary education (17%) than others (3% to 8%) and the share of those neither dissatisfied nor satisfied was high among those with university (60%) and polytechnic (48%) education compared to others (31% to 48%).

Type of education was related to a statistically significant difference in satisfaction with the quantity of information provided by *Posiva* ( $\chi^2$  (18, N=467) = 39.75,  $p$ = .002). Those with natural sciences and computing, and technology and transport in their education were those most frequently satisfied or highly satisfied with the quantity of information provided by Posiva (64%/49%) and those with health and welfare, and humanities, arts and culture in their education were those least frequently satisfied or highly satisfied (17%/23%).

Like type of education, line of occupation was related to a statistically significant difference in satisfaction with the quantity of information provided by *Posiva* ( $\chi^2$  (22, N=536) = 42.21,  $p$ = .006). Those working in finance, real estate and business support services were most frequently satisfied, with 57% of them satisfied or highly satisfied with the quantity of information provided by Posiva, followed by those working in manufacturing and mining (55% satisfied or highly satisfied) and those working in energy, heat and water supply (48% satisfied or highly satisfied). Those working in education, health and social services and in "other civil and personal services"<sup>33</sup>, and those who are not currently in working life were least often (24%/27%/29%) satisfied or highly satisfied with quantity of information provided by Posiva. The share of those highly dissatisfied or satisfied was highest among those working in public administration and defence (40%) or in accommodation and food services (40%).

Political affiliation was related to two statistically highly significant differences in satisfaction with quantity of information provided by *local authorities* ( $\chi^2$  (20, N=553) = 47.15,  $p$ = .001) and by *Posiva* ( $\chi^2$  (20, N=558) = 46.50,  $p$ = .001) and to two statistically significant differences in satisfaction with quantity of information provided by *TVO and Fortum* ( $\chi^2$  (20, N=563) = 41.62,  $p$ = .003) and by *political parties* ( $\chi^2$  (20, N=558) = 38.51,  $p$ = .008). Of those oriented towards the three biggest parties, the Finnish Centre Party, the National Coalition Party and the Finnish Social Democratic Party, just over 20% (22%/21%/23%) were satisfied

<sup>33</sup> Other than public administration and defence, or education, health and social services (see Table 10).

or highly satisfied with information disseminated by local authorities and of those oriented towards the True Finns Party 13%. Whereas those oriented towards other parties were not at all satisfied, as none (0%) among those oriented towards the Left-Wing Alliance, the Green League of Finland, the Finnish Christian Democrats or the other parties without representation in Parliament were satisfied or highly satisfied with information provided by local authorities.

Personal income was related to one statistically significant difference, in satisfaction with quantity of information provided by *Posiva* ( $\chi^2(10, N=503) = 24.64, p = .006$ ). Those earning less than 40,000 euros a year were less satisfied with the quantity of information disseminated by Posiva than those earning more. The most satisfied were those earning 60,000 euros or more a year, 68% in this income group were satisfied or highly satisfied with the quantity of information provided by Posiva. In the income group earning from 40,000 to 59,999 euros 52% were satisfied or highly satisfied with quantity of information from Posiva. Whereas with those groups earning less than 40,000 a year, share of those who were satisfied varied between 29% and 39%.

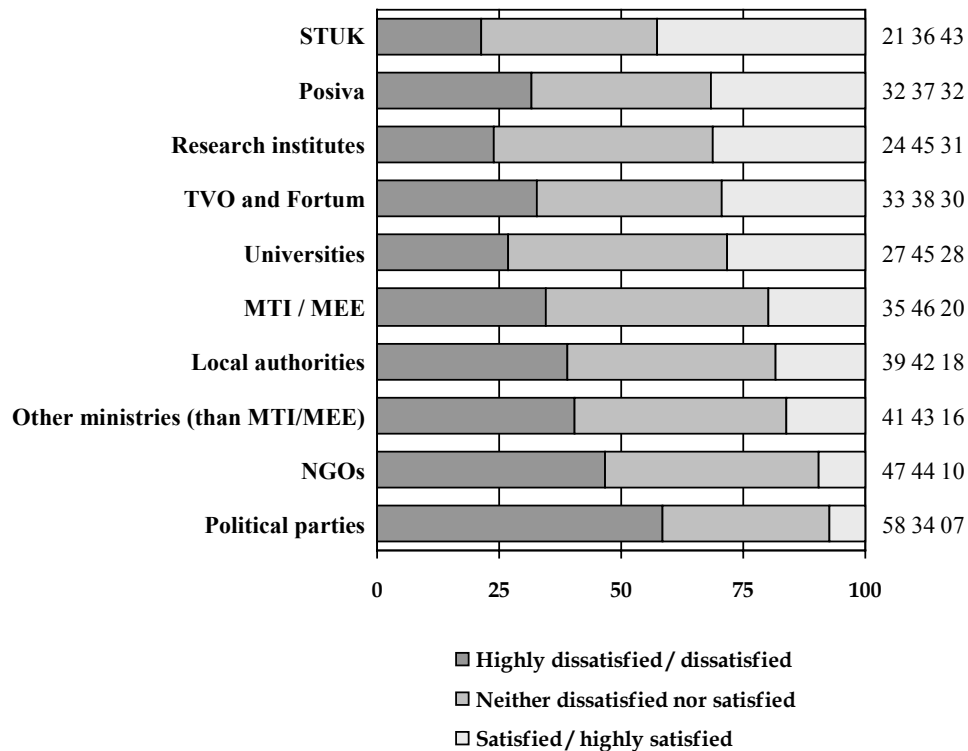
#### 4.3 Confidence in information provided by different actors

As stated in the previous chapter the second aim of the research was to determine how local people perceive the information provided by different actors in the field. When the first part of the question used addressed the subject of satisfaction with quantity of information, the second part of the question, which is examined in this chapter, addressed the subject of satisfaction regarding confidence in information. The question used in the survey was: "How satisfied or dissatisfied are you regarding [...] confidence in information disseminated by different parties concerning final disposal?" As in the first part of the question ten different information providers were listed and respondents were asked to indicate their level of their satisfaction with them on a five-step scale from "Highly dissatisfied" to "Highly satisfied". (For the questionnaire [in Finnish], see Appendix.)

As Figure 9 shows, residents considered *STUK* the most reliable source of information. 42% of respondents reported being satisfied or highly satisfied regarding confidence in information disseminated by *STUK* in relation to final disposal. Around thirty percent were also satisfied or highly satisfied with information provided by *Posiva* (32%), *research institutes* (31%), *TVO and Fortum* (30%), and *universities* (28%). Only 20% or less were satisfied or highly satisfied with information provided by other nuclear waste management actors. The *political parties* were given the clearly poorest ratings as 58% of respondents reported that they were dissatisfied with the political parties as sources of information. In addition, almost half of respondents were highly dissatisfied or dissatisfied with information disseminated by *NGOs* (47%), more than two out of five with information disseminated by *other ministries (than MTI/MEE)* (41%) and almost two out of five with information disseminated by *local authorities* (39%).

Table 17 shows the percentage share of those respondents highly dissatisfied regarding information disseminated by different nuclear waste management actors. The share of those highly dissatisfied regarding confidence in information provided by *political parties* was high, around one third of the respondents (32%) were highly dissatisfied with it. This was more than the combined percentages for dissatisfied and highly dissatisfied respondents for *STUK*,

research institutes and universities (21%/24%/27%, see Figure 9). Additionally, 22% of respondents were highly dissatisfied with information provided by NGOs and 17% with information provided by local authorities. Again (as with quantity of information) at first sight these figures do not necessarily look very high, but considering that half of the ten actors listed had only 20% or less of respondents satisfied or highly satisfied (combined) they seem quite high.



**Figure 9.** Satisfaction regarding confidence in information disseminated by certain main actors in Finnish nuclear waste management (%).

**Table 17.** Those highly dissatisfied regarding confidence in information disseminated by certain main actors in Finnish nuclear waste management (%).

Political parties	32
NGOs	22
Local authorities	17
MTI / MEE	15
Other ministries (than MTI/MEE)	15
TVO and Fortum	14
Posiva	13
Universities	10
STUK	10
Research institutes	09



Comparison between residents of Eurajoki and residents of neighbouring municipalities (Table 18) reveals that the information providers which were found most satisfactory were the same in both groups – only the order was different. In both cases respondents were most satisfied with confidence in information disseminated by *STUK* but residents of Eurajoki were somewhat more satisfied with confidence in information provided by *Posiva* and *TVO and Fortum* than residents of neighbouring municipalities. Table 18 shows that residents of neighbouring municipalities rated *research institutes* second with 31% and *universities* third with 29% satisfied or highly satisfied with confidence in information disseminated by them, *Posiva* comes fourth with 28% and *TVO and Fortum* fifth with 26% satisfaction rate, whereas residents of Eurajoki rated *Posiva* second with 37% and *TVO and Fortum* third with a 34% satisfaction rate (9%/8% [percentage points] increase) leaving *research institutes* (30%) and *universities* (26%) fourth and fifth (only 1%/3% [percentage points] decrease). Differences in (satisfaction with) confidence in information with information disseminated by *TVO and Fortum* ( $\chi^2$  (2, N=542) = 9.96,  $p = .007$ ) and *Posiva* ( $\chi^2$  (2, N=546) = 9.14,  $p = .010$ ) were statistically significant ( $.001 < p \leq .010$ ).

**Table 18.**

Five information providers found most satisfactory ("satisfied / highly satisfied" > 25%) regarding confidence among certain main actors in Finnish nuclear waste management (%). Comparison between Eurajoki and neighbouring municipalities.

		Highly dissatisfied / dissatisfied	Neither dissatisfied nor satisfied	Satisfied / highly satisfied
Eurajoki	STUK	26	30	44
	Posiva	33	30	37
	TVO and Fortum	36	30	34
	Research institutes	27	43	30
	Universities	32	42	26
Neighbours	STUK	18	41	41
	Research institutes	22	47	31
	Universities	23	47	29
	Posiva	31	42	28
	TVO and Fortum	30	43	26

When the survey data was examined in relation to other socio-demographic background variables, a number of statistically highly significant ( $p \leq .001$ ) and statistically significant ( $.001 < p \leq .010$ ) differences was observed.

The difference between men and women was statistically highly significant in the case of *TVO and Fortum* ( $\chi^2$  (2, N=542) = 14.32,  $p = .001$ ) and statistically significant in the case of *Posiva* ( $\chi^2$  (2, N=544) = 12.04,  $p = .002$ ). 39% of the women were highly dissatisfied or dissatisfied and 24% were satisfied or highly satisfied, whereas 36% of the men were satisfied or highly satisfied and 25% highly dissatisfied or dissatisfied regarding confidence in information disseminated by *TVO and Fortum*. Regarding *Posiva* 37% of women were highly dissatisfied or dissatisfied and 26% were satisfied or highly satisfied, and 38% of the men were satisfied or highly satisfied and 25% highly dissatisfied or dissatisfied.

There were many statistically highly significant differences between different age groups, in satisfaction regarding confidence in information disseminated by *MTI / MEE* ( $\chi^2$  (10, N=529) = 32.84,  $p= .000$ ) *other ministries (than MTI/MEE)* ( $\chi^2$  (10, N=521) = 30.01,  $p= .001$ ) *local authorities* ( $\chi^2$  (10, N=524) = 34.46,  $p= .000$ ) *political parties* ( $\chi^2$  (10, N=527) = 57.63,  $p= .000$ ) and *research institutes* ( $\chi^2$  (10, N=522) = 34.59,  $p= .000$ ). There were also statistically significant differences in satisfaction with information provided by *Posiva* ( $\chi^2$  (10, N=536) = 27.32,  $p= .002$ ) and *STUK* ( $\chi^2$  (10, N=530) = 26.56,  $p= .003$ ) In addition to these differences based on age, comparison between different generations revealed statistically significant differences in the case of *universities* ( $\chi^2$  (12, N=522) = 28.68,  $p= .004$ ). Of the different age groups those aged 25-34 were most satisfied with information provided by MTI / MEE with 37% being satisfied or highly satisfied with confidence regarding ministry's information, followed by those aged 24 or under (24%) and those aged 45-54 (21%). In other age groups percentages were between 15% and 17%. With other ministries (than MTI/MEE) those aged 25-34 and 24 or under were again the most satisfied (28%/26% "satisfied / highly satisfied") other age groups being clearly less satisfied (11 to 15% "satisfied / highly satisfied"). This trend continues for local authorities, of 25-34 olds 30% and those aged 24 or under 23% were satisfied or highly satisfied and of others 14 to 18%. With political parties, research institutes and STUK differences was better characterised by absence of dissatisfaction. In the case of confidence in information disseminated by political parties, the share of those highly dissatisfied or dissatisfied with confidence was 27% in the age group 24 or under and 40% in the age group 25-34, whereas in other age groups share was between 65% and 73%. With research institutes the share of highly dissatisfied or dissatisfied in age group 24 or under was only 8% and in the age group 25-34 even less at 5%. In other groups the share was between 15% and 33%. With STUK share was 11% in the age group 24 or under, 5% in the age group 25-34 and between 18% and 31% in other age groups. In the case of information provided by Posiva 25-34 olds stand out, as 52% this age group were satisfied or highly satisfied with confidence regarding the information while in other groups share of those satisfied or highly satisfied was between 25% and 35%. Regarding confidence in information disseminated by universities, the older generations were more dissatisfied than the younger generations. Of older generations 44% of the generation of war and depression, 34% of the generation of the transformation, 28% of the suburban generation and 24% of the welfare generation were highly dissatisfied or dissatisfied with confidence regarding information disseminated by universities but of younger generations 18% of the media generation, 15% of the new generation and only 9% of the rising generation were highly dissatisfied or dissatisfied.

Relationship status was related to a statistically significant difference in the case of *political parties* ( $\chi^2$  (6, N=539) = 17.13,  $p= .009$ ). Single respondents were less dissatisfied with confidence in information disseminated by political parties (42% "highly dissatisfied / dissatisfied") than other groups (55% to 65% "highly dissatisfied / dissatisfied").

Level of education was related to numerous statistically highly significant differences in confidence, in the cases of *political parties* ( $\chi^2$  (10, N=535) = 41.36,  $p= .000$ ), *MTI / MEE* ( $\chi^2$  (10, N=537) = 38.29,  $p= .000$ ), *other ministries (than MTI/MEE)* ( $\chi^2$  (10, N=528) = 34.93,  $p= .000$ ), *Posiva* ( $\chi^2$  (10, N=543) = 33.04,  $p= .000$ ), *research institutes* ( $\chi^2$  (10, N=531) = 31.63,  $p= .000$ ), *TVO and Fortum* ( $\chi^2$  (10, N=541) = 31.34,  $p= .001$ ) and one statistically significant difference in case of *local authorities* ( $\chi^2$  (10, N=531) = 26.15,  $p= .004$ ). Those with polytechnic and upper-secondary education were most satisfied (20%/15% "satisfied / highly satisfied") regarding confidence in information disseminated by political parties and those with university and college-level education were least satisfied (2%/2% "satisfied / highly satisfied"). In other groups, among those with vocational training and those with no

qualification after basic education the figures also remained rather low (7%/8%). Those with polytechnic degree also had great confidence in MTI / MEE as 48% of those with this degree were either satisfied or highly satisfied regarding confidence in information provided by MTI / MEE. However, among those with college-level education only 10% and those with vocational education 16% shared this view, while in other groups the percentage remained between 20% and 27%. Other ministries (than MTI/MEE) were again most trusted by those with polytechnic education (36% "satisfied / highly satisfied") followed this time by those with upper-secondary education (33% "satisfied / highly satisfied") while those with college-level and vocational education were least confident (10%/11% "satisfied / highly satisfied") and those with no qualification after basic education and those with university education falling in between (16%/20%). The greatest confidence in information disseminated by Posiva was again found among those with polytechnic education (64% "satisfied / highly satisfied") while the lowest was found among those with vocational training (24%). In other groups 30% to 34% of the respondents were satisfied. Regarding research institutes, the confidence level was highest among those with polytechnic education (47% "satisfied / highly satisfied") followed by those with upper-secondary education (41% "satisfied / highly satisfied"), lowest among those with college-level and vocational training (25%/27% "satisfied / highly satisfied"), with those with university education and those with no qualification after basic education falling in between (31%/33%). In the case of information disseminated by TVO and Fortum the highest confidence level was found, once again, among those with polytechnic education (60% "satisfied / highly satisfied") and the lowest confidence level was found among those with vocational training (22% "satisfied / highly satisfied"), while other groups fall in between (28% to 37% "satisfied / highly satisfied"). In the case of information disseminated by the local authorities, 33% of those with polytechnic education were either satisfied or highly satisfied regarding confidence in information provided, while among other groups percentage was between 13% and 23%.

The socio-economic group was related to statistically significant or highly significant differences in all cases. There were highly significant differences in satisfaction regarding confidence in information disseminated by *political parties* ( $\chi^2$  (16, N=535) = 51.56,  $p = .000$ ), *STUK* ( $\chi^2$  (16, N=539) = 49.54,  $p = .000$ ), *other ministries (than MTI/MEE)* ( $\chi^2$  (16, N=529) = 45.43,  $p = .000$ ), *local authorities* ( $\chi^2$  (16, N=532) = 43.84,  $p = .000$ ), *TVO and Fortum* ( $\chi^2$  (16, N=543) = 41.83,  $p = .000$ ), *research institutes* ( $\chi^2$  (16, N=531) = 40.19,  $p = .001$ ), and statistically significant differences regarding confidence in information disseminated by *NGOs* ( $\chi^2$  (16, N=532) = 37.37,  $p = .002$ ), *universities* ( $\chi^2$  (16, N=531) = 37.06,  $p = .002$ ) and *Posiva* ( $\chi^2$  (16, N=545) = 32.42,  $p = .009$ ). As many as four out of five farmers distrusted the information provided by political parties (82% "highly dissatisfied / dissatisfied") whereas among students and those unemployed or doing domestic work distrust was at considerably lower level (25%/43% "highly dissatisfied / dissatisfied") and in other groups somewhat lower level (50% to 69% "highly dissatisfied / dissatisfied"). Information provided by STUK, on other hand, was quite highly trusted by farmers (56% "satisfied / highly satisfied") and most trusted by white-collar workers (66% "satisfied / highly satisfied"). The least satisfied regarding confidence in information from STUK were those unemployed or doing domestic work (19% "satisfied / highly satisfied"). Among other groups trust was at reasonable level (36% to 47% "satisfied / highly satisfied"). Regarding other ministries (than MTI/MEE) those most satisfied with the information provided by them were white-collar workers and students (33%/30% "satisfied / highly satisfied") and least satisfied those unemployed or doing domestic work, and senior executives (5%/8% "satisfied / highly satisfied"), other groups falling in between (12%/21% "satisfied / highly satisfied"). Also regarding the information provided by local authorities those most satisfied were white-collar

workers and students (33%/25% "satisfied / highly satisfied") and least satisfied those unemployed or doing domestic work, and senior executives (0%/8% "satisfied / highly satisfied"). In the case of the information provided by TVO and Fortum those most satisfied were white-collar workers and self-employed people or employers (50%/47% "satisfied / highly satisfied") and least satisfied those unemployed or doing domestic work, and farmers (10%/12% "satisfied / highly satisfied"). With information provided by research institutes, students and self-employed people or employers were most satisfied (45%/41% "satisfied / highly satisfied") and those unemployed or doing domestic work least satisfied (10% "satisfied / highly satisfied"). In the case of NGO's, people were rather dissatisfied regarding confidence in information produced by these. Farmers and self-employed people or employers were significantly dissatisfied (71%/59% "highly dissatisfied / dissatisfied") while those unemployed or doing domestic work were not very dissatisfied (14% "highly dissatisfied / dissatisfied"). This was the only group where fewer than 30% of respondents were dissatisfied, whereas in rest of the groups 31% to 51% were at least somewhat dissatisfied ("highly dissatisfied / dissatisfied"). In the case of universities, those most satisfied regarding confidence in information disseminated by them were white-collar workers, senior executives, and self-employed people or employers (45%/38%/38% "satisfied / highly satisfied"), and least satisfied those who were unemployed or doing domestic work, and retirees (10%/19% "satisfied / highly satisfied"). Those most satisfied with information disseminated by Posiva were white-collar workers and self-employed people or employers (53%/44% "satisfied / highly satisfied"), and least satisfied were those who were unemployed or doing domestic work (14% "satisfied / highly satisfied").

Line of occupation was related to a statistically significant difference in satisfaction regarding confidence in information disseminated by *TVO and Fortum* ( $\chi^2$  (22, N=520) = 43.60,  $p = .004$ ). Those working in energy, heat and water supply and those working in finance, real estate and business support services were most satisfied (59%/50% "satisfied / highly satisfied"), whereas those working in education, health and social services and in agriculture, forestry etc. were least satisfied (16%/17% "satisfied / highly satisfied").

Political affiliation was related to four statistically highly significant differences in satisfaction regarding confidence in information provided by *local authorities* ( $\chi^2$  (20, N=525) = 75.16,  $p = .000$ ), *MTI / MEE* ( $\chi^2$  (20, N=531) = 49.61,  $p = .000$ ), *other ministries (than MTI/MEE)* ( $\chi^2$  (20, N=522) = 49.37,  $p = .000$ ), *STUK* ( $\chi^2$  (20, N=531) = 47.22,  $p = .001$ ) and to three statistically significant differences, in the cases of information provided by *TVO and Fortum* ( $\chi^2$  (20, N=536) = 42.34,  $p = .002$ ), *NGOs* ( $\chi^2$  (20, N=524) = 41.60,  $p = .003$ ) and *Posiva* ( $\chi^2$  (20, N=538) = 40.68,  $p = .004$ ). Of those oriented towards the National Coalition Party 36% and of those oriented towards the Finnish Centre Party 26% were satisfied or highly satisfied with information disseminated by local authorities, whereas those oriented towards the Green League of Finland or the Left-Wing Alliance were not at all satisfied, as none (0%) of these were satisfied or highly satisfied with information provided by local authorities. In the case of information provided by MTI / MEE it was again those oriented towards the two biggest parties, the Finnish Centre Party and the National Coalition Party, with high level of satisfaction (24%/38% "satisfied / highly satisfied") and again those oriented towards the Green League of Finland and the Left-Wing Alliance who were least satisfied (0%/5%), of those oriented towards parliamentary parties. With information provided by other ministries (than MTI/MEE) the same trend continues. The highest figures are found among those oriented towards the National Coalition Party (35%) and the Finnish Centre Party (20%) and the lowest among those oriented towards the Left-Wing Alliance (0%) and the Green League of Finland (6%), with those oriented towards the True Finns Party

coming very close (7%). Regarding confidence in information disseminated by STUK, a large number of those oriented towards the three biggest parties, the Finnish Centre Party, the National Coalition Party and the Finnish Social Democratic Party were satisfied (41%/62%/48% "satisfied / highly satisfied") while those oriented towards the Green League of Finland were not very satisfied (12% "satisfied / highly satisfied"), the figures for those oriented towards other parliamentary parties were between 21% and 33%. With information disseminated by TVO and Fortum, and Posiva those oriented towards the National Coalition Party again had the highest percentage of those who were satisfied or highly satisfied regarding confidence in their information. In the case of the TVO and Fortum 52% of those oriented towards the National Coalition Party and none (0%) of those oriented towards the Green League of Finland were satisfied or highly satisfied with information, and in the case of Posiva 51% of those oriented towards the National Coalition Party and none (0%) of those oriented towards the Green League of Finland were satisfied or highly satisfied. With information provided by NGO's, however the situation was different. Of those oriented towards the parliamentary parties, those oriented towards the Left-Wing Alliance were most satisfied regarding confidence in information provided by NGO's (29% "satisfied / highly satisfied") and those oriented towards the National Coalition Party and the True Finns Party were the least satisfied (3%/3% "satisfied / highly satisfied").

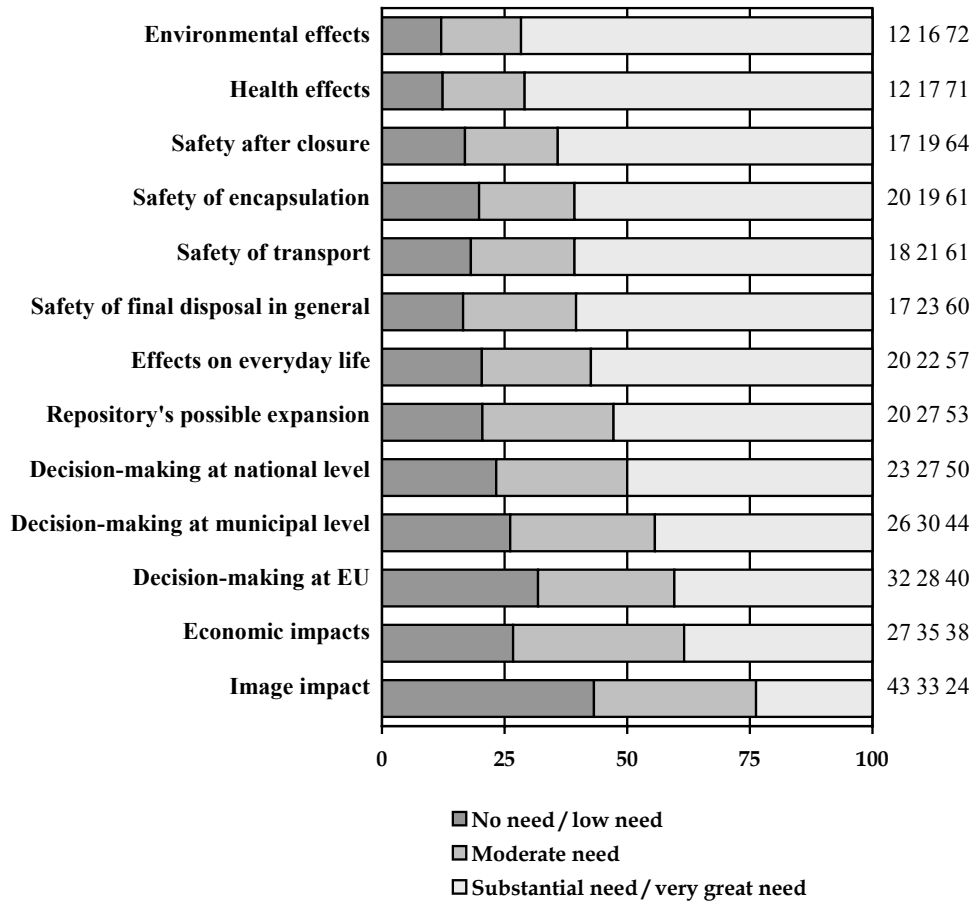
Personal income was related to three statistically significant differences, in the cases of *TVO and Fortum* ( $\chi^2$  (10, N=489) = 28.04,  $p$ = .002), *MTI / MEE* ( $\chi^2$  (10, N=486) = 26.35,  $p$ = .003) and *Posiva* ( $\chi^2$  (10, N=491) = 25.34,  $p$ = .005). In all these cases those belonging to the highest income group earning 60,000 euros or more a year were most satisfied regarding confidence in information disseminated by these actors. With both TVO and Fortum, and Posiva 70% and with MTI / MEE 52% of those in the highest income group were either satisfied or highly satisfied. Those least satisfied in the case of the TVO and Fortum, and MTI / MEE were those belonging to the second lowest income group earning 10,000 to 19,999 euros a year (22%/13% "satisfied / highly satisfied") and in the case of Posiva those earning the least, under 10,000 euros a year (23% "satisfied / highly satisfied").

#### 4.4 Information needs

The third aim of the research was to discern what kind of information needs people in the area have in relation to SNF final disposal. The question used in the survey was: "What kind of information needs do you have regarding final disposal related issues?" Thirteen different final disposal related information areas were listed and respondents were asked to indicate the level of their need for information in these areas on a five-step scale from "No need for information" to "Very great need for information". (For the questionnaire [in Finnish], see Appendix.)

As Figure 10 shows, in spite of relatively low dissatisfaction with quantity of information offered by three major actors in siting process, namely Posiva, TVO and Fortum, and STUK (Figure 8), residents clearly articulate a need for information regarding various final disposal related issues. Areas where information is most needed are *environmental effects*, 72% of the residents indicating substantial or very great need for information, *health effects*, 71% indicating substantial or very great need for information, and *safety after closure*, 64% indicating substantial or very great need for information.

Table 19 further indicates how great the need is, as regarding *environmental effects* and *health effects* around half of respondents (48%/48%) reported a very great need for information in these areas and regarding *safety after closure* almost 40 percent (37%). All in all, within the 13 areas elicited there were only four areas where under a quarter of respondents reported a very great need for information.



**Figure 10.** Information needs regarding certain issues related to final disposal of spent nuclear fuel (%).

**Table 19.**

Those experiencing very great need for information regarding certain issues related to final disposal of spent nuclear fuel (%).

<b>Health effects</b>	48
<b>Environmental effects</b>	48
<b>Safety after closure</b>	38
<b>Safety of transport</b>	32
<b>Safety of encapsulation</b>	32
<b>Safety of final disposal in general</b>	30
<b>Effects on everyday life</b>	28
<b>Repository's possible expansion</b>	27
<b>Decision-making at national level</b>	26
<b>Decision-making at municipal level</b>	22
<b>Decision-making at EU</b>	22
<b>Economic impacts</b>	13
<b>Image impact</b>	10

Comparison between the residents of Eurajoki and those of neighbouring municipalities (Table 20) revealed that, in the six cases where the greatest overall needs for information were detected, need for information was approximately at the same level in Eurajoki and in the neighbouring municipalities. Regarding *environmental effects*, *health effects* and *safety after closure* there was hardly any difference at all, and while in other cases there was some differences between the groups, these were not statistically significant.

**Table 20.**

Six issues where reported need for information ("substantial need / very great need") was greatest (%). Comparison between Eurajoki and neighbouring municipalities.

		<b>No need / low need</b>	<b>Moderate need</b>	<b>Substantial need / very great need</b>
<b>Eurajoki</b>	<b>Environmental effects</b>	12	17	71
	<b>Health effects</b>	13	17	70
	<b>Safety of transport</b>	18	18	65
	<b>Safety after closure</b>	18	18	64
	<b>Safety of encapsulation</b>	18	18	64
	<b>Safety of final disposal in general</b>	17	21	62
<b>Neighbours</b>	<b>Environmental effects</b>	12	16	72
	<b>Health effects</b>	12	17	71
	<b>Safety after closure</b>	16	20	64
	<b>Safety of final disposal in general</b>	17	24	59
	<b>Safety of encapsulation</b>	21	20	58
	<b>Safety of transport</b>	18	24	58

When the survey data was examined in relation to other socio-demographic background variables, a number of statistically highly significant ( $p \leq .001$ ) and statistically significant ( $.001 < p \leq .010$ ) differences were observed.

The difference between men and women was statistically highly significant in the case of *environmental effects* ( $\chi^2$  (2, N=585) = 18.21, p= .000) and statistically significant in the cases of *health effects* ( $\chi^2$  (2, N=587) = 11.73, p= .003) and *effects on everyday life* ( $\chi^2$  (2, N=583) = 10.06, p= .007). In all these areas the share of women experiencing substantial or very great need for information (79%/77%/64%) was greater than the share of men experiencing the same kind of need for information in these areas (63%/64%/51%).

There were statistically highly significant differences in information needs between different generations regarding *decision-making at national level* ( $\chi^2$  (12, N=571) = 32.97, p= .001) and statistically significant differences regarding *decision-making at EU* ( $\chi^2$  (12, N=574) = 27.06, p= .008) and *safety of transport* ( $\chi^2$  (12, N=575) = 26.54, p= .009). In all of these those belonging to the rising generation were most numerous in experiencing no need or little need for information (49%/58%/41%). In relation to decision-making at national level and decision-making at EU those reporting the smallest share of those experiencing no need or little need for information were those belonging to the generation of the transformation (16%/23%), and in the case of the safety of transport those belonging to the generation of war and depression and to the suburban generation (14%/14%).

Relationship status was related to three statistically significant differences in information needs regarding *health effects* ( $\chi^2$  (6, N=594) = 21.36, p= .002), *decision-making at national level* ( $\chi^2$  (6, N=588) = 19.40, p= .004) and *repository's possible expansion* ( $\chi^2$  (6, N=587) = 19.22, p= .004). The share of those reporting little or no need for information about health effects was greatest among those who were single or living in a common-law marriage (20%/19%), whereas of those who were married or living in a registered relationship, and those who were divorced, separated or widowed a much lower share (10%/4%) reported little or no need for information in this area. Regarding decision-making at national level, 36% of single respondents reported little or no need for information in this area, whereas only 13% of divorced, separated or widowed respondents reported little or no need, those living in a common-law marriage and those who were married or living in a registered relationship falling in between (20%/23%). Regarding the repository's possible expansion, the share of those reporting little or no need for information was greatest among single respondents (33%), followed by those living in a common-law marriage (24%), while among respondents who were married or living in a registered relationship and divorced, separated or widowed respondents shares of those reporting little or no need for information in this area were somewhat lower (17%/14%).

Level of education was related to one statistically significant difference regarding *decision-making at national level* ( $\chi^2$  (10, N=582) = 23.74, p= .008). Those with polytechnic education reported less need for information (27% "substantial need / very great need") than others (40% to 55%).

Type of education was related to two statistically significant differences concerning need for information, in the case of *environmental effects* ( $\chi^2$  (18, N=487) = 37.09, p= .005) and *health effects* ( $\chi^2$  (18, N=488) = 35.77, p= .008). Those with education in agriculture and forestry, and technology and transport reported the greatest share (24%/20%) of those perceiving little or no need for information regarding environmental effects, followed closely by those with education in the humanities, arts and culture (18%) and those belonging to the group "other" with no specified type of education (18%). Among other groups the share of those reporting little or no need for information about environmental effects was low (0% to 10%). Likewise with health effects, the greatest numbers of those reporting little or no need for information



were found among those with education in technology and transport, and in agriculture and forestry (20%/18%) this time followed closely only by those with education in the humanities, arts and culture (14%), others accounting for only a small share of those with no need or low need for information in this area (4% to 11%).

Socio-economic group was related to one statistically significant difference regarding *decision-making at national level* ( $\chi^2$  (16, N=584) = 36.11, p= .003). Almost 40% of those respondents who were unemployed or doing domestic work (39%) and students (38%) reported little or no need for information regarding decision-making at national level, whereas under 15% of retirees (13%), and senior executives (13%) reported little or no need for this kind of information.

Personal income was related to one statistically significant difference, namely *safety of transport* ( $\chi^2$  (10, N=522) = 23.67, p= .009). Those earning 60,000 euros or more a year and those earning less than 10,000 euros a year reported a greater share of those perceiving little or no need for information on safety of transport (45%/24%) compared to the other income groups (12% to 18%)

#### 4.5 Discussion

In the survey of 1994 the respondents were asked to name the most important source of information in nuclear waste issues of six alternatives given (Kurki 1995, Fig. 5). Over 60% of respondents in Eurajoki named newspapers as the most important source of information in nuclear waste issues. However, at the same time over 50% of the respondents named TV as the most important source. The TVO Information leaflet or Internet were not among the given options. (Table 21.)

**Table 21.**

The most important sources of information in nuclear waste issues among respondents in Eurajoki 1994 (%). According to Kurki (1995, Fig. 5).

<b>Newspapers</b>	62
<b>TV</b>	53
<b>Local newspapers</b>	31
<b>Radio programmes of Public Broadcasting Company YLE</b>	14
<b>Literature</b>	10
<b>Local commercial radios</b>	07

When the results of the 1994 survey are compared with the results of our 2008 survey (Table 20) it is clear that the mass media has retained its position as a primary source of information in nuclear waste issues. In 1994 newspapers were the most important information source and in 2008 newspapers were still the most followed information source. However, if one focuses on those consulting different information sources "actively", the 2008 survey reveals that the TVO News leaflet surpasses newspapers as most consulted media. Furthermore, the list of six most "fairly actively or actively" consulted information sources among residents of Eurajoki (Table 14) ranked both the TVO News leaflet and the Posiva leaflet higher than television. Although industry leaflets were not mentioned in the survey of 1994, it seems that TVO and

Posiva have succeeded in positioning their own leaflets among the most actively used information sources in Eurajoki. Thus the nuclear industry controls a direct information channel to local residents which is free from interpretations of the media. It is presumable that in the long run this has influences on residents' opinions and way of framing the issue.

One interesting issue is respondents' self-reflections concerning the level of information they have obtained (Table 22). Although one must keep in mind the varying wording of the statements used to elicit opinions, one could conclude that among residents of Eurajoki the number of respondents reporting that they have insufficient information decreased in ten years. In 1996 around 50% of the residents of Eurajoki estimated that they knew too little about final disposal of nuclear waste. Roughly one third responded that according to their view they knew enough. The question used was "How much do I estimate that I know about final disposal of nuclear waste?" Options given were too little, a little and enough. (Harmaajärvi, Litmanen and Kaunismaa 1998, 43.) In 2008 only one third of respondents in Eurajoki disagreed with the statement "In my opinion I have enough information regarding the plan for final disposal" whereas around one third also agreed with the statement. (Table 22.)

At the national level, the share of those estimating that they have insufficient information seems to be much higher compared to Eurajoki. In 2007 in a nation-wide survey (Litmanen et al. 2010), in which Finns were posed a statement "In my opinion I know enough regarding the Finnish nuclear waste management", 58% of the respondents reported that they did not have enough information. According to the same survey, in Satakunta region, the share of those reporting that they did not have sufficient information was 57%. As Table 22 indicates this places it near the national level and further from the municipalities neighbouring Eurajoki which makes sense. Correspondingly the share of those estimating that they had sufficient information was highest among residents of Eurajoki and lowest at national level, residents of neighbouring municipalities with residents of Satakunta region placed in between. In the survey by Aho (2008, 35–36) the share of those who agreed with the statement "I have obtained enough information concerning final disposal of spent nuclear fuel" in Eurajoki was exceptionally high (56%). (Table 22.)

**Table 22.**

Sufficiency of information regarding final disposal according to respondents. (%). Comparison between different studies.

	<b>Eurajoki 1996 (Harmaajärvi et al.)<sup>1</sup></b>	<b>Eurajoki 2007 (Aho)<sup>2</sup></b>	<b>Eurajoki 2008 (Our survey)</b>	<b>Neighbours of Eurajoki 2008 (Our survey)</b>	<b>Satakunta 2007 (Litmanen et al.)<sup>3</sup></b>	<b>Finns 2007 (Litmanen et al.)<sup>3</sup></b>
<b>Not enough</b>	53	31	33	45	57	58
<b>Hard to say</b>	13	12	34	29	25	28
<b>Enough</b>	34	56	34	26	18	13

<sup>1</sup> Harmaajärvi, Litmanen and Kaunismaa (1998, 29), numbers estimated from a figure.

<sup>2</sup> Aho (2008, 35).

<sup>3</sup> Litmanen et al. (2010).

Thus it is clear that after a long site selection process (started in Eurajoki in the mid 1980s) and after a decade of post site selection phase, the residents of Eurajoki still want more information regarding the final disposal of SNF. In the survey of 1996 (Harmaajärvi, Litmanen and Kaunismaa 1998) there were six issues which especially raised the interest of the respondents. Approximately 90% of the respondents wanted to have a lot or somewhat

more information about the following questions, in the following order: general safety of the nuclear waste facility, the safety of transportation, the safety of encapsulation, the safety of final disposal, health impacts and environmental and ecological impacts. The surveys of 1994 and 2007 (Kurki 1995; Aho 2008) – both funded by the energy industry – were focused on the reliability and sufficiency of diverse information sources, not on issues of possible further information needs of residents.

In the survey of 2008 the top six issues which raised concern were different from those of 1996 as environmental effects and health effects were now at the top before safety issues (such as safety after closure, of encapsulation, of transport, of final disposal in general) (Table 20). In 1996 approximately 75% of respondents in Eurajoki requested a lot or somewhat more information about economic impacts and in 2008 73% needed more information about these issues. With these figures economic impacts took the second last position among 13 pre-structured issues concerning needs of information regarding final disposal of SNF in the survey of 2008. In the survey of 1996 economic impacts was in seventh place (Harmaajärvi, Litmanen and Kaunismaa 1998). Thus the needs for information seem to have changed from safety issues towards environmental and health effects. In both of the surveys (of 1996 and 2008) the method was the same (pre-structured lists of issues) which is important to take into account when evaluating the results.

From the point of view of confidence in some main information providers the residents of Eurajoki have become more critical. In 1994 around every fifth (22%) of the respondents in Eurajoki disagreed with the statement "I obtain reliable information regarding nuclear waste from the power companies (TVO, IVO<sup>34</sup>)", whereas almost two thirds (62%) of the respondents agreed with the statement (Kurki 1995, Fig. 9c). In 2008 figures indicating confidence in the power companies as information providers were quite different as 36% were highly dissatisfied or dissatisfied and only 34% were satisfied or highly satisfied with confidence in information provided by TVO and Fortum (Table 18). In 1994 attitude towards environmental movements was more critical than towards the power companies as around two fifths (41%) disagreed with the statement "I obtain reliable information regarding nuclear waste from the environmental movement" and around third (30%) agreed with the statement (Kurki 1995, Fig. 9d). In 2008 47% of the respondents of Eurajoki were highly dissatisfied or dissatisfied regarding confidence in information disseminated by NGOs and only 10% were highly satisfied or satisfied (Figure 9). Thus, power companies still enjoyed more confidence although general attitude had become more critical towards them, too.

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<sup>34</sup> See Abbreviations and terms.

## 5 Perceived impacts and threats

After eliciting about information issues, the second part of the research concentrated on the actual views of the people in the area. The SNF repository project is an undertaking of great magnitude. Consequently it is almost inevitable that it affects various aspects of life in the area. As stated earlier (Chapter 2.4) the repository has been under construction for a while already, and if everything goes according plan the project will continue for several decades (and, of course, after the project itself has ended, the repository will remain even longer). What we were interested in was how people in the area perceive the effects of constructing the final disposal facility and whether it poses some kind of threat.

### 5.1 Impacts of the repository

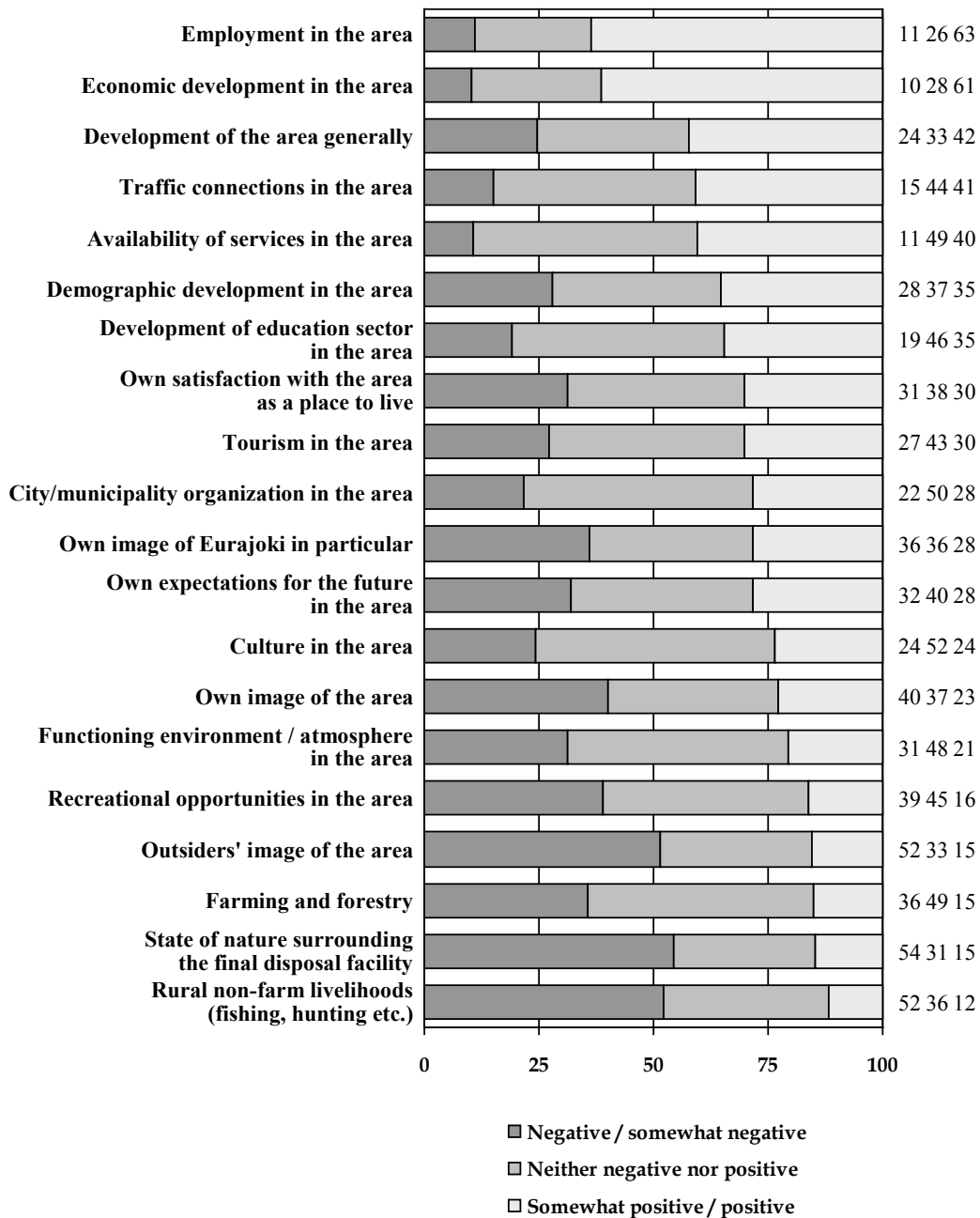
The first aim of the second part of the research was to examine how local people perceive the effects of repository project. The question used in the survey was: "How constructing the final disposal facility in the area in your opinion affect the following issues?" A list of twenty different issues was presented to respondents and they were asked to assess effect to each of these issues on a five-step scale from "Negatively" to "Positively". (For the questionnaire [in Finnish], see Appendix.)

As Figure 11 shows, 42% of the residents estimate that the final disposal facility has a somewhat positive or positive impact on the *development of the area generally* but at the same time 31% estimate that the construction of the repository has a negative or somewhat negative effect to the *functioning environment / atmosphere in the area*. This sends a rather mixed message about people's opinions concerning the effects of the project. While many estimate effects of the repository to be positive in issues like the *employment in the area* (63% "somewhat positive / positive"), *economic development in the area* (61% "somewhat positive / positive") and issues concerning infrastructure (e.g. *traffic connections in the area* 41%) it seems that people also realise that this kind of development comes at a cost. Over 50% perceive the effects of the repository to be negative or somewhat negative in issues of *state of nature surrounding the final disposal facility* (54%), *rural non-farm livelihoods* (52%) and *outsiders' image of the area* (52%), followed by such issues as *own image of the area* (40%) and recreational opportunities in the area (39%).

According to the municipal image study by Corporate Image Oy (Posiva 2007; see also Seppälä 2010) the residents of Eurajoki estimated the influence of final disposal on their

municipality of domicile clearly more favourably than consumers elsewhere in Finland. The attractiveness of Eurajoki as a domicile and as a business location, as well as its attraction to tourists were alternatives for which the respondents gave positive estimates clearly more than negative. Eurajoki was perceived by the residents of the municipality as a developing, business friendly and agriculture and forestry intensive municipality and a good place to live more often than the other municipalities included in the study. The study by Corporate Image Oy, funded by Posiva, was conducted in October-December 2006 by interviewing 500 consumers, 200 representatives of businesses and 200 residents of Eurajoki over the telephone.

Tables 23 and 24 show the percentage shares of those respondents who perceive the effects of the repository to be outright positive and those who perceive the effects to be outright negative. The results are consistent with those above, as *employment in the area* and *economic development in the area* are the issues in which the greatest share of respondents (22%/21%) assessed the impact of the repository to be "positive" while the *state of nature surrounding the final disposal facility* and *rural non-farm livelihoods* are the issues in which greatest share of respondents (30%/23%) assessed impact of the repository to be "negative".



**Figure 11.**  
Perceived impact of final disposal facility on certain issues (%).

**Table 23.**

Four issues where the number of those assessing impact to be "positive" was greatest (%).

<b>Employment in the area</b>	22
<b>Economic development in the area</b>	21
<b>Own satisfaction with the area as a place to live</b>	13
<b>Development of the area generally</b>	13

**Table 24.**

Five issues where the number of those assessing the impact to be "negative" was greatest (%).

<b>State of nature surrounding the final disposal facility</b>	30
<b>Rural non-farm livelihoods (fishing, hunting etc.)</b>	23
<b>Outsiders' image of the area</b>	21
<b>Own image of the area</b>	19
<b>Own image of Eurajoki in particular</b>	18

Comparison between residents of Eurajoki and residents of neighbouring municipalities revealed that there is pretty much consensus on the top three issues where the effects of the repository are greatest (Tables 25 and 26). This applies to both negative and positive effects. On the positive side, the greatest share of both those living in Eurajoki and those living in neighbouring municipalities estimate that the construction of the repository has most effects on *employment in the area* (66%/62% "somewhat positive / positive") and *economic development in the area* (63%/61% "somewhat positive / positive") and *development of the area generally* (45%/40% "somewhat positive / positive"). On the negative side, the majority of both assess that the construction of the repository has most effects on the *state of nature surrounding the final disposal facility* (56%/53% "negative / somewhat negative"), *rural non-farm livelihoods* (51%/53% "negative / somewhat negative") and *outsiders' image of the area* (51%/52% "negative / somewhat negative").

**Table 25.**

Five issues on which the greatest numbers of respondents perceived impact to be on the positive ("somewhat positive / positive") side (%). Comparison between Eurajoki and neighbouring municipalities.

		Negative / somewhat negative	Neither negative nor positive	Somewhat positive / positive
Eurajoki	Employment in the area	13	21	66
	Economic development in the area	13	25	63
	Development of the area generally	26	29	45
	Availability of services in the area	12	44	45
	Traffic connections in the area	17	39	45
Neighbours	Employment in the area	10	28	62
	Economic development in the area	09	30	61
	Development of the area generally	23	36	40
	Traffic connections in the area	14	48	38
	Availability of services in the area	10	53	37

**Table 26.**

Six issues on which the greatest numbers of respondents perceived the impact to be on the negative ("negative / somewhat negative") side (%). Comparison between Eurajoki and neighbouring municipalities.

		Negative / somewhat negative	Neither negative nor positive	Somewhat positive / positive
Eurajoki	State of nature surrounding the final disposal facility	56	28	16
	Rural non-farm livelihoods	51	37	11
	Outsiders' image of the area	51	33	16
	Own image of the area	40	35	25
	Own image of Eurajoki in particular	38	28	34
	Own expectations for the future in the area	37	30	33
Neighbours	State of nature surrounding the final disposal facility	53	32	14
	Rural non-farm livelihoods	53	35	12
	Outsiders' image of the area	52	33	15
	Recreational opportunities in the area	41	45	14
	Own image of the area	41	39	21
	Farming and forestry	35	51	14

When the survey data was examined in relation to other socio-demographic background variables, a number of statistically highly significant ( $p \leq .001$ ) and statistically significant ( $.001 < p \leq .010$ ) differences was observed.

The difference between men and women was statistically highly significant regarding perceived impacts of the repository on *state of nature surrounding the final disposal facility* ( $\chi^2 (2, N=576) = 40.81, p = .000$ ), *own image of the area* ( $\chi^2 (2, N=583) = 34.86, p = .000$ ),



own image of Eurajoki in particular ( $\chi^2$  (2, N=582) = 30.70, p= .000), own satisfaction with the area as a place to live ( $\chi^2$  (2, N=580) = 28.25, p= .000), own expectations for the future in the area ( $\chi^2$  (2, N=578) = 25.94, p= .000), functioning environment / atmosphere in the area ( $\chi^2$  (2, N=573) = 24.93, p= .000), development of the area generally ( $\chi^2$  (2, N=576) = 19.91, p= .000), development of education sector in the area ( $\chi^2$  (2, N=576) = 15.74, p= .000), rural non-farm livelihoods ( $\chi^2$  (2, N=576) = 14.99, p= .001), and statistically significant for farming and forestry ( $\chi^2$  (2, N=578) = 11.81, p= .003). In all these cases, a greater share of women than men perceived the effect of the repository to be negative and a greater share of men than women perceived the effect of the repository to be positive. 66% of women assessed effect of the repository to be negative or somewhat negative and 8% somewhat positive or positive on the state of nature surrounding the final disposal facility, whereas 41% of men assessed the effect to be negative or somewhat negative and 22% assessed it to be somewhat positive or positive. Regarding own image of the area, the share of women perceiving the effect of the repository to be negative or somewhat negative was 49% and the share of women perceiving the effect to be somewhat positive or positive was 14%, while for men the corresponding figures were 31% and 33%. Regarding effect on own image of Eurajoki in particular, women's assessments were 43% negative or somewhat negative and 19% somewhat positive or positive, and men's assessments 28% negative or somewhat negative and 39% somewhat positive or positive. Regarding effect on own satisfaction with the area as a place to live women's assessments were 41% negative or somewhat negative and 23% somewhat positive or positive, and men's 22% negative or somewhat negative and 38% somewhat positive or positive. Regarding effect on own expectations for the future in the area, the figures for women were 40%/21% and for men 23%/36%. For functioning environment / atmosphere in the area the figures were 36%/13% and 26%/30%, for development of the area generally 27%/33% and 21%/52%, for development of the education sector in the area 23%/28% and 15%/43%, for rural non-farm livelihoods 60%/10% and 44%/14%, and finally for farming and forestry 42%/13% and 29%/16%.

There were three statistically highly significant differences between age groups regarding perceived impacts of the repository on *tourism in the area* ( $\chi^2$  (10, N=568) = 37.46, p= .000), *farming and forestry* ( $\chi^2$  (10, N=570) = 44.34, p= .000), *recreational opportunities in the area* ( $\chi^2$  (10, N=567) = 29.90, p= .001), and two statistically significant differences regarding *rural non-farm livelihoods* ( $\chi^2$  (10, N=568) = 28.35, p= .002) and *outsiders' image of the area* ( $\chi^2$  (10, N=567) = 23.22, p= .010). In all these cases, except the last, those belonging to the age group 65 or over reported the greatest share of those assessing the effects of the repository as somewhat positive or positive. Regarding tourism in the area, around half (48%) of those aged 65 or over and around third (34%) of those aged 55-64 assessed the effect of the repository to be somewhat positive or positive, while the share of those aged 35-44 agreeing with this assessment was around one sixth (17%). Other age groups fall between these groups with around a quarter (21% to 26%) perceiving the effect to be somewhat positive or positive. Regarding farming and forestry the share of those aged 65 or over perceiving the effect to be on the positive side was 29%, whereas among those aged 35-44 and 45-54 only few saw the effects in a positive light (4%/5% "somewhat positive / positive"), in other age groups the shares of those seeing effects in a positive light being between 10% and 18%. Regarding recreational opportunities in the area, the share of those perceiving the effect of the repository to be somewhat positive or positive in the group aged 65 or over was 23% and of those in groups aged 45-54 and 24 or under 10% in both cases, in other groups the shares being between 13% and 19%. Regarding rural non-farm livelihoods those perceiving the effects most positively were those aged 65 or over (19% "somewhat positive / positive") and those aged 55-64 (17% "somewhat positive / positive") with others being rather less positive (4% to

9% "somewhat positive / positive"). In the last case, outsiders' image of the area, those aged 24 or under were the most positive group, with 20% perceiving effect of the repository to be somewhat positive or positive, the positivity of those aged 65 or over being on a comparable level (19%). However, those aged 65 or over were the least negative group as 34% of them assessed the effect to be negative or somewhat negative, while in other groups, the share of those assessing the effect to be negative or somewhat negative was between 48% and 61%.

Level of education was related to three statistically highly significant differences concerning the perceived effects of the repository, in cases of *recreational opportunities in the area* ( $\chi^2$  (10, N=576) = 36.16, p= .000), *farming and forestry* ( $\chi^2$  (10, N=582) = 33.30, p= .000) and *rural non-farm livelihoods* ( $\chi^2$  (10, N=579) = 28.92, p= .001). Regarding recreational opportunities in the area the situation is quite interesting, as those with vocational training perceived the effect of the repository most negatively (47% "negative / somewhat negative") and at the same time most positively (20% "somewhat positive / positive"), after those with no qualification after basic education (21% "somewhat positive / positive"). This derives from the fact that those with vocational training reported the lowest share, 32%, of those assessing the effects to be neither negative nor positive, whereas those with upper secondary education reported the highest share at 67% while the shares of other groups ranged from 44% to 60%. The situation with the repository's perceived effects on farming and forestry was in fact rather similar with regard to vocational training as in this area too, those respondents with vocational training perceived the effect of the repository most negatively (43% "negative / somewhat negative") and at the same time most positively (15% "somewhat positive / positive"), after those with no qualification after basic education (24% "somewhat positive / positive"). What may be most noteworthy regarding perceived impact on farming and forestry, however, is how positive those with no qualification after basic education were (24% "somewhat positive / positive") compared to others, including also those with vocational training (7% to 15% "somewhat positive / positive"). Regarding the repository's perceived effects on rural non-farm livelihoods those with no qualification after basic education were also most positive (21% "somewhat positive / positive") compared to others (2% to 14% "somewhat positive / positive").

Type of education was related to five statistically significant differences concerning the perceived effects of the repository, namely on *city/municipality organization in the area* ( $\chi^2$  (18, N=479) = 38.17, p= .004), *development of education sector in the area* ( $\chi^2$  (18, N=484) = 37.86, p= .004), *own satisfaction with the area as a place to live* ( $\chi^2$  (18, N=482) = 37.63, p= .004), *own image of the area* ( $\chi^2$  (18, N=485) = 36.68, p= .006) and *non-farm livelihoods* ( $\chi^2$  (18, N=484) = 35.60, p= .008). Those with education in technology and transport, and those belonging to the group "other" with no specified type of education reported the greatest share (43%/42%) of those assessing the effect of the repository as somewhat positive or positive for the city/municipality organization in the area, whereas those with education in the humanities, arts and culture, likewise business, administration and social sciences reported the smallest shares (14%/14% "somewhat positive / positive"), others falling in between (23% to 36% "somewhat positive / positive"). Those with education in the humanities, arts and culture also reported the greatest share of those assessing the effect of the repository to be negative or somewhat negative (41%). With development of the education sector in the area, those belonging to the group "other" with not specified type of education and those with education in technology and transport again reported a rather large share (58%/45%) of those assessing the effect of the repository as somewhat positive or positive, while other groups had a more modest share of those assessing the effect to be positive (27% to 35% "somewhat positive / positive"). Those with education in the humanities, arts and culture reported the greatest share

of those assessing the effect of the repository to be negative or somewhat negative (45%). Regarding own satisfaction with the area as a place to live those with education in technology and transport and those with education in the humanities, arts and culture stood out, the former having the greatest share (41%) of those assessing the effect of the repository to be somewhat positive or positive and the latter the greatest share of those assessing the effect of the repository to be negative or somewhat negative (55%). Regarding own image of the area, those with education in the humanities, arts and culture reported the greatest share (35%) of those assessing the effect of the repository to be positive, but this time the group assessing the effect of the repository most negatively was those with education in the natural sciences and computing (73% "negative / somewhat negative"). Regarding non-farm livelihoods what stands out was that those having just general education were more positive than others (21% "somewhat positive / positive").

Socio-economic group was related to one statistically highly significant difference regarding perceived effects of the repository, regarding *farming and forestry* ( $\chi^2$  (16, N=581) = 50.17,  $p = .000$ ), with two statistically significant differences in cases of *own image of the area* ( $\chi^2$  (16, N=585) = 32.44,  $p = .009$ ) and *tourism in the area* ( $\chi^2$  (16, N=579) = 32.14,  $p = .010$ ). Regarding farming and forestry and tourism in the area the greatest share of those seeing the effects of the repository as positive was found among retirees (29%/43% "somewhat positive / positive") and regarding own image of the area among self-employed people or employers (45% "somewhat positive / positive"). While in all of these three cases the smallest share of those seeing effects of the repository as somewhat positive or positive was found among those unemployed or doing domestic work (0% with farming and forestry, 4% with own image of the area, 17% with tourism in area).

Political affiliation was related to numerous statistically highly significant differences regarding; *development of the area generally* ( $\chi^2$  (20, N=574) = 70.11,  $p = .000$ ), *own image of the area* ( $\chi^2$  (20, N=578) = 59.33,  $p = .000$ ), *economic development in the area* ( $\chi^2$  (20, N=580) = 57.75,  $p = .000$ ), *own image of Eurajoki in particular* ( $\chi^2$  (20, N=578) = 55.88,  $p = .000$ ), *own expectations for the future in the area* ( $\chi^2$  (20, N=575) = 52.51,  $p = .000$ ), *own satisfaction with the area as a place to live* ( $\chi^2$  (20, N=577) = 50.13,  $p = .000$ ), *state of nature surrounding the final disposal facility* ( $\chi^2$  (20, N=574) = 49.57,  $p = .000$ ), *functioning environment / atmosphere in the area* ( $\chi^2$  (20, N=570) = 46.76,  $p = .001$ ), *demographic development in the area* ( $\chi^2$  (20, N=575) = 45.28,  $p = .001$ ), *city/municipality organization in the area* ( $\chi^2$  (20, N=569) = 44.90,  $p = .001$ ), *availability of services in the area* ( $\chi^2$  (20, N=576) = 44.64,  $p = .001$ ), and three statistically significant differences regarding *rural non-farm livelihoods* ( $\chi^2$  (20, N=572) = 41.72,  $p = .003$ ), *employment in the area* ( $\chi^2$  (20, N=574) = 41.25,  $p = .003$ ) and *recreational opportunities in the area* ( $\chi^2$  (20, N=572) = 37.89,  $p = .009$ ). In all cases where differences were statistically highly significant with the exception of availability of services in the area, those oriented towards the National Coalition Party and the Finnish Centre Party reported the largest share of those who perceived repository's impact as somewhat positive or positive among those oriented towards the parties represented in Parliament. Furthermore, in all of these cases (where those oriented towards the National Coalition Party and the Finnish Centre Party had the largest share) except one, the share of those perceiving the effects positively was larger among those oriented towards the National Coalition Party than those oriented towards the Finnish Centre Party. Regarding perceived effects on demographic development in the area, the share of those assessing the effect of the repository as somewhat positive or positive was the same among those oriented towards the National Coalition Party and among those oriented towards the Finnish Centre Party (46% "somewhat positive / positive"). Regarding availability of services in the area, those oriented

towards the National Coalition Party still reported the largest share (59%) of those perceiving the repository's impact as somewhat positive or positive, but instead of those oriented towards the Finnish Centre Party (43%), it was those oriented towards the Finnish Social Democratic Party who reported (although just barely), the second largest share of those assessing the effect of the repository as somewhat positive or positive (44%). With statistically significant differences, in the case of rural non-farm livelihoods, those oriented towards the Finnish Social Democratic Party and the Finnish Centre Party reported the greatest share of those perceiving repository's effects in a positive light (17%/16% "somewhat positive / positive") among those oriented towards the parliamentary parties. Regarding employment in the area, those reporting the greatest share of those perceiving repository's effects in a positive light were those oriented towards the National Coalition Party and the Finnish Centre Party (76%/72% "somewhat positive / positive"), and regarding recreational opportunities in the area, those oriented towards the Left-Wing Alliance and the Finnish Social Democratic Party (29%/25% "somewhat positive / positive"). In 11 cases out of these 14 listed, those oriented towards the Green League of Finland reported the smallest share of those who perceived repository's impact as somewhat positive or positive among those oriented towards the parliamentary parties. Regarding economic development in the area, those oriented towards the Finnish Christian Democrats reported the smallest share (29% "somewhat positive / positive"), regarding state of nature surrounding the final disposal facility, those oriented towards the Left-Wing Alliance (0% "somewhat positive / positive") and regarding the demographic development in the area, those oriented towards the Left-Wing Alliance and the Finnish Christian Democrats (14%/14% "somewhat positive / positive").

Personal income was related to two statistically highly significant differences concerning perceived effects of the repository, regarding *own image of Eurajoki in particular* ( $\chi^2$  (10, N=521) = 30.32, p= .001) and *own image of the area* ( $\chi^2$  (10, N=522) = 29.97, p= .001), and one statistically significant difference regarding *state of nature surrounding the final disposal facility* ( $\chi^2$  (10, N=516) = 27.77, p= .002). Those with income of 60,000 euros or more a year reported more (62%) and those with income under 10,000 euros a year less (17%) of those who perceived repository's impact as somewhat positive or positive on their own image of Eurajoki in particular compared to other income groups (27% to 36%). Regarding own image of the area the situation remained basically the same. Those with income of 60,000 euros or more a year reported the greatest share (48%) and those with income under 10,000 euros a year reported for the smallest share (10%) of those who perceive repository's impact to be somewhat positive or positive, other income groups falling in between (20% to 32%). However, regarding state of nature surrounding the final disposal facility differences between groups were clearer when shares of those assessing the effects of the repository to be negative or somewhat negative were compared. Those with income of 60,000 euros or more a year and those in the income group earning from 40,000 to 59,999 euros a year reported for the smallest share (25%/36%), and those with income of 10,000 euros or less and those belonging to the income group from 20,000 to 29,999 euros a year reported for the greatest share (65%/62%) of those perceiving the impact of the repository to be negative or somewhat negative.

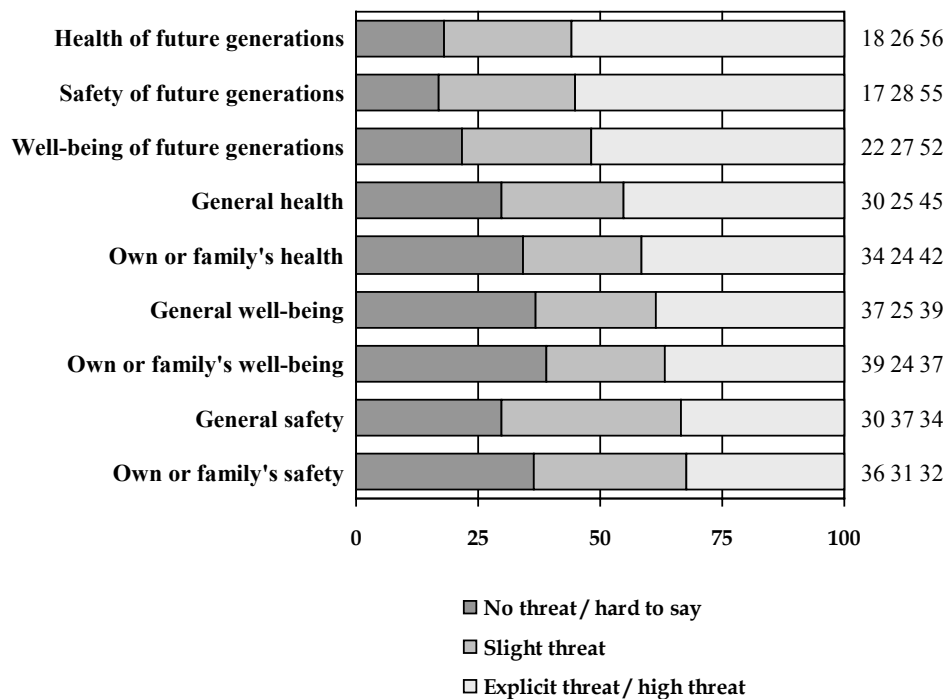
## 5.2 Threats

Study on risk perception has established that there is a discrepancy between the views of the experts and the general public's perception of the risks associated with SNF. The research has

shown that general public tend to fear nuclear technology, the radiation risks are perceived differently than other risks and strong negative cognitive images are associated with nuclear wastes. (e.g Desvousges et al. 1993; Easterling and Kunreuther 1995, 131-132; Slovic 1987; Slovic, Layman and Flynn 1993.) The second aim of the second part of the research was to examine how local people perceive possible threats. The question used in the survey was: "Do you perceive the final disposal facility to cause a threat to any of these?" A list of nine risk dimensions was presented to respondents and they were asked to assess the level of threat perceived to these on a four-step scale from "I do not perceive [threat]" to "I perceive high [threat]" with extra option of "hard to say". (For the questionnaire [in Finnish], see Appendix.)

Figure 12 demonstrates the magnitude of the risk perception in various risk dimensions. It illustrates that the residents perceive that the repository poses the greatest threat on the risk dimensions involving future generations. Over half of the respondents perceived an explicit threat or high threat over the health of future generations (56%), the safety of future generations (55%) and the well-being of future generations (52%), whereas on the other dimensions the share of those who perceived at least explicit threat was somewhat lower (45% to 32%). What comes to perceived threat to present generations, it is easy to discern, considering shares of those perceiving at least explicit threat, that people are more concerned about health issues than well-being and safety issues. The share of those perceiving threat to health in this level was consistently larger than share of those perceiving threat to well-being, and share of those perceiving a threat to well-being was consistently larger than share of those perceiving a threat to safety.

Table 27 shows the percentage shares of those respondents who perceive that repository poses high threat. When the shares of those perceiving a high threat in each dimension are compared, it is obvious the risk dimensions involving future generations still stand out.



**Figure 12.**  
Extent of perceived threat posed by repository on certain risk dimensions (%).

**Table 27.**  
Those perceiving repository to pose "high threat" on certain risk dimensions (%).

Health of future generations	39
Safety of future generations	36
Well-being of future generations	35
General health	24
Own or family's health	23
General safety	18
General well-being	18
Own or family's well-being	17
Own or family's safety	16

Comparison between residents of Eurajoki and residents of neighbouring municipalities revealed that there really is not much difference between them, as Table 28 shows. Regarding risk dimensions where greatest numbers of respondents perceived at least explicit threat, the share of respondents perceiving this kind of threat was at the same level in both groups. This is true in all four risk dimensions.

**Table 28.**

Four risk dimensions on which greatest numbers of respondents perceived that substantial threat ("explicit threat / high threat") was posed by repository (%). Comparison between Eurajoki and neighbouring municipalities.

		No threat / hard to say	Slight threat	Explicit threat / high threat
Eurajoki	Health of future generations	20	23	57
	Safety of future generations	18	27	56
	Well-being of future generations	24	24	51
	General health	32	22	46
Neighbours	Health of future generations	17	28	55
	Safety of future generations	16	29	55
	Well-being of future generations	19	29	52
	General health	29	27	44

When the survey data was examined in relation to other socio-demographic background variables, a number of statistically highly significant ( $p \leq .001$ ) and statistically significant ( $.001 < p \leq .010$ ) differences was observed.

The difference between men and women was statistically highly significant in all cases, *safety of future generations* ( $\chi^2$  (2, N=582) = 40.12,  $p = .000$ ), *health of future generations* ( $\chi^2$  (2, N=587) = 39.79,  $p = .000$ ), *general health* ( $\chi^2$  (2, N=586) = 38.34,  $p = .000$ ), *own or family's well-being* ( $\chi^2$  (2, N=583) = 33.69,  $p = .000$ ), *own or family's health* ( $\chi^2$  (2, N=580) = 32.39,  $p = .000$ ), *general safety* ( $\chi^2$  (2, N=587) = 30.79,  $p = .000$ ), *own or family's well-being* ( $\chi^2$  (2, N=582) = 27.99,  $p = .000$ ), *general well-being* ( $\chi^2$  (2, N=578) = 25.50,  $p = .000$ ) and *own or family's safety* ( $\chi^2$  (2, N=587) = 17.33,  $p = .000$ ). In all of these women accounted for a larger share than men of those judging the repository as an explicit or high threat. Nonetheless both women and men assessed substantial threat ("explicit threat / high threat") to be highest on the same risk dimensions, the health of future generations (68%/42%), safety of future generations (67%/41%), well-being of future generations (62%/39%), general health (54%/34%) and own or family's health (51%/31%).

There were four statistically significant differences in perceived threat between different age groups, regarding *own or family's well-being* ( $\chi^2$  (10, N=573) = 26.63,  $p = .003$ ), *own or family's health* ( $\chi^2$  (10, N=570) = 25.70,  $p = .004$ ), *general well-being* ( $\chi^2$  (10, N=569) = 25.46,  $p = .005$ ) and *general health* ( $\chi^2$  (10, N=576) = 23.72,  $p = .008$ ). In all these cases those in the age group 55-64 reported the greatest and those belonging to the age group 65 or over reported the second greatest share of those perceiving explicit threat or high threat. Furthermore, in all of these cases, except in the case of general well-being, those aged 24 or under reported the lowest and those aged 25-34 the second lowest share of those perceiving at least explicit threat, while with general well-being order was the other way around.

Type of education was related to one statistically highly significant difference regarding perceived threats posed by repository, regarding *health of future generations* ( $\chi^2$  (18, N=488) = 41.29,  $p = .001$ ), and three statistically significant differences regarding *general health* ( $\chi^2$  (18, N=487) = 39.08,  $p = .003$ ), *general safety* ( $\chi^2$  (18, N=488) = 36.67,  $p = .006$ ) and *well-being of future generations* ( $\chi^2$  (18, N=483) = 35.51,  $p = .008$ ). In all these, those with education in technology and transport reported the greatest share of those perceiving no threat or finding it hard to say if they perceived any. Regarding the health of future generations and

well-being of future generations, those reporting the greatest share of those perceiving explicit threat or high threat were those with education in education and teaching (81%/75%), and those with education in health and welfare (73%/65%). Regarding general health, the order between these two is the reverse, as the share of those perceiving at least explicit threat was greatest (60%) among those with education in health and welfare and second greatest (57%) among those with education in education and teaching. In the case of the general safety, those with education in health and welfare stood out with greatest share of those perceiving this kind of threat (48% perceived "explicit threat / high threat").

Line of occupation was related to one statistically highly significant difference concerning perceived threat, regarding *general well-being* ( $\chi^2$  (22, N=551) = 54.61,  $p = .000$ ), and four statistically significant differences regarding *own or family's health* ( $\chi^2$  (22, N=555) = 45.28,  $p = .002$ ), *own or family's well-being* ( $\chi^2$  (22, N=555) = 43.15,  $p = .005$ ), *health of future generations* ( $\chi^2$  (22, N=560) = 42.47,  $p = .005$ ) and *general health* ( $\chi^2$  (22, N=558) = 42.05,  $p = .006$ ). Regarding general well-being, those working in finance, real estate and business support services and those working in transport, storage and communication reported the greatest share of those who did not necessarily see the repository as a threat (64%/57% "no threat / hard to say"). Regarding own or family's health the order of these groups was reversed, those working in transport, storage and communication reported the greatest share (57%) and those working in finance, real estate and business support services the second greatest (50%). In addition, regarding general well-being there were two groups in which over half assessed the repository to pose a slight threat, those working in accommodation and food services (60%) and those working in "other civil and personal services"<sup>35</sup> (58%). Regarding own or family's health, as many as 70% of those working in accommodation and food services assessed the repository to pose a slight threat. Regarding own or family's well-being the same trend continued; those working in transport, storage and communication and those in finance, real estate and business support services reported the greatest share of those who do not necessarily see the repository as a threat (61%/59% "no threat / hard to say") and a large share (73%) of those working in accommodation and food services assessed the repository to pose a slight threat. Regarding the health of future generations almost three out of four (74%) of those working in education, health and social services perceived the repository as a substantial threat ("explicit threat / high threat"), whereas 38% of those working in energy, heat and water supply estimated that the repository does not necessarily pose a threat ("no threat / hard to say"). Regarding general health around three out of five (58%) of those working in education, health and social services perceived the repository as an explicit threat or high threat, whereas among those working in energy, heat and water supply, those working in transport, storage and communication and among those working in manufacturing and mining there were many who did not necessarily see the repository as a threat (48%/48%/43% "no threat / hard to say").

Statistically significant or highly significant differences in perceived threat were found between groups with different political affiliations within all risk dimensions. There were statistically highly significant differences regarding *general safety* ( $\chi^2$  (20, N=582) = 57.99,  $p = .000$ ), *own or family's safety* ( $\chi^2$  (20, N=582) = 49.12,  $p = .000$ ), *safety of future generations* ( $\chi^2$  (20, N=578) = 48.49,  $p = .000$ ), *general health* ( $\chi^2$  (20, N=582) = 51.40,  $p = .000$ ), *own or family's health* ( $\chi^2$  (20, N=576) = 54.71,  $p = .000$ ), and statistically significant differences regarding *general well-being* ( $\chi^2$  (20, N=575) = 42.56,  $p = .002$ ), *health of future generations* ( $\chi^2$  (20, N=581) = 41.63,  $p = .003$ ), *well-being of future generations* ( $\chi^2$  (20,

<sup>35</sup> Other than public administration and defence, or education, health and social services (see Table 10).



N=578) = 41.48,  $p = .003$ ) and *own or family's well-being* ( $\chi^2$  (20, N=577) = 41.37,  $p = .003$ ). In all cases those oriented towards the Green League of Finland made up the greatest share (63%-95%) of those perceiving explicit threat or high threat among those oriented towards the parties represented in Parliament. Regarding own or family's health and general well-being, the second largest share of those perceiving explicit threat or high threat was found among those oriented towards the Finnish Christian Democrats (64%/62%), while in other cases those oriented towards the Left-Wing Alliance (55%-73%) occupied the second place. Moreover, those oriented towards the National Coalition Party reported the smallest share of those perceiving explicit threat or high threat among those oriented towards the parliamentary parties (15%-40%) in all of these cases, except own or family's well-being where those oriented towards the Finnish Centre Party made up the smallest share (26%).

Personal income was related to five statistically significant differences concerning perceived threat, regarding *health of future generations* ( $\chi^2$  (10, N=522) = 28.11,  $p = .002$ ), *safety of future generations* ( $\chi^2$  (10, N=519) = 27.92,  $p = .002$ ), *own or family's well-being* ( $\chi^2$  (10, N=520) = 27.00,  $p = .003$ ), *own or family's health* ( $\chi^2$  (10, N=515) = 23.84,  $p = .008$ ) and *general well-being* ( $\chi^2$  (10, N=515) = 23.21,  $p = .010$ ). In all of these, the greatest share of those who do not necessarily perceive the repository as a threat ("no threat / hard to say") was found among those earning 60,000 euros or more a year, and the second greatest among those earning from 40,000 to 59,999 euros a year. Regarding the health of future generations, 52% of those earning 60,000 euros or more and 27% of those earning from 40,000 to 59,999 euros perceived no threat or found it hard to say if they perceived any, while in other income groups the percentage varied between 15% and 17%. Regarding the safety of future generations, 48% of those earning 60,000 euros or more and 25% of those earning from 40,000 to 59,999 euros perceived no threat or found it hard to say if they perceived any, while in other income groups the percentage varied between 13% and 17%. With own or family's well-being the shares were 79% of those earning 60,000 euros or more, 50% of those earning from 40,000 to 59,999 euros and 31% to 41% of other income groups. Regarding own or family's health, 69% of those earning 60,000 euros or more, 45% of those earning from 40,000 to 59,999 euros and 27% to 35% of other income groups did not perceive the repository as a threat ("no threat / hard to say"). And finally regarding general well-being, 69% of those earning 60,000 euros or more, 47% of those earning from 40,000 to 59,999 euros and 32% to 38% of other income groups did not perceive the repository as a threat ("no threat / hard to say") to general well-being.

### 5.3 Discussion

The study of how respondents in Eurajoki perceived the impacts of the repository indicated that, e.g., residents perceive that repository has positive impact on the employment (66%) and economic development (63%) (Table 25). In 1994 residents also saw these issues very positively. Nearly 70 percent (68%) of the respondents shared the view that the construction of a final disposal facility would bring more workplaces and sources of livelihood to the host community (Kurki 1995, Fig. 29; Litmanen 1996, 163).

However, residents of Eurajoki still have to balance between positive and negative effects, because, e.g., over half of the respondents in Eurajoki perceived that the repository has negative or somewhat negative effects on the state of nature surrounding the final disposal facility (56%) (Table 26). In contrast to these figures, the attitudes in 1994 were slightly

different as far as it is possible to say on the basis of the statement "I am afraid that the final disposal repository of nuclear waste will produce serious problems on the nature of host community". Only 38% of respondents agreed with the statement and 45% disagreed (Kurki 1995, Fig. 30; Litmanen 1996, 170-171). The other statement which was used in 1994 was "The disadvantages to people and living nature the entombing of high level nuclear waste will bring are minor". 41% agreed or somewhat agreed with the statement and 34% disagreed or somewhat disagreed (Kurki 1995, Fig. 35; Litmanen 1996, 159-160). On the ground of the figures from 1994 it is possible to say that the share of concerned people was over 40 percent and not concerned below 40 percent. Even though we hesitate to draw any firm conclusions, today's picture seems to be somewhat different as over half of the residents seem to think that the final disposal facility will have negative effects on the nature surrounding it. Could it be that over a decade ago the possibility of siting and construction of the facility was seen to be far in the future, but the 2001 decision-in-principle and nearing of 2012 deadline for construction license have made the project more concrete for the residents?

Local people worried about the image of the host municipality. In 1994 the share of those who were concerned (33%) over the image of Eurajoki because of the final disposal facility was almost the same as those who were not concerned (35%). The statement which measured the effect to the image was "The final disposal facility would be deleterious to the reputation of the host municipality" (Kurki 1995, Fig. 46; Litmanen 1996, 176-177). In contrast to these figures today's figures show that the majority of respondents in Eurajoki perceived that the facility has negative or somewhat negative effect on outsiders' image of the area (51%) whereas one third (33%) did not perceive any effects at all and 16% perceived the effects to be positive (Table 26). Here it is seen that the worries about the image of the municipality have not vanished. From these figures it is difficult to discern any trend in time because of the incomparability, but it is certain local people have been worried and still worry about how the repository affect the image of their home locality.

Table 29 shows how respondents in different studies have perceived the safety of final disposal of spent nuclear fuel in to the bedrock. In our survey one third (32%) of the respondents in Eurajoki agreed with the view that final disposal to Finnish bedrock is safe and 42% disagreed. Fourteen years before our survey the trust in the safety of final disposal was higher as nearly half (49%) of the respondents in Eurajoki agreed with the view that final disposal is safe and only one fourth disagreed with it. In the data gathered in Eurajoki 2007 the share of those who disagreed and agreed with the view was almost the same (37%/38%). The figures were almost the same in the region of Satakunta as in Eurajoki municipality. (Table 29.)

Our data of 2008 shows that in neighbouring municipalities of Eurajoki the amount of those who share the view that the final disposal is safe is almost the same as in Eurajoki, but the opposition to the view is greater (49%). When these figures are compared to the 2007 national survey (Litmanen et al. 2010) one can see that the acceptance of the view that final disposal is safe is larger among the whole population than in Eurajoki. From these figures one might draw the conclusion that people living near the nuclear waste disposal site are more concerned about the safety of the disposal plans. Still one has to be cautious, because our secondary analysis of Energy Attitudes of the Finns (1983-2008) survey data from the same year than Limanen et al.'s national survey (2007) shows that in that data situation is reversed (Table 29; see also Figures 13-17).

**Table 29.**

Those agreeing and disagreeing with the view that final disposal in bedrock is safe (%). Comparison between different studies.

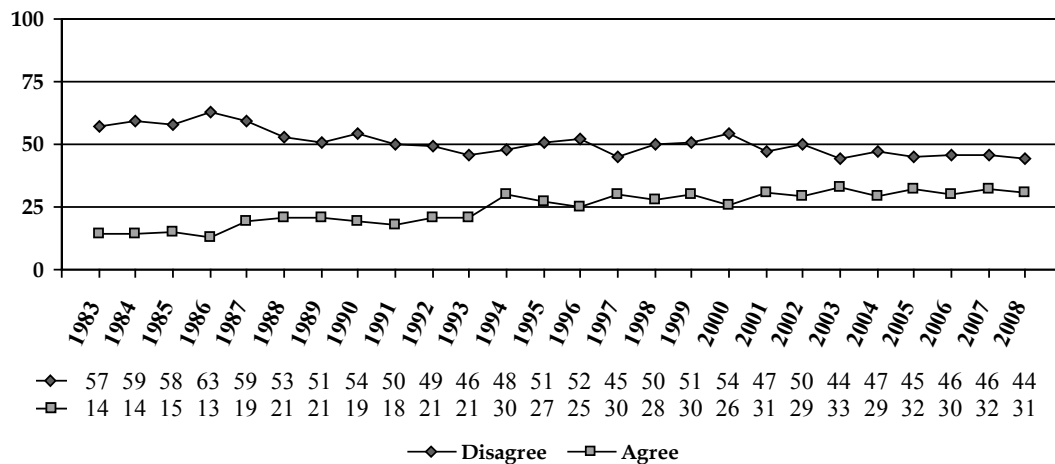
	Eurajoki 1994 (Kurki) <sup>1</sup>	Eurajoki 2007 (Energy att.) <sup>2</sup>	Eurajoki 2008 (Our survey)	Neighbours of Eurajoki 2008 (Our survey)	Satakunta 2007 (Energy att.) <sup>2</sup>	Finns 2007 (Energy att.) <sup>2</sup>	Finns 2007 (Litmanen et al.) <sup>3</sup>
<b>Disagree</b>	25	37	42	49	38	46	31
<b>Hard to say</b>	26	25	26	21	23	22	29
<b>Agree</b>	49	38	32	30	39	32	40

<sup>1</sup> Kurki (1995, Fig. 33).

<sup>2</sup> Secondary analysis of Energy Attitudes of the Finns (1983-2008) 2007 survey data.

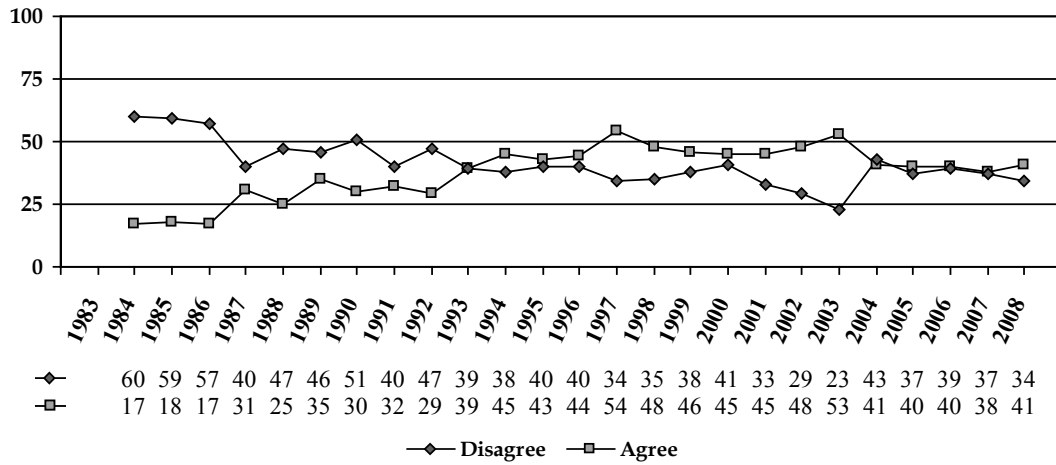
<sup>3</sup> Litmanen et al. (2010)

In light of the comparison of these different surveys one can say that there is quite much ambivalence on the safety of final disposal at the local, regional, and national level. Even though the determined planning of the final disposal has continued over two decades and there is an official decision-in-principle on the final disposal the majority of people are at least hesitant on the safety of the decision. (See also Figures 13-17.)

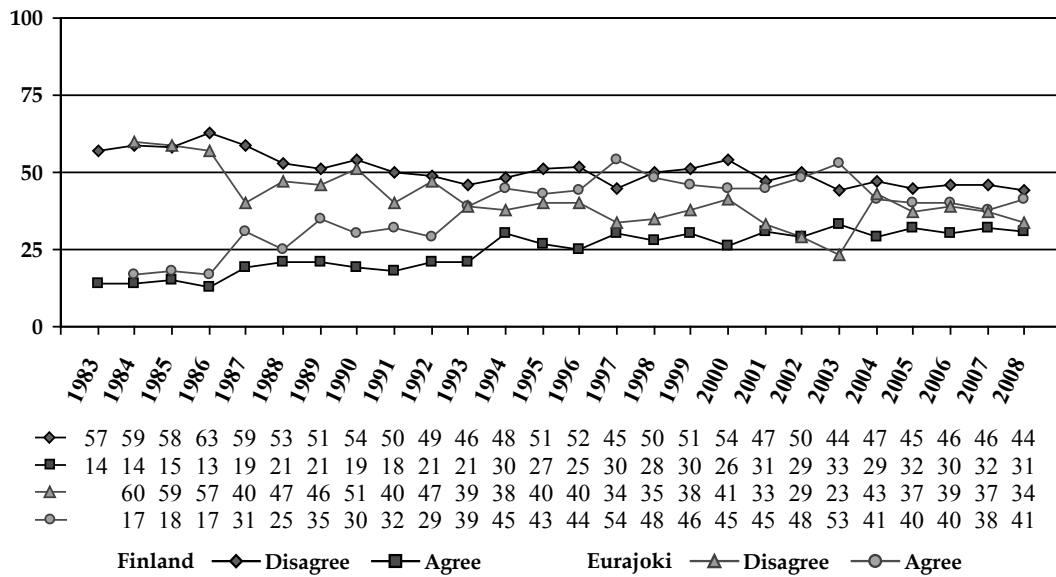


**Figure 13.**

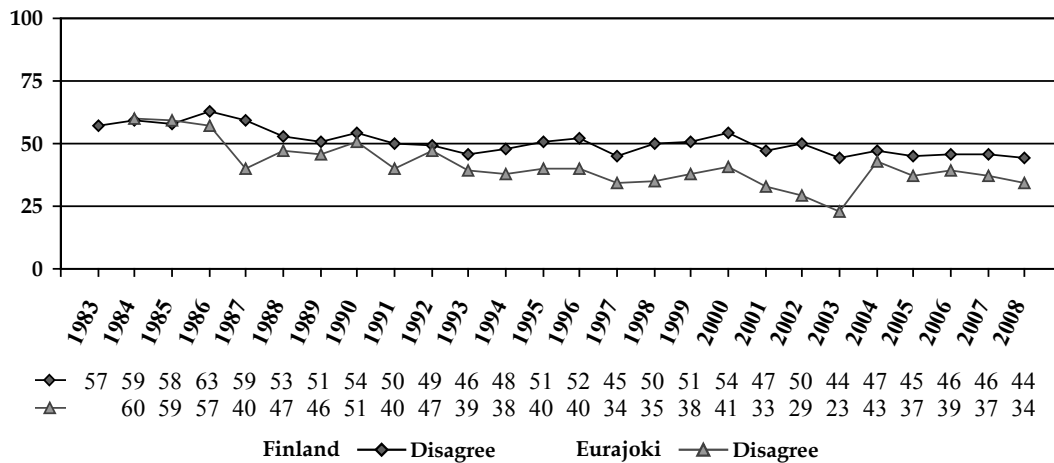
Finns disagreeing and agreeing with the view that final disposal in the Finnish bedrock is safe (%) Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.



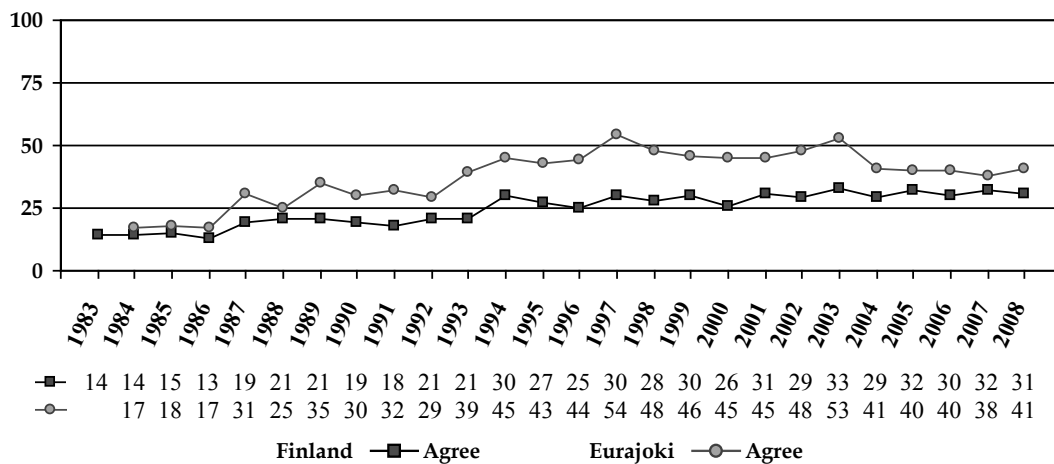
**Figure 14.** Residents of Eurajoki disagreeing and agreeing with the view that final disposal in the Finnish bedrock is safe (%) Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.



**Figure 15.** Those disagreeing and agreeing with the view that final disposal in the Finnish bedrock is safe (%). Comparison between Finland and Eurajoki. Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.



**Figure 16.** Those disagreeing with the view that final disposal in the Finnish bedrock is safe (%). Comparison between Finland and Eurajoki. Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.

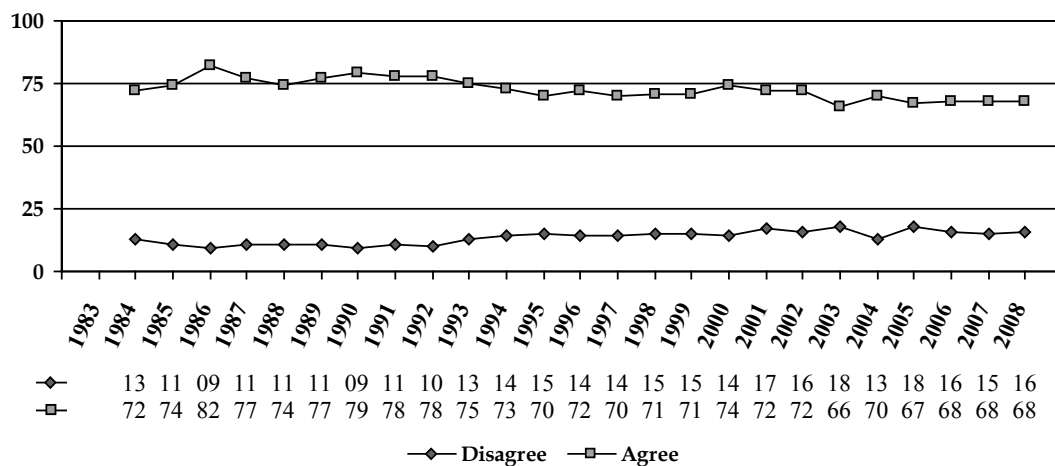


**Figure 17.** Those agreeing with the view that final disposal in Finnish bedrock is safe (%). Comparison between Finland and Eurajoki. Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.

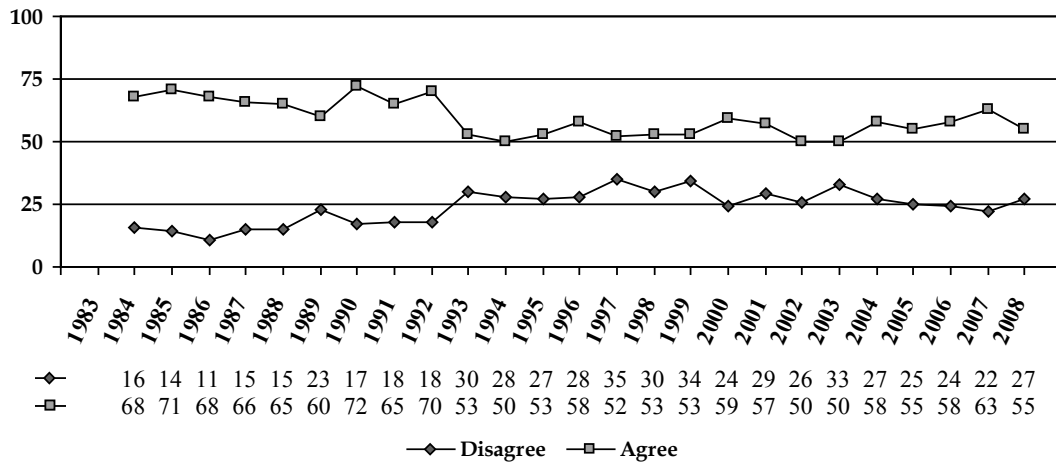
Another way to analyse the feeling of safety among residents is to look at how threatened people in Eurajoki feel living near the disposal site. In 1994, 38% of the respondents from Eurajoki agreed with the statement "I would be afraid to live near a disposal site" (Kurki 1995, Fig. 44). According to Aho (2008, 34) in 2007 45% of the respondents from Eurajoki shared the view that "Siting of the planned spent nuclear fuel repository in my home municipality makes me afraid", whereas 50% disagreed with the statement (Aho 2008, 34). The figures are not totally comparable because of the different statements used in the surveys, but at least they indicate that there has been and still are plenty of people in Eurajoki who are afraid of the final disposal in their home municipality. The findings of our own secondary analysis of Energy Attitudes of the Finns (1983-2008) survey data from the same year than Aho's survey 2007 also seem to confirm this (see Figures 18-22). The statement used in the Energy Attitudes survey was "Nuclear waste constitutes a constant threat to the life of future

generations." Both in Eurajoki and the national sample a large majority (63%/68%) of respondents agreed with the statement, whereas 22% of respondents in Eurajoki and 15% of respondents in the national sample disagreed. In addition, our own survey and Energy Attitudes survey's figures from 2008 seems to concur with this conclusion (see Figures 12,18-22).

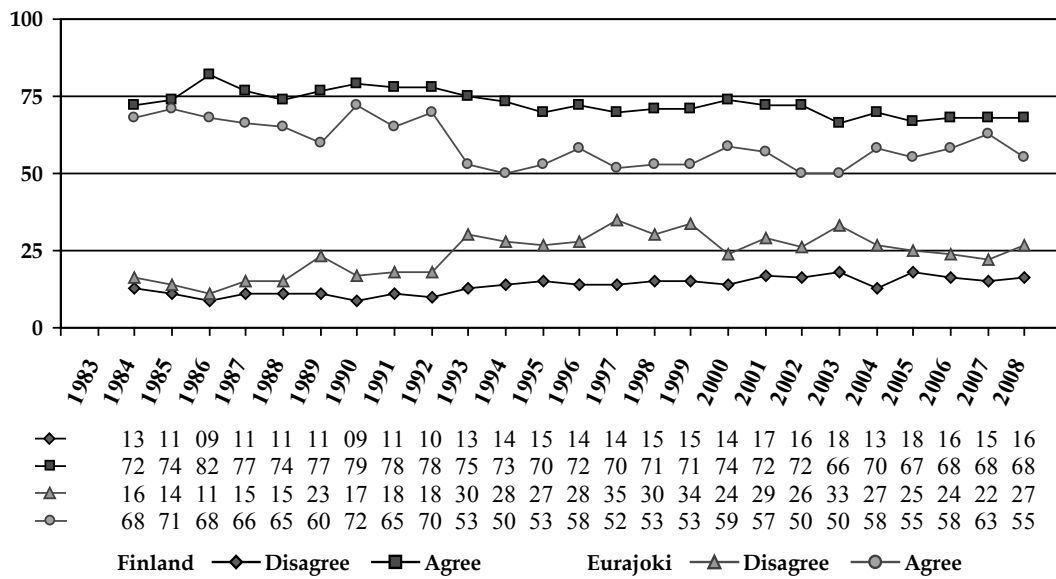
The feeling of safety can be divided into different components. For instance, the time dimension is an important factor in the case of nuclear waste because of the long lived hazardousness of the waste. Above was described mainly through findings of Kurki (1995) and Aho (2008) how the residents perceived living near the disposal site from the contemporary perspective. In our survey we asked the respondents also to assess the threat to future generations. Over half of the respondents perceived explicit threat or high threat over the health of future generations (56%), the safety of future generations (55%) and the well-being of future generations (52%) (Figure 12). We also asked respondents to express their opinion of the statement "Nuclear waste constitutes a constant threat to the life of future generations" also used in other surveys. In three different surveys the figures concerning the perceived continuous threat to future generations was roughly the same. 1) In our survey 58% of the respondents in Eurajoki and 60% in its neighbouring municipalities agreed with the statement. The share of those who disagreed was 24% in Eurajoki and 22% in neighbouring municipalities. 2) The 2007 national survey (Litmanen et al. 2010) indicated further that 64% of Finns agreed with the statement and in Satakunta region 59%. The share of those who disagreed was at the national level 16% and in Satakunta region 12%. Again 3) 2007 data from the nationwide annual Energy Attitudes of the Finns (1983-2008) survey validates the findings as among Finns, as mentioned above, 68% agreed and 15% disagreed with this view. Among respondents of Satakunta region 62% agreed and 23% disagreed. The statement was exactly the same in all of these three surveys.



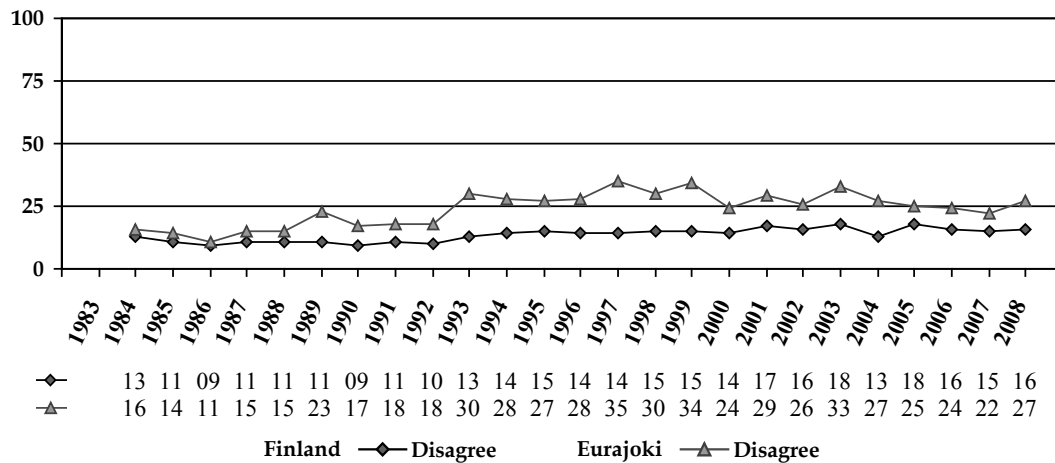
**Figure 18.** Finns disagreeing and agreeing with the view that nuclear waste constitutes threat to future generations (%) Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.



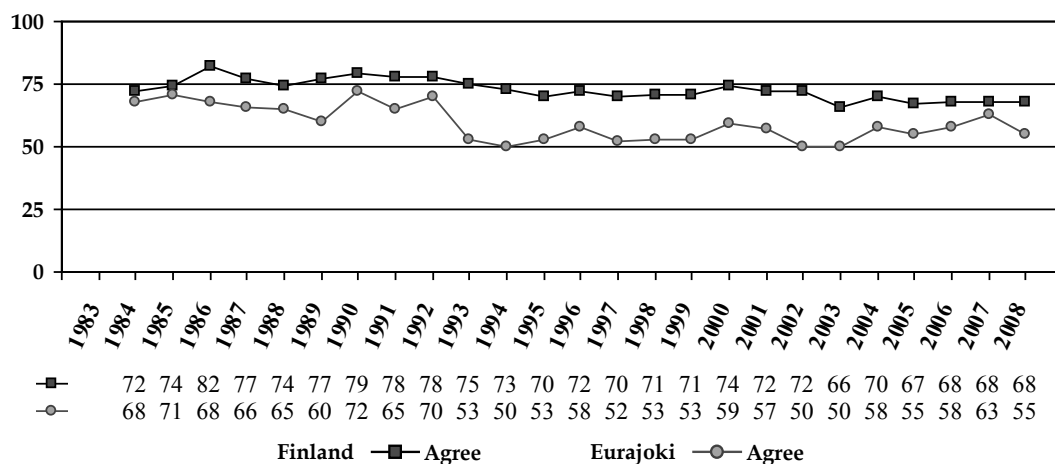
**Figure 19.** Residents of Eurajoki disagreeing and agreeing with the view that nuclear waste constitutes threat to future generations (%) Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.



**Figure 20.** Those disagreeing and agreeing with the view that nuclear waste constitutes threat to future generations (%). Comparison between Finland and Eurajoki. Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.



**Figure 21.** Those disagreeing with the view that nuclear waste constitutes threat to future generations (%). Comparison between Finland and Eurajoki. Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.



**Figure 22.** Those disagreeing with the view that nuclear waste constitutes threat to future generations (%). Comparison between Finland and Eurajoki. Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.

By comparing these Finnish results with the figures of the 2008 Eurobarometer, which focused on public opinions on nuclear waste in 27 European Union Member States, it is clear that there are similarities in the figures, as the report (Eurobarometer 2008, 28) states that

"...41% of Europeans on average totally agree that there is no safe way of getting rid of high level radioactive waste, while just under a third (31%) tend to agree. Only 14% disagree and a similar share does not know nor has any opinion about it. In Greece, Sweden, France, Germany and Finland around eight in ten respondents



(totally or tend to) agree that there is no safe way of getting rid of high level radioactive waste."

Regarding the deep underground disposal of high level nuclear waste the public opinion seems rather divided in the European Union. When the respondents were asked to evaluate the statement "Deep underground disposal represents the most appropriate solution for long-term management of high level radioactive waste" people from countries with operational nuclear power plants were generally more likely to think that deep underground disposal is the most appropriate solution for long-term management of high level radioactive waste, than people from other countries. In Finland (65% agree, 29% disagree and 6% don't know), Sweden (63%, 23% and 14%) and Hungary (63%, 25% and 12%) this idea gets more support than anywhere else in the EU27 (Eurobarometer 2008, 33.)

## **6 Acceptance of final disposal and expanding the repository**

In the third part of the research the respondents' opinions about final disposal (and in some cases nuclear power) were elicited with several opinion statements. The main theme in this part was to find out how willing or unwilling the respondents were to accept final disposal of SNF.

### **6.1 Where should domestic SNF be disposed of and whose waste are to be accepted**

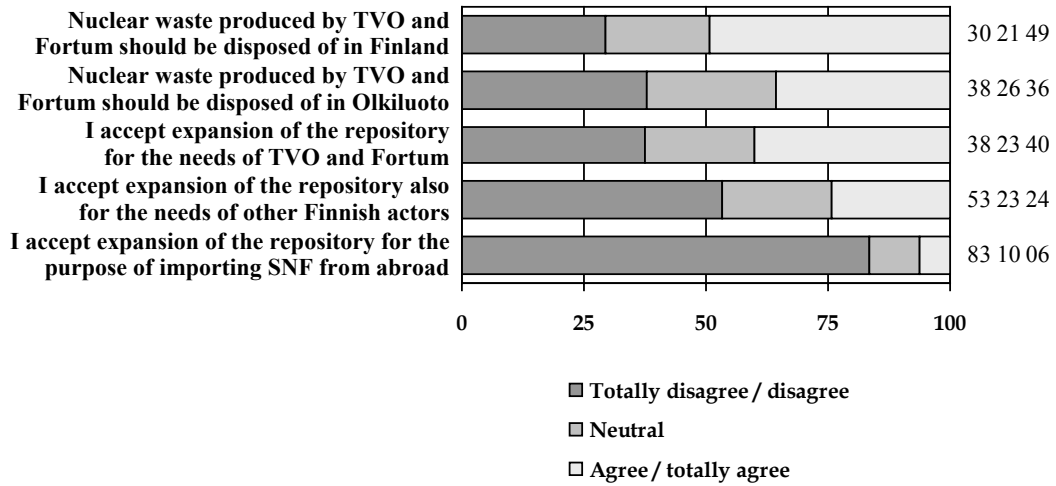
What we wanted to know was where waste produced by domestic NPPs should be disposed of according to respondents, and if they would be willing to expand the final disposal repository for different actors. The statements used to elicit opinions were: "Nuclear waste produced by TVO and Fortum should be disposed of in Finland", "Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto", "I accept expansion of the final disposal repository for the needs of TVO and Fortum", "I accept expansion of the final disposal repository also for the needs of other Finnish actors" and "I accept expansion of the final disposal repository for the purpose of importing SNF from abroad". The respondents were asked to indicate their opinion on a five-step scale from "totally agree" to "totally disagree".

As Figure 23 shows, around half concur (49% agree / totally agree) that nuclear waste produced by current NPP operators TVO and Fortum should be disposed of in Finland. Support for the final disposal decreased by little over 10 percentage points (to 36%) when respondents were asked whether SNF should be disposed of in their vicinity. However, the share of those totally disagreeing or disagreeing with disposal rose only by 8 percentage points (from 30% to 38%), which can hardly be interpreted as serious Not-In-My-Backyard phenomenon (NIMBY<sup>36</sup>). What is obvious, however, is that the acceptance level is noticeably lower when statements refer to the possibility of a repository housing SNF of some other actor than TVO or Fortum, especially if that actor is foreign.

Table 30 shows the percentage share of those respondents who totally disagree with the statements. The results are clearly in line with those presented above, as the share of those totally disagreeing rises considerably when statements refer to the possibility of a repository housing the SNF of some other actor than TVO or Fortum.

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<sup>36</sup> See Abbreviations and terms.



**Figure 23.** Those disagreeing and agreeing with certain statements regarding final disposal (%).

**Table 30.** Those totally disagreeing with certain statements regarding final disposal (%).

<b>I accept expansion of the repository for the purpose of importing SNF from abroad</b>	73
<b>I accept expansion of the repository also for the needs of other Finnish actors</b>	36
<b>I accept expansion of the repository for the needs of TVO and Fortum</b>	24
<b>Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto</b>	23
<b>Nuclear waste produced by TVO and Fortum should be disposed of in Finland</b>	18

Comparison between residents of Eurajoki and residents of neighbouring municipalities (Table 31) revealed that those residing in neighbouring municipalities are more critical ("totally disagree / disagree") towards the final disposal of SNF produced by current actors than those living in Eurajoki. At the same time, however, those residing in neighbouring municipalities are clearly less critical than those living in Eurajoki of other actors than TVO or Fortum.

**Table 31.**

Those agreeing with certain statements regarding final disposal (%). Comparison between Eurajoki and neighbouring municipalities.

		Totally disagree / disagree	Neutral	Agree / totally agree
Eurajoki	Nuclear waste produced by TVO and Fortum should be disposed of in Finland	24	24	52
	Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto	36	23	42
	I accept expansion of the repository for the needs of TVO and Fortum	39	19	42
	I accept expansion of the repository also for the needs of other Finnish actors	62	19	20
	I accept expansion of the repository for the purpose of importing SNF from abroad	89	07	05
Neighbours	Nuclear waste produced by TVO and Fortum should be disposed of in Finland	34	19	47
	Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto	40	29	31
	I accept expansion of the repository for the needs of TVO and Fortum	37	25	39
	I accept expansion of the repository also for the needs of other Finnish actors	48	25	28
	I accept expansion of the repository for the purpose of importing SNF from abroad	79	13	07

When the survey data was examined in relation to other socio-demographic background variables, some statistically highly significant ( $p \leq .001$ ) and statistically significant ( $.001 < p \leq .010$ ) differences were observed.

The difference between men and women was statistically highly significant in all statements, *I accept expansion of the final disposal repository for the needs of TVO and Fortum* ( $\chi^2$  (2, N=580) = 28.33,  $p = .000$ ), *nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto* ( $\chi^2$  (2, N=582) = 25.31,  $p = .000$ ), *I accept expansion of the final disposal repository also for the needs of other Finnish actors* ( $\chi^2$  (2, N=580) = 24.07,  $p = .000$ ), *I accept expansion of the final disposal repository for the purpose of importing SNF from abroad* ( $\chi^2$  (2, N=582) = 18.11,  $p = .000$ ) and *nuclear waste produced by TVO and Fortum should be disposed of in Finland* ( $\chi^2$  (2, N=577) = 14.49,  $p = .001$ ). In all these cases men reported a larger share of those who agree or totally agree with the statement, than women. Regarding the statement "I accept expansion of the final disposal repository for the needs of TVO and Fortum" 52% of men and 31% of women agreed or totally agreed. Regarding the statement "Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto" 46% of men and 26% of women agreed or totally agreed. Regarding the statement "I accept expansion of the final disposal repository also for the needs of other Finnish actors" 33% of men and 16% of women agreed. Regarding "I accept expansion of the final disposal repository for the purpose of importing SNF from abroad" 9% of men and 3% of women, and with "Nuclear waste produced by TVO and Fortum should be disposed of in Finland" 58% of men and 42% of women agreed.

There was a statistically significant difference in attitude towards the statements between different generations, regarding the statement *I accept expansion of the final disposal*

*repository for the purpose of importing SNF from abroad* ( $\chi^2$  (12, N=573) = 31.04,  $p = .002$ ). Those belonging to the rising generation reported the lowest share, 56%, of those totally disagreeing or disagreeing with the statement whereas others reported a substantially higher share, 78% to 88%, of those totally disagreeing or disagreeing. Moreover, in accordance with this, those belonging to the rising generation reported the greatest share of those taking a neutral stance to the statement, 31%, and greatest share of those agreeing or totally agreeing with the statement, 14%. Among other generations share of those taking a neutral stance to the statement was between 3% and 14% and while the share of those agreeing or totally agreeing with the statement among those belonging to the generation of war and depression rose to 10% with other generations share remained between 4% and 8%.

Level of education was related to one statistically highly significant difference concerning attitude towards the statements, regarding the statement *nuclear waste produced by TVO and Fortum should be disposed of in Finland* ( $\chi^2$  (10, N=582) = 29.24,  $p = .001$ ), and one statistically significant difference, regarding the statement *I accept expansion of the final disposal repository also for the needs of other Finnish actors* ( $\chi^2$  (10, N=584) = 26.88,  $p = .003$ ). Regarding the statement "Nuclear waste produced by TVO and Fortum should be disposed of in Finland", those with upper secondary education reported the greatest share of those taking a neutral stance to the statement (41%) and at same time the lowest share of those totally disagreeing or disagreeing with the statement (17%), whereas those with a polytechnic education reported the lowest share of those taking a neutral stance to the statement (8%) and at same time the highest share of those who agree or totally agree with the statement (65%). Regarding the statement, "I accept expansion of the final disposal repository also for the needs of other Finnish actors", again those with a upper secondary school education reported the greatest share of those taking a neutral stance to the statement (50%) and at same time the lowest share of those totally disagreeing or disagreeing with the statement (31%), whereas this time those with college-level education reported the lowest share of those taking a neutral stance to the statement (15%) and at same time the greatest share of those who agree or totally agree with the statement, together with those with university education (30%/30%).

Type of education was related to three statistically significant differences concerning attitude towards the statements, regarding the statements *nuclear waste produced by TVO and Fortum should be disposed of in Finland* ( $\chi^2$  (18, N=484) = 39.80,  $p = .002$ ), *I accept expansion of the final disposal repository for the needs of TVO and Fortum* ( $\chi^2$  (18, N=485) = 38.22,  $p = .004$ ) and *nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto* ( $\chi^2$  (18, N=487) = 38.05,  $p = .004$ ). Regarding the statement "Nuclear waste produced by TVO and Fortum should be disposed of in Finland", those belonging to the group "other" with not specified type of education reported the greatest share and those with technology and transport as line of education the second greatest share of those agreeing or totally agreeing with the statement (75%/65%), whereas, those with education in health and welfare reported the greatest share of those who totally disagree or disagree with the statement. Regarding the statement "I accept expansion of the final disposal repository for the needs of TVO and Fortum", those with education in services and security reported the greatest share of those agreeing or totally agreeing with the statement (62%) and, as with the previous statement, those with education in technology and transport reported the second greatest share of those agreeing or totally agreeing with the statement (53%). Those with education in education and teaching reported the smallest share of those agreeing or totally agreeing with the statement (19%). Regarding the statement "Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto", those with education in technology and transport reported the

greatest share of those who agree or totally agree with the statement (50%) and those with education in health and welfare reported the greatest share of those who totally disagree or disagree with the statement (51%).

There was a statistically significant difference between different socio-economic groups regarding the statement *Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto* ( $\chi^2$  (16, N=586) = 32.33, p= .009). White-collar workers reported the greatest share of those agreeing or totally agreeing with the statement (50%) and blue-collar workers reported the greatest share of those totally disagreeing or disagreeing with the statement (48%).

There were two statistically highly significant differences between groups with different political affiliations concerning attitude towards the statements *I accept expansion of the final disposal repository for the needs of TVO and Fortum* ( $\chi^2$  (20, N=577) = 57.75, p= .000) and *nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto* ( $\chi^2$  (20, N=579) = 45.49, p= .001), and a statistically significant difference in the case of the statement *I accept expansion of the final disposal repository also for the needs of other Finnish actors* ( $\chi^2$  (20, N=579) = 41.55, p= .003). With all of these cases those oriented towards the National Coalition Party reported the largest share (65%/57%/49%) and those oriented towards the Finnish Centre Party reported the second largest share (49%/48%/29%) of those who agree or totally agree with the statement, among those oriented towards the parties represented in Parliament.

Personal income was related to three statistically significant differences regarding attitude towards the statements, in case of statements *Nuclear waste produced by TVO and Fortum should be disposed of in Finland* ( $\chi^2$  (10, N=517) = 25.78, p= .004), *Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto* ( $\chi^2$  (10, N=521) = 25.64, p= .004) and *I accept expansion of the final disposal repository also for the needs of other Finnish actors* ( $\chi^2$  (10, N=579) = 24.97, p= .005). Regarding the statement "Nuclear waste produced by TVO and Fortum should be disposed of in Finland", three out of five or more of those belonging to income groups earning 30,000 to 39,999 euros a year, 60,000 euros or more a year, or 40,000 to 59,999 euros a year agreed or totally agreed with the statement (60%/62%/70%). The share of those agreeing or totally agreeing with the statement being between 39% and 49% in other income groups. Regarding the statement "Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto", the greatest shares of those agreeing or totally agreeing with the statement were found among those earning 60,000 euros or more a year, and 40,000 to 59,999 euros a year (66%/52%) while the share of those agreeing or totally agreeing with the statement within other income groups was considerably lower (26% to 40%). Regarding the statement "I accept expansion of the final disposal repository also for the needs of other Finnish actors", the greatest shares of those agreeing or totally agreeing with the statement were also found among those earning 60,000 euros or more a year, and 40,000 to 59,999 euros a year (55%/34%), the share of those agreeing or totally agreeing with the statement being lower in other income groups (15% to 25%).

## 6.2 Discussion

The findings of our survey show that nearly half (49%) of the respondents shared the view ("agree / totally agree") that nuclear waste produced by current NPP operators TVO and

Fortum should be disposed of in Finland. But when asked about willingness to accept SNF disposal in their vicinity the figure was 10 percentage points lower (36%) and the share of those people who disagreed or totally disagreed was 38%. (Figure 23.)

Concerning Eurajoki, in 1994 the respondents in Eurajoki considered that Finland has to take care of its own nuclear waste. The share of those who agreed with the statement was 84%, whereas share of those who disagreed was only 6% (Kurki 1995, Fig. 25). In contrast to these figures the acceptance of disposal in the respondents' home community, Eurajoki, was much lower. The size of this so-called NIMBY phenomenon can clearly be seen in the figures produced by Kurki. The share of those who agreed with the statement "Nuclear waste can be disposed of in Finland, but rather somewhere else than in my home domicile" was 28% and the share of those who disagreed was 33%. From these figures we can see how attitudes among the residents of Eurajoki were now divided as nearly the same amount of people would accept and deny the disposal in their vicinity. It is also noteworthy that as many as 39% of respondents neither agreed nor disagreed. (Kurki 1995, Fig. 23)

When this same issue was approached in a slightly different way the figures were somewhat different. The share of those who agreed with statement "Even though the disposal of nuclear waste in the bedrock would be safe, I do not want it in my domicile" was 38% and the share of those who disagreed with the statement was 37% (Kurki 1995, Fig. 47; Table 32). From these figures we can see that the emphasis on the safety of final disposal in statement increased the acceptance among residents of Eurajoki, but it also increased the number of those who would reject the disposal plans. This can be explained by looking at the share of those who did not take sides. Whereas in this case only 26% were neutral (neither agreed nor disagreed) in the previous case of the statement above the share of the same group were as much as 39% (Kurki 1995, Fig. 23 and 47).

**Table 32.**

Attitudes towards final disposal in Olkiluoto (%). Comparison between different studies.

	Eurajoki 1994 (Kurki) <sup>1</sup>	Eurajoki 2007 (Aho) <sup>2</sup>	Eurajoki 2008 (Our survey)	Neighbours of Eurajoki 2008 (Our survey)	Satakunta 2007 (Litmanen et al.) <sup>3</sup>	Finns 2007 (Litmanen et al.) <sup>3</sup>
<b>Negative</b>	38	34	36	40	24	21
<b>Neutral</b>	26	26	23	29	31	37
<b>Positive</b>	37	40	42	31	45	42

<sup>1</sup> Kurki (1995, Fig. 47).

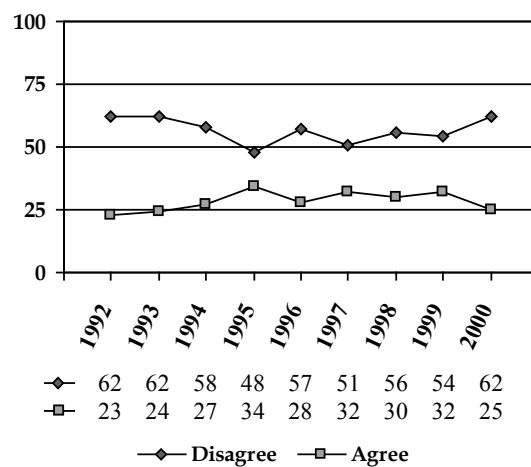
<sup>2</sup> Aho (2008, 31,77).

<sup>3</sup> Litmanen et al. (2010).

In Table 32 we have gathered figures regarding attitudes towards the final disposal in Olkiluoto. In our survey we posed a statement to the respondents that "Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto" and asked them to express their opinion. Interesting to note was that the share of those who agreed with the statement was higher among the respondents in Eurajoki (42%) than among the respondents of neighbouring municipalities (31%). Still the disapproval of the idea was nearly at the same level, in the case of neighbouring municipalities at 40% and in the case of Eurajoki at 36%. Aho (2008, App. 1) asked respondents "what is your own attitude to the final disposal of spent nuclear fuel at Olkiluoto". Respondents could choose their answer on the 5-step scale from

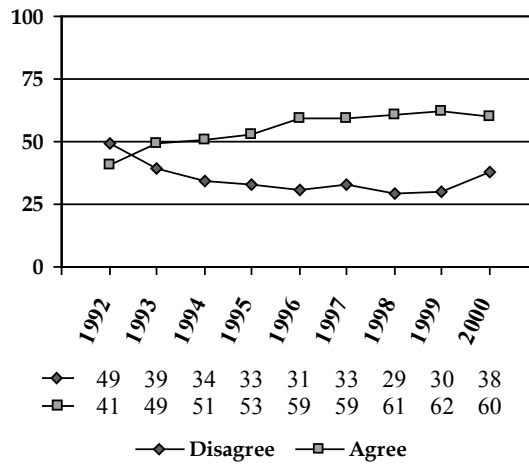
"very negative" to "very positive" with additional option of "I cannot say". Aho's figures came very close to ours even though asking questions and posing statements are somewhat different approaches. The comparison of the figures of the surveys in Table 32 indicate that the opposition towards final disposal in the locality is over one third (varying from 34% to 40%) and the support of the plans is around 40-42% in Eurajoki alone, but in neighbouring municipalities the support is about 10 percentage points weaker (31%).

Comparing these recent findings to the findings of 1994 (Table 32), we see that the number of those supporting and those opposing are almost at the same level. On the ground of this kind of unorthodox comparison one can suggest a preliminary conclusion that the attitude structures are quite enduring. If this, indeed, is the case, then the effects of the DiP in 2001 and earlier the positive decision of the municipality of Eurajoki seem to be minor on the level of acceptance. Besides the formal decision making there has been continuous PR-work to promote the idea of final disposal (see e.g. Kojo 2006). In addition to these there has also been the determined work of Posiva to advance the planning and create more knowledge and understanding for the implementation of the project. And still it seems that these advances in research and planning have not had a major, lasting effect on the acceptance of the project. The findings of the secondary analysis of the Energy Attitudes of the Finns (1983-2008) survey data regarding attitude towards final disposal to one's own municipality (Figures 24-28) indicate that this holds true among the whole population (see e.g. Figure 24) but not necessarily completely in the case of Eurajoki (see e.g. Figure 25). However, the time series stops at the year 2000 so it is hard to say anything certain about the recent developments.

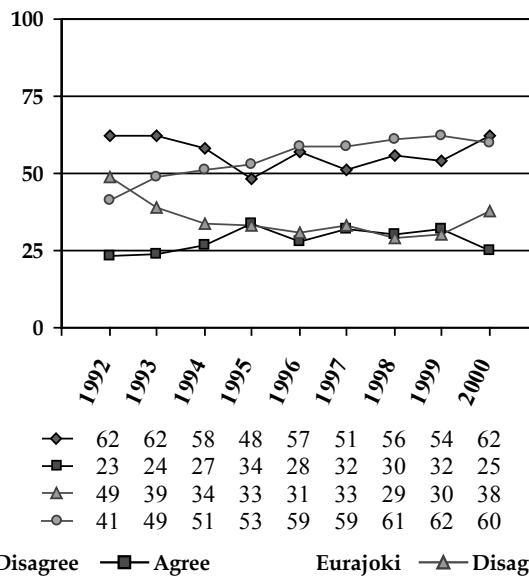


**Figure 24.** Finns disagreeing and agreeing with final disposal to one's own municipality if research showed it to be safe (%) Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.

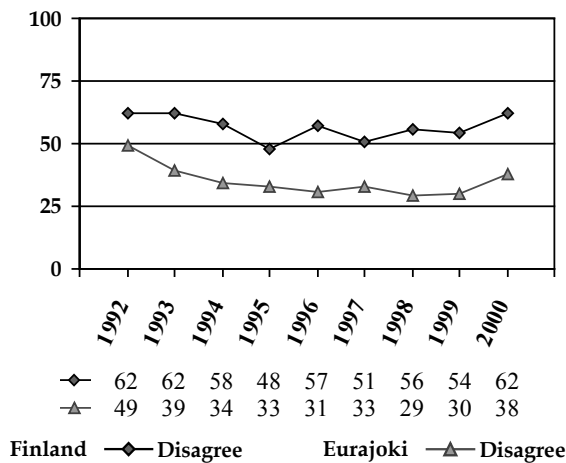




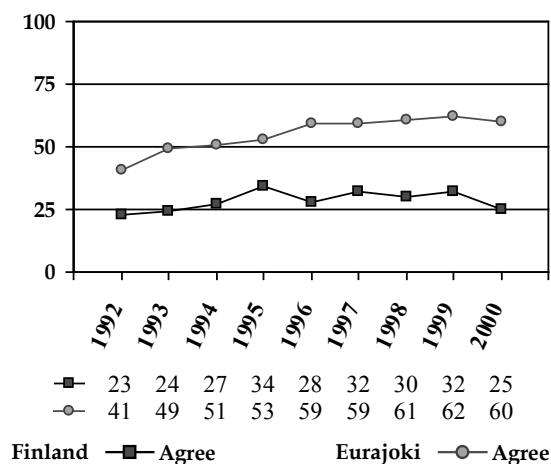
**Figure 25.** Residents of Eurajoki disagreeing and agreeing with final disposal to one's own municipality if research showed it to be safe (%) Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.



**Figure 26.** Those disagreeing and agreeing with final disposal to one's own municipality if research showed it to be safe (%). Comparison between Finland and Eurajoki. Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.



**Figure 27.** Those disagreeing with final disposal to one's own municipality if research showed it to be safe (%). Comparison between Finland and Eurajoki. Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.



**Figure 28.** Those agreeing with final disposal to one's own municipality if research showed it to be safe (%). Comparison between Finland and Eurajoki. Based on data from the annual Energy Attitudes of the Finns (1983-2008) study.

In contrast to the today's local acceptance it is interesting to examine how people in Satakunta region and how Finns generally accept the final disposal of nuclear waste in Olkiluoto. The two last columns in the Table 32 show that the acceptance is nearly at the same level in both of the cases. Among the Finns 42% and among the residents of Satakunta region 45% accept the final disposal in Olkiluoto. The share of those who disagreed with the final disposal was approximately one fifth (Satakunta 24% and Finland 21%). It is noteworthy that in both of these cases the share of those who hesitated or were not able to make their mind was over 30% (Satakunta 31% and Finland 37%). It is especially interesting that there were so many

people who were not able to express their views on the issue. The statement used to elicit opinions in the national survey which produced the figures for Finns and Satakunta region was "Nuclear waste produced in Finland should be disposed of in Olkiluoto" (Litmanen et al. 2010).

Our survey indicated clearly that the present nuclear power companies' additional wastes are more welcome than the newcomers', let alone the case if nuclear waste were to be imported into Finland. Statistically significant results tell that among men the acceptance of different nuclear waste activities tend to be greater than among women.

## **7 Focus on Eurajoki**

### **7.1 Some frequently used explanation types for attitudes towards final disposal**

There is a number of diverse aspects that have to be taken into consideration when trying to understand the rationality of a nuclear community. Here we look at acceptance of expanding the repository among those residing in Eurajoki in relation to the assumptions of six explanation types often used in the research literature when studying the acceptance of different kinds of risks, and especially risks related to nuclear wastes and nuclear power.

This chapter is an abridged version of the authors' article "The rationality of acceptance in a nuclear community: analysing residents' opinions on the expansion of the SNF repository in the municipality of Eurajoki, Finland" published in *International Journal of Nuclear Governance, Economy and Ecology* (Litmanen, Kojo and Kari 2010).

The problem of nuclear waste has been the Achilles heel of nuclear power for decades. While Europeans stress that there is an urgent need to find a solution to the problem rather than leaving it unsolved for later generations, the vast majority of people also share the view that there is no safe way of disposing of high-level radioactive waste (Eurobarometer 2008, 24; see also OECD 2009). Many countries are currently considering their nuclear power policy and addressing the need to increase the share of nuclear power in electricity production. From this perspective, the societal questions surrounding Finnish nuclear waste management are interesting, as Finland has already reached a decision regarding the actual site of the SNF repository. While many countries are still debating the appropriate means of dealing with their nuclear waste, the nuclear industry in Finland is asking permission to expand its disposal capacity.

The Olkiluoto site in the municipality of Eurajoki was chosen as the site for further investigation in accordance with the Decision in Principle (DiP) of the Finnish Government in 2000. The DiP was ratified by Parliament in May 2001. The local residents have thus lived through the post-site selection phase for nearly one decade and the residents have experienced years of risk communication after the site selection. The original DiP application of Posiva was approved by the local council in 2000, and expansion of the SNF repository has moreover been approved by the local council of the municipality of Eurajoki to date. Expansion of the repository was approved without a vote in connection with the TVO NPP project in December 2008 (one dissenting opinion), and again in August 2009 by 22 votes to 4 in connection with

the Fortum NPP project. According to the Nuclear Energy Act, the local council has the right of veto.

As a theoretical framework, we apply the concept of nuclear community constituted by the municipality of Eurajoki with two operating NPP units and the repository of intermediate and low-level nuclear waste in the Finnish context. Furthermore, a new 1600 MW European Pressurized Reactor and the Underground Rock Characterization Facility which is to be a part of the SNF repository are under construction in Olkiluoto. Eurajoki is defined as a nuclear community as it is a municipality which is economically heavily dependent on and politically interrelated with the operations of the nuclear industry (see more about the case of Eurajoki in Kojo 2009; see also Bergmans et al. 2008). Due to its economic dependency, long history and close cooperation with the nuclear industry, the majority of the population of a nuclear community are more positively disposed towards nuclear power than the general public (Easterling and Kunreuther 1995, 162; Eiser, van der Pligt and Spears 1995; Kiljunen 2007; van der Pligt 1992, 75–89).

Easterling and Kunreuther (1995, 123) identified four factors that determine whether or not an individual opposes or tolerates a proposed repository. The factors are as follows:

- 1 the extent of risk that the repository appears to impose on the health of nearby residents
- 2 anticipated impacts on the physical environment and the local economy
- 3 the degree to which building the repository appears appropriate from the social welfare standpoint
- 4 the perceived fairness of the siting process

Nevertheless, a favourable view of these factors does not automatically guarantee local acceptance. Krannich, Little and Cramer (1993) concluded in a study of attitudes of rural Nevada residents that responses to the proposed SNF repository appeared to be influenced by a complex set of factors, ranging from the unique sociocultural settings to widely divergent experiences linked to past and present nuclear testing and to cross-generational risk perceptions. Thus, a number of diverse aspects have to be taken into consideration when trying to understand the rationality of a nuclear community.

Instead of focusing on broader societal and political issues, we concentrate on the rationality of the residents of the nuclear community. The local acceptance figures for Eurajoki are analysed in relation to the assumptions of the six explanation types often used in the research literature when studying the acceptance of different kinds of risks.

The first assumption used in analysis is information deficit (e.g. Slovic 1987; Wynne 1995; Desvousges et al. 1993). According to this assumption, opposition to the SNF repository is due to lack of correct information among the local lay people. The second assumption is social trust in the main actors responsible for disposal safety (e.g. Desvousges et al. 1993; Mushkatel, Nigg and Pijawka 1993). In Finnish SNF management, the Radiation and Nuclear Safety Authority (STUK) and the developer Posiva play the key roles with regard to safety issues. The third assumption is the respondent's personal benefit-cost calculation (e.g. Fischhoff et al. 2009). According to conventional compensation theory, "to win the support of a prospective host municipality, the compensation offered has to be large enough to offset the net disutility imposed by the facility" (Frey, Oberholzer-Gee and Eichenberger 1996, 1299). The literature (Vari, Reagan-Cirincione and Mumpower 1994; Jenkins-Smith and Kunreuther 2001; Chung, Kim and Rho 2008; Kojo 2009; Kojo and Richardson 2009) suggests that

economic compensation may play an important role in the siting process. However, one should be aware of disagreement regarding how far the cost-benefit analysis should be extended into the realm of social and political consequences (van der Pligt 1992, 164). There have also been a number of cases where proposals of compensation have caused a bribe effect, resulting in a negative disposition (Frey, Oberholzer-Gee and Eichenberger 1996). The fourth assumption focuses on moral responsibility. The moral and ethical questions regarding SNF issues have been investigated from many perspectives (e.g. Krannich, Little and Cramer 1993; Easterling and Kunreuther 1995; Frostenson 2008). Here, the moral aspect is based on the assumption that the residents of a nuclear community may feel a moral responsibility to manage nuclear waste because a NPP is located in the municipality. The fifth assumption addresses perceived risks and threats. Studies of the perception of nuclear waste risks have revealed that there is a discrepancy between the public's perception of the risks associated with SNF repositories and the view of the experts. The radiation risks are perceived qualitatively differently than other health risks and strong negative cognitive images are associated with nuclear wastes (e.g. Desvousges et al. 1993; Easterling and Kunreuther 1995, 131-132; Slovic 1987; Slovic, Layman and Flynn 1993). The sixth assumption focuses on the attitude to nuclear power. One useful factor in explaining peoples' attitudes toward repository issues is their overall view of nuclear energy (e.g. Dunlap et al. 1993, 147; Desvousges et al. 1993, 206). Given that siting issues are related to other nuclear issues, the acceptance of expanding the final disposal facility is also compared to support for nuclear power.

Expansion statements used in the analysis are **Expansion statement 1**: "I accept the expansion of the final disposal repository for the needs of TVO and Fortum" and **expansion statement 2**: "I accept the expansion of the final disposal repository also for the needs of other Finnish actors".

The relationship between the aforementioned assumptions and expansion statements regarding acceptance of the repository is investigated using correlation analysis. The focus is exclusively on those respondents residing in the municipality of Eurajoki (N=245). The reported correlation coefficients are Kendall's rank correlation coefficients (Kendal's tau-b,  $\tau_{\text{Ken,b}}$ ). In cases where multiple variables are used to measure the relationship between assumptions and expansion statements, only the highest correlations are reported. (About used methods see Chapter 3.3.2.)

### 7.1.1 Information deficit

Respondents' views on whether they had sufficient information on the final disposal project in general were evenly distributed. One third (34%) agreed ("agree / totally agree") with the statement "In my opinion I have enough information regarding the plan for final disposal", one third (33%) disagreed ("totally disagree / disagree") and one third (34%) was neutral. Table 33 shows that there is indeed a correlation between information deficit variables and two expansion statements. Regarding the first expansion statement the greatest correlations are with health effects, effects on everyday life and environmental effects. Regarding the second expansion statement the greatest correlations are with the general safety of SNF and the safety of transport. People needing more information on these issues are less likely to be willing to accept the expansion of repository. However, the correlations in both cases are rather weak and in the case of expansion statement 2 even weaker than in the case of expansion statement 1.

**Table 33.**Correlation between information deficit and acceptance of the repository expansion ( $\tau_{Ken,b}$ ).

Stated information deficit regarding...	Acceptance of the expansion for...	
	TVO and Fortum (Expansion statement 1)	Other domestic operators (Expansion statement 2)
General safety of SNF	-.200 (p= .001, N=237)	-.190 (p= .001, N=239)
Safety of transport	-.184 (p= .002, N=236)	-.174 (p= .004, N=237)
Safety of encapsulation	-.228 (p= .000, N=236)	-.155 (p= .010, N=236)
Health effects	-.278 (p= .000, N=238)	-.150 (p= .012, N=238)
Environmental effects	-.236 (p= .000, N=238)	-.157 (p= .009, N=239)
Effects on everyday life	-.242 (p= .000, N=236)	-.157 (p= .008, N=238)
Municipal decision-making		-.156 (p= .009, N=237)
Safety after closure	-.226 (p= .000, N=237)	
Image impact	-.204 (p= .000, N=235)	-.190 (p= .001, N=239)

### 7.1.2 Social trust

Trust in the nuclear waste management company Posiva is polarized, as exactly the same percentage, 39%, of residents of Eurajoki indicated trust ("agree / totally agree") and distrust ("totally disagree / disagree") when asked to state their opinions on statement "I trust Posiva regarding the risk assessment of the final disposal project". An interesting finding is that trust in the authorities in risk assessment is lower than in the case of Posiva; 32% of respondents stated that they agreed or totally agreed with the statement "I trust the authorities regarding the risk assessment of the final disposal project", with 39% of respondents totally disagreeing or disagreeing with the statement. As Table 34 shows, both expansion statements correlate with trust in both Posiva and the authorities. A fairly strong correlation can be found between trust and expansion statement 1 and a weaker but still noteworthy correlation can be found between trust and expansion statement 2.

**Table 34.**Correlation between trust and acceptance of the repository expansion ( $\tau_{Ken,b}$ ).

Trust in...	Acceptance of the expansion for...	
	TVO and Fortum (Expansion statement 1)	Other domestic operators (Expansion statement 2)
Posiva's expertise	.581 (p= .000, N=238)	.333 (p= .000, N=238)
Authorities' expertise	.527 (p= .000, N=240)	.310 (p= .000, N=241)

### 7.1.3 Benefits and other impacts

Some residents have reservations concerning benefits of the final disposal project in general. Almost half (47%) concur (agree / totally agree) with the statement "The economic benefits of the final disposal of nuclear waste will not compensate the non-economic costs", whereas, around quarter (24%) disagree or totally disagree with the statement. From a slightly different perspective the shares are more evenly divided as 39% disagree or totally disagree with the statement "The benefits of the final disposal of nuclear waste will exceed the costs", while 31% agree or totally agree with the statement. Table 35 indicates how strongly residents'

positive understanding of their own home community correlates with expansion statement 1. Seeing the repository's impact as positive for the area as a place to live, to their own expectations for the future of the area and to the own image of the area clearly relates to increased acceptance of the repository expansion for the needs of TVO and Fortum. With expansion statement 2 this kind of correlation is weaker and the correlation to benefits exceeding the costs relatively stronger. However, even in this case, it can be seen that respondents valued overall benefits over economic benefits. Nevertheless, a negative correlation can be found between the economic statement and expansion statements 1 and 2. If a person considers that the economic benefits do not compensate for other drawbacks, this correlates with opposition to the repository expansion. (Effects of the final disposal facility on regional and municipal economy have been recently assessed for Posiva by Laakso et al. 2007.)

**Table 35.**

Correlations between certain benefits or impacts and acceptance of the repository expansion ( $\tau_{Ken,b}$ ).

<b>Stated benefit of or impact on...</b>	<b>Acceptance of the expansion for...</b>	
	<b>TVO and Fortum</b> (Expansion statement 1)	<b>Other domestic operators</b> (Expansion statement 2)
<b>Respondents' own image of their area</b>	.567 (p= .000, N=235)	.394 (p= .000, N=236)
<b>Respondents' own expectations for the future of their area</b>	.582 (p= .000, N=236)	.356 (p= .000, N=237)
<b>Respondents' own satisfaction with the area as a place to live</b>	.592 (p= .000, N=235)	.384 (p= .000, N=236)
<b>Attitude to the statement...</b>		
<b>Economic benefits of final disposal of nuclear waste will not compensate the non-economic costs</b>	-.544 (p= .000, N=235)	-.374 (p= .000, N=236)
<b>Benefits of final disposal of nuclear waste will exceed the costs</b>	.553 (p= .000, N=228)	.415 (p= .000, N=229)

#### 7.1.4 Moral responsibility

One dimension of residents' perceptions of their own municipality's responsibility can be seen in Table 36. Acceptance of the expansion is to some extent more likely to be found among people reporting (agree / totally agree) a moral responsibility to approve the disposal of SNF in Eurajoki because there are NPPs located in Eurajoki. Regarding the extent of agreeing with moral responsibility, 43% of the residents of Eurajoki share the view of a moral obligation, but 33% do not acknowledge a moral responsibility.

**Table 36.**

Correlation between perceived moral responsibility and acceptance of the repository expansion ( $\tau_{Ken,b}$ ).

<b>Attitude to the statement...</b>	<b>Acceptance of the expansion for...</b>	
	<b>TVO and Fortum</b> (Expansion statement 1)	<b>Other domestic operators</b> (Expansion statement 2)
<b>The Municipality of Eurajoki has a moral responsibility to approve the disposal of SNF as it has approved the location of NPPs in its area</b>	.498 (p= .000, N=229)	.364 (p= .000, N=230)



### 7.1.5 Risks / threats

As Table 37 illustrates, the safer individuals perceive the final disposal to be, the more willing they are to accept the repository expansion, and conversely, the more people associate risks with the repository, the greater is the opposition to the idea of the expansion. The correlation between expansion for the needs of other companies and perceived safety is weaker than for the needs of TVO and Fortum. Overall, the majority of respondents, 58%, share the view that "Nuclear waste constitutes a constant threat to the life of future generations", whereas, around one out of four (24%) disagrees or totally disagrees with the statement. Another statement stating that "Nuclear waste can be disposed of safely in the Finnish bedrock" changes the figures such that 42% totally disagree or disagree and 32% agree or totally agree.

**Table 37.**

Correlations between risks/threats and acceptance of the repository expansion ( $\tau_{Ken,b}$ ).

Perceived risk or threat to...	Acceptance of the expansion for...	
	TVO and Fortum (Expansion statement 1)	Other domestic operators (Expansion statement 2)
<b>General safety</b>	-.531 (p= .000, N=239)	-.381 (p= .000, N=241)
<b>Own or family's safety</b>	-.502 (p= .000, N=239)	-.345 (p= .000, N=240)
<b>Safety of future generations</b>	-.477 (p= .000, N=239)	-.336 (p= .000, N=240)
<b>Health of future generations</b>	-.504 (p= .000, N=240)	-.338 (p= .000, N=241)
<b>General health</b>	-.480 (p= .000, N=238)	
<b>Attitude to the statement...</b>		
<b>Nuclear waste constitutes a constant threat to the life of future generations</b>	-.544 (p= .000, N=235)	-.374 (p= .000, N=236)
<b>Nuclear waste can be safely disposed of in Finnish bedrock</b>	.553 (p= .000, N=228)	.415 (p= .000, N=229)

### 7.1.6 Attitude towards nuclear power

There are slightly more of those who disagree with the general idea of constructing more nuclear power facilities than those who agree with the idea as 42% totally disagree or disagree and 37% agree or totally agree with the statement "The construction of more nuclear power in Finland should be allowed". The figures also remain almost the same when respondents are asked more specifically about further construction in the vicinity, although, there is slight increase in those disagreeing (47% totally disagree / disagree, 38% agree / totally agree) with the statement "The fourth NPP unit should be constructed in Olkiluoto". The correlation between the attitude towards nuclear power and the idea of expansion of the repository is shown in Table 38. It indicates how especially the favourable attitude towards the construction of more nuclear power in the respondents' vicinity relates to an increase in the acceptance of the repository expansion for the needs of TVO and Fortum. The correlation between general positive attitude towards nuclear power and acceptance of the expansion for the needs of TVO and Fortum is slightly lower and both nuclear power statements' correlations to expansion for other companies considerably lower.

**Table 38.**Correlation between attitude to nuclear power and acceptance of the repository expansion ( $\tau_{\text{Ken,b}}$ ).

<b>Attitude to the statement...</b>	<b>Acceptance of the expansion for...</b>	
	<b>TVO and Fortum</b> (Expansion statement 1)	<b>Other domestic operators</b> (Expansion statement 2)
<b>The construction of more nuclear power in Finland should be allowed</b>	.634 (p= .000, N=229)	.382 (p= .000, N=230)
<b>The fourth NPP unit should be constructed in Olkiluoto</b>	.644 (p= .000, N=229)	.418 (p= .000, N=231)

### 7.1.7 Summary

The survey indicated that less than half (42%) of the residents of the municipality of Eurajoki are willing to accept the expansion of the repository for the needs of the 'older' nuclear operators, TVO and Fortum. The disposal needs of possible newcomers are less tolerated. The assumption that the nuclear community's residents' lack of information on final disposal issues explains their acceptance of or opposition to the expansion of the SNF repository is not very accurate. Although there is a correlation, the correlation is rather weak when compared to the other factors analysed. More explanatory power can be found among the factors of social trust, perceived benefits, perceived risks and, in particular, attitudes to nuclear power. How individuals perceive the moral responsibility of a nuclear community to accept certain new nuclear waste management activities is also closely related. These results reinforce the findings of some other studies (see Dunlap et al. 1993; Slovic, Layman and Flynn 1993) that other factors than knowledge and information about nuclear waste have a more important bearing on the way that the residents of nuclear communities rationalise the acceptability of different nuclear waste activities. Nonetheless, the question of information and knowledge cannot be ignored. As Desvousges et al. (1993) stress, there is a need for two-way communication to enable information flow also from the public in order to create more dialogue. After the early 1990s, nuclear waste management has indeed passed through a 'participatory turn' in a number of countries (Bergmans et al. 2008).

An intriguing finding is the connection between 'self-respect' or respect for one's own community and acceptance of the expansion. The more that people value the final disposal facility as a positive part of their local district and its future, the more likely they are to accept the expansion for the needs of TVO and Fortum. This finding is in line with the findings of other studies in which the residents of nuclear communities have given more support for the SNF repository siting than residents of other communities. For instance, Krannich, Little and Cramer (1993, 284) indicated that opposition and concern were strongest in the communities farthest from Yucca Mountain, and lowest among those located nearest to the repository site. Even though familiarity with nuclear activities may increase acceptance of a repository siting or expansion of a repository, one must keep in mind that ambivalence towards nuclear waste management will exist among the local population (Dunlap et al. 1993, 166).

In general, if, after cost-benefit analysis an individual draws the conclusion that the disadvantages outweigh the benefits, he or she is more likely to be opposed to the repository expansion. Perceived risks do correlate with acceptance of the repository expansion. Those perceiving SNF disposal as safe are more likely to support the expansion, but those who perceive risks are more likely to reject the idea. These findings concur with those of earlier

studies on the acceptance of repository siting (e.g., Easterling and Kunreuther 1995, 162; Krannich, Little and Cramer 1993, 278). Another curious finding is that a general attitude towards nuclear power has a weaker explanatory power than acceptance of an NPP unit in the vicinity of Eurajoki. We can surmise, therefore, that familiarity with the nuclear industry, as associated with the 'self-respect' of a nuclear community, has considerable explanatory power with respect to such findings.

## **7.2 A nuclear oasis or something else?**

This chapter contains an abridged version of the conference paper "Nuclear oasis or something else? Analysing Eurajoki as nuclear community" (Kari 2009) prepared for the international "Managing Radioactive Waste" conference held in Gothenburg, Sweden, 15-17 December 2009, modified for this report and with some additional information provided.

As a rule, the communities that have gone furthest in considering a final disposal facility for SNF and where the progress in siting has been fastest already have some type of nuclear installation or installations within their areas (NEA 2003, 25). This is also true in the case of Eurajoki. There are two operational NPP units and one NPP unit under construction in Eurajoki and if TVO's application for a new NPP is approved by the Government that would bring yet another NPP unit to the area. Looking at nuclear waste management, there is interim storage for SNF, and also a low and intermediate level radioactive waste repository on the site. Communities like these are usually addressed as 'nuclear communities' or 'nuclear oases', but the Nuclear Energy Agency's (NEA) report (2007, 41) suggests that "[t]hese may be called communities with 'industry awareness'."

Essentially the communities in question are just communities which have nuclear activities in their areas. However, the presence of the nuclear industry is considered to be such a weighty issue that it somehow defines the whole community and so we speak of 'nuclear communities'. It is assumed that nuclear activity is not just something that is going on in the area, but instead being "nuclear" becomes part of the community's identity. In fact, 'nuclear communities' can be characterised as "communities who host nuclear activities and are conscious of their nuclear identity" (NDA 2007, 89). Communities hosting nuclear activity where waste is already stored or produced have a level of familiarity with the subject and knowledge of the benefits, risks and impacts inherent in nuclear facilities.

While it is evident that in communities that host nuclear installations the nuclear industry is somehow an essential part of the community, there are different theories about how a community is influenced by nuclear activity and why there is heightened readiness to accept radioactive waste management facilities in these communities.

The predominant 'nuclear oasis' approach was introduced by Andrew Blowers at the turn of the 1990s. Blowers pointed out that, nuclear waste repositories had been rejected in greenfield locations. He concluded that places that already host existing nuclear facilities are the only places where repositories may be welcome. Making them resemble oases in the desert for the nuclear industry, which is trying to make final disposal projects to survive in hostile surroundings. Although Blowers states that greater readiness to accept repositories may be in some small part due to familiarity with the industry and growth within the nuclear culture, he stresses such aspects as dependency, unequal power relations and the process of peripheralization. Blowers' theory emphasises industry's economic leverage and dependent

workforce, and therefore dependency, as a reason for greater acceptance of SNF repositories in nuclear communities. (Blowers 2002, 72-74; Blowers, Lowry and Solomon 1991; Marshall 2005, 3; Kojo, Kari and Litmanen 2009b, 2.)

The NEA report of 2007, however, promotes exactly the opposite view to that presented by Blowers. The report offers a challenging 'industry awareness' interpretation, claiming that readiness to consider hosting a repository should not be seen as a sign of dependency. Instead, the reason for readiness arises from cultural integration. This means more than mere familiarity. According to the theory presented in the report, those communities with nuclear installations already within their areas have integrated the industrial activity and cognitive understanding into their culture and thus have an existing cultural basis for facility development. The report states that developing joint solutions builds on and adds to that cultural basis. The cognitive understanding mentioned refers to the idea that we tend to interpret issues through schemes we develop in relation to our cultural surroundings. This means, for example, that where others perceive threats, residents of these communities are better equipped to perceive something that solves a problem related to a familiar energy source. From this point of view the SNF facility could even be something to be proud of. (Kojo, Kari and Litmanen 2009b, 2; NEA 2007, 41-42; see also Kojo and Kari 2010.) Thus, the challenging 'industry awareness' interpretation, emphasises close relationships and cultural integration, and therefore shared understanding, as a reason for greater acceptance for SNF repositories in nuclear communities.

Olkiluoto fits the description of 'nuclear oasis' in that the SNF facility was not rejected and there is already nuclear activity in the area. As Eurajoki is also a municipality which is economically heavily dependent on and politically interrelated with the nuclear industry (e.g. Kojo 2009) it clearly has features indicating that it could be categorized as one of the 'nuclear oases'. In fact, the theory has been used in explaining the decision-making in Eurajoki regarding the repository (e.g. Kojo and Richardson 2009; Litmanen 1994). On the other hand the view emphasising unequal power relations and dependency is challenged by a new 'industry awareness' interpretation focusing on the cultural capacity of a municipality to understand and approve nuclear activities (Kojo, Kari and Litmanen 2009b, 2). The development of a close partnership between the industry and the municipality since the late 1990s (e.g. Kojo 2009.) suggests that Eurajoki may be, or may be moving towards being a 'community with industrial awareness'.

Our aim here is to examine how well the term nuclear oasis actually fits Eurajoki in the light of the survey, what indications there are of features that would fit the challenging industry awareness interpretation and what insights in general the views of the local residents bring to the discussion. As in the Chapter 7.1 the focus of the analysis is exclusively on those respondents residing in the municipality of Eurajoki (N=245) and the reported correlation coefficients are Kendall's rank correlation coefficients (Kendal's tau-b,  $\tau_{\text{Ken,b}}$ ). (About used methods see Chapter 3.3.2.)

### 7.2.1 Analysis

As it was seen in Chapter 6.1 (Table 31), over half, 52%, of the residents of Eurajoki agree or totally agree that the SNF of TVO and Fortum should be disposed of in Finland. When asked about disposal in their home community support decreases only 10 percentage points; 42% of the residents agree or totally agree that the SNF of TVO and Fortum should be disposed of in Olkiluoto. Even though support decreases, the acceptance of final disposal to Olkiluoto is

quite strong, and it can be concluded that according to the survey there really is no substantial NIMBY phenomenon to speak of in the community. Regarding the enlargement of the repository, exactly the same proportion of residents (42%) that accept (agree / totally agree) with final disposal in the area of their home community is also ready to accept expanding the repository for the needs of the current actors TVO and Fortum. However, attitudes start to change when people are asked about other actors. Around three out of five (62%) are not ready (totally disagree / disagree) and one out of five (20%) is ready (agree / totally agree) to accept the expansion of the repository for possible other Finnish actors, and the idea of importing SNF to Olkiluoto is very firmly rejected as 89% of residents totally disagree or disagree with it. (See also Kojo, Kari and Litmanen 2009b.)

These results show that we should at least consider other than purely economic reasons for acceptance of final disposal. For example, accepting imported SNF could bring very substantial economic benefits to the community but it is nevertheless clearly not accepted. When acceptance of possible other domestic actors is also much lower than current actors, it can be deduced that being already present in the community somehow affects the acceptability of final disposal. However, Blowers specifically mentions workforce issues in connection with the leverage that the nuclear industry has over the community. This could explain why those operators already within the community are better accepted. That, however, means that the perceived impacts of the repository on employment would have to be very closely related to acceptance of the disposal of SNF produced by TVO and Fortum at Olkiluoto. In one sense this also seems to be the case. In the survey respondents were asked about how constructing the final disposal facility in the area in their opinion would impact on certain issues (see Chapter 5.1). When the relation of the repository's perceived impacts on employment in the area and acceptance of the disposal of SNF produced by TVO and Fortum to Olkiluoto is analysed it is clear that these things do indeed correlate and the correlation is statistically highly significant ( $\tau_{Ken,b} = .274$ ,  $p = .000$ ,  $N=235$ ) On the other hand, this result appears in a totally different light when put to context and it is pointed out that respondents were presented with 20 different issues regarding repository's impacts, and regardless of the statistically highly significant correlation observed, among 20 different impact – acceptance correlations examined in relation to acceptance of the disposal of SNF produced by TVO and Fortum at Olkiluoto, this correlation was only the 15th strongest (Table 39.)

**Table 39.**

Correlations between certain impacts named in the survey and attitude towards the statement "Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto" in order of the strength of correlation ( $\tau_{Ken,b}$ ).

Perceived impact to...	Correlation to the statement
1 Own image of Eurajoki in particular	.455 (p= .000, N=237)
2 Own satisfaction with the area as a place to live	.442 (p = .000, N=234)
3 Own expectations for the future in the area	.424 (p= .000, N=236)
4 Own image of their area	.421 (p= .000, N=235)
5 Functioning environment / atmosphere in the area	.414 (p= .000, N=234)
...	
11 Economic development in the area	.302 (p= .000, N=236)
...	
15 Employment in the area	.274 (p= .000, N=235)
...	

In addition, respondents were also asked about their information needs in 13 different issues related to final disposal (Chapter 4.4). Presented issues did not cover employment in particular, but respondents were asked more generally about the information needs relating to economic impacts. The respondents did not, however, indicate any special interest in economic issues. The number of those reporting great need for information on the economic impacts of final disposal was fairly high (45%), but again this should be put into context. When asked about information needs related to final disposal, need for information about economic impacts was second lowest of 13 issues presented in the survey (for the greatest needs see Table 20).

We can conclude that in the analysis, some issues were found that did not support the notion of economic issues and dependency of workforce being central to the acceptance of SNF disposal, as Blowers essentially asserts. In light of Table 31, on other hand, it is quite reasonable to suggest that a close relationship between the community and those actors currently operating in the area could have a positive effect on the acceptance of disposal, which in turn is what the industry awareness theory essentially claims. But is there anything else in the survey data that supports the challenging interpretation?

The notion of industry awareness is based on a close relationship which involves sharing and integration. These are things that need trust, so residents of the community should demonstrate this, a serious imbalance in the power relations could also manifest as lack of trust. This means that if the industry awareness approach is right, trust should be closely related to acceptance of the disposal of SNF produced by TVO and Fortum in Olkiluoto. According to the correlation analysis trust and acceptance of final disposal are indeed related, and the correlation is statistically highly significant ( $\tau_{\text{Ken,b}} = .443$ ,  $p = .000$ ,  $N = 236$ ). When we put that into context we can see that the correlation in this case is clearly higher than the correlation in the case of perceived impact on employment mentioned earlier. (In fact comparing this trust – acceptance correlation to the greatest impact – acceptance correlations in Table 39 reveals that this correlation strength would have earned second place in the list.) In addition, no overwhelming lack of trust was observed as the same proportion (39%) of respondents agree or totally agree and totally disagree or disagree with the statement "I trust Posiva regarding the risk assessment of the final disposal project" as already mentioned in Chapter 7.1.2.

Of course if building the repository really is, as the industry awareness approach presumes, seen as the development of a joint solution to existing nuclear activities and if it builds on the existing cultural basis, this means that final disposal and its effects should be seen somehow as part of the whole package (which comes with being "nuclear") rather than an independent project. In the survey this theme was approached by asking respondents' opinions about how difficult it is to estimate the effects of final disposal as a whole, apart from other nuclear activities. Around half, 49%, found it either very difficult (21%) or difficult (29%) to distinguish final disposal from other nuclear activities and around one in four, 26%, found it either easy (18%) or very easy (8%). In other words, it does indeed appear that it is not very easy for residents of Eurajoki to distinguish final disposal from existing activities, instead, the final disposal project seems to blend in with other ongoing projects.

### 7.2.2 Summary

Analysis of the survey indicated that there are some reasons to take a critical stance towards the predominant 'nuclear oases' approach, which emphasises economic leverage and dependent workforce, and therefore dependency, as a reason for greater acceptance of SNF repositories in nuclear communities. The results demonstrated that in Eurajoki the SNF of new nuclear waste management actors are not as welcome as the SNF of those actors already operating in the community, even though it is quite clear that this could mean new economic benefits. The data also demonstrated that the relation of perceived impacts to employment and acceptance of the disposal of SNF was clear, but not as strong as could have been expected, as the relation was not among the strongest compared to other impact – acceptance relations observed in the survey. Moreover, residents of Eurajoki did not feel any special need for information about the economic impacts of the repository as information need on this issue was the second lowest information need of those presented in the survey

If residents of Eurajoki thought that their community is economically dependent or that the community's workforce is dependent on the nuclear industry to the extent that the community is relatively powerless or subject to economic risk, it would make sense that they would be very tempted by possible new economic opportunities which new nuclear waste management actors could possibly offer. It would also make sense that residents would be very interested in getting information about the economic impacts of the repository and that repository's impact on employment would have a fundamental effect on the acceptance of a repository. Because this was not the case in Eurajoki, the results imply that we should also consider other explanations than those offered by 'nuclear oases' theory for the heightened readiness to accept an SNF repository in Eurajoki and also in other communities that already have nuclear facilities.

Analysis of the survey also suggested that the 'industry awareness' approach emphasizing close relationships and cultural integration and therefore shared understanding, as reasons for greater acceptance for SNF repositories in nuclear communities, could indeed be a viable option or addition to the 'nuclear oases' approach. The results demonstrated that if a nuclear waste management actor is already present in the community then residents are more willing to accept final disposal of that actor's SNF, but willingness does not readily extend to other actors within the industry. It was also concluded that trust and acceptance of final disposal are related and that the relation is considerably stronger than that between impacts on employment and acceptance of disposal and in same range as the strongest of the impact – acceptance relations mentioned earlier. And last but not least it was shown that the final disposal project seems to blend in with other ongoing nuclear activities.

All these results fit the challenging 'industry awareness' interpretation. Being present in some form is of course a prerequisite for a relationship. To establish such a relationship that it involves shared understanding or integration into cultural basis of the community, as the theory implies, the presence would have to be very significant indeed. It is consistent with the 'industry awareness' interpretation that this kind of relationship could be formed with certain actor(s) present within the community without it spreading to the industry as a whole. Trust on the other hand is both a prerequisite and outcome of shared understanding and easily damaged if one party thinks that the other is using unequal power relations to its advantage. This means that the connection identified between trust and acceptance of the final disposal of the SNF and quite high support for the notion that the SNF of nuclear waste management actors currently present within community should be disposed in Olkiluoto is more consistent

with the 'industry awareness' interpretation than the 'nuclear oases' interpretation. The most telling of results, however, is that the final disposal project seems to blend in with other ongoing nuclear activities, for this should indeed somehow be the case if the final disposal project is built on and adds to the existing cultural basis and cognitive understanding and is therefore part of the ongoing process within the community.

All in all, the results imply that we should consider 'industry awareness' as an explanatory model when examining the acceptance of the disposal of SNF in nuclear communities. What has to be remembered, however, is that the survey involved residents of the community not its decision-makers, to whom economic considerations may be more tangible. Nevertheless, regarding the what comes to cultural basis, the decision-makers of community share the same cultural base as the rest of the community, which, according to the 'industry awareness' theory, through cognitive understanding integrated into the culture, would make some decisions culturally more viable than others.



## 8 Conclusions

The main objectives of the SEURA research project behind this report were to study residents' opinions in the municipality of Eurajoki and its neighbouring municipalities regarding the socio-economic and socio-political impacts of the final disposal facility and information needs and ways of obtaining information regarding the plan for final disposal. In this report we have presented the results of the 2008 survey compared those of other surveys and, in addition, in Chapter 7 also examined some possible explanations for attitudes towards final disposal. We conclude by characterizing the opinions from the point of view of the developments of the last decades and returning to the themes of research project by examining the rationality of nuclear community and taking a look at information issues.

### 8.1 Mounting confidence about safety

First, let us consider how Finnish attitudes to nuclear waste have developed over the years and how Finns perceive these issues in the European context. Local people's attitudes can be related to a long-term trend in general trust in the safety of the Finnish nuclear waste management model. Our secondary analysis of data gathered for the annual Finnish energy attitudes study showed that in Finland the confidence in the safety of final disposal has grown very slowly over the last 25 years. The magnitude of the shift was from one fifth to one fourth when the respondents were asked about disagreeing and agreeing with the view that final disposal in the Finnish bedrock is safe (Figure 2).

Examination of the time-series revealed four phases regarding the share of those confident about the safety of nuclear waste management: 1) 1983–86 around 15% were confident, 2) 1987–93 around 20%, 3) 1994–2000 confidence fluctuated between 25% and 30%, and 4) 2001–08 confidence stabilised around 30%. At the same time the share of sceptics, those dubious about the safety, decreased. The analysis indicated that this time series also had four phases: 1) 1983–86 ever so slightly increasing scepticism from 57% to 63%, 2) 1987–93 generally decreasing trend down to 46%, 3) 1994–2000 scepticism fluctuated between 45% and 54%, and 4) 2001–08 scepticism stabilised to around 45%. In the European context according to Eurobarometer (2007, 29; see also Chapter 2.2) confidence in the safety of the disposal of radioactive waste among Finns is on the average level at 45% (see Figure 3), not at all on such a high level as one might have supposed on the basis of other nuclear power attitudes. After all, according to Eurobarometer (2007, 25) 77% of the Finns thought that it was possible to operate NPPs safely.

The comparison of several surveys in Chapter 6.2 revealed that among the Finnish general public there was less opposition to the plans for final disposal than at the local level. Both in Eurajoki and its neighbouring municipalities the plan for final disposal in Olkiluoto was opposed by over one third (between 34% and 40%) of the residents. It is interesting that the support for final disposal in the near vicinity, in the municipality of Eurajoki, was stronger than in neighbouring municipalities. In Eurajoki around 40% of respondents were in favour of the project, but in the neighbouring municipalities the share of those in favour was around 10 percent units lower. The obvious explanation is that the nuclear waste management company has long mostly focused its co-operation, communication and public relation activities on stakeholders in Eurajoki. Furthermore, support indicates that the company has managed to some extent to persuade the residents of Eurajoki to host the repository. However, even in Eurajoki there is a clear difference between the local political elite and the residents. The local councillors are more in favour of the project than the residents of Eurajoki. For example, in 2009 only four local councillors out of 27 voted against the expansion of the repository. Thus only 15% of local councillors opposed whereas according to our study 39% of local residents were against the expansion.

## **8.2 Rationality of nuclear community and social cleavage**

The first main objective of the SEURA research project was to study residents' opinions in Eurajoki and its neighbouring municipalities regarding the socio-economic and socio-political impacts of the final disposal of spent nuclear fuel. Roughly speaking, what we found out was that even though the majority of people tend to assess socio-economic impacts as positive nuclear waste has created quite a remarkable social cleavage in the area.

In Chapter 7 we discussed two competing approaches to interpret the rationality of a nuclear community. The nuclear oasis approach suggests that local acceptance is based on the heavy economic dependence of a small, peripheral municipality on the powerful nuclear industry. The challenging industry awareness approach interprets the readiness to accept the siting of a SNF disposal repository from the perspective of cultural adaptation. The community and its residents have close relations to the nuclear industry, which produces cultural adaptation, integration and understanding of nuclear activities. A result of this closeness, partnership and coexistence is a greater acceptance of the for industry's aspirations among the residents of the nuclear community. Even though the data was not originally planned to test these approaches, the analysis yielded some interesting findings. For instance, those residents of Eurajoki who perceived the impacts of the repository to be positive for the general socio-cultural development of the municipality were more willing to accept an SNF repository in Olkiluoto. The importance of the economic and employment considerations behind the acceptance were identified, but these factors were not as strongly correlated with acceptance as other general socio-cultural satisfaction factors. Such findings speak on behalf of the industry awareness approach.

However, the picture is more complicated. According to our findings, there was both trust (39% of respondents) and distrust (39%) among the residents of Eurajoki on Posiva's expertise on nuclear waste management (Chapter 7.1.2). The time-series analysed in Chapter 2 revealed that the long-term presence of nuclear industry in the locality together with national nuclear waste policy had increased the share of those who are confident that disposal of into the bedrock is safe. As noted above, at the national level the development of trust in

general safety of nuclear waste management has been fairly linear and coherent, but at the local level the development is more fluctuating than linear. Therefore one cannot conclude that the dominant perspective among the residents is the cultural integration of nuclear industry in community. The residents' cultural adaptation to the nuclear industry is neither harmoniously advanced nor homogenously dispersed.

For instance, in our survey the general picture in socio-economic issues at the local level was ambivalent. Residents did indeed acknowledge the economic benefits of the project for the municipality, but they also voiced doubts that it may have some negative effects. On the one hand residents of the area estimated the effects of the repository to be positive in economic and community development issues. The majority of the respondents perceived positive impacts on employment in the area (63% "somewhat positive / positive") and economic development in the area (61%) and many also on issues pertaining to infrastructure (e.g. traffic connections in the area, 41%). On the other hand people were concerned over the negative effects of the final disposal facility. Over half of the residents perceived the effects to be negative or somewhat negative on issues such as the state of nature surrounding the final disposal facility (54%), rural non-farm livelihoods (52%) and outsiders' image of the area (52%) and over one third also on issues such as own image of the area (40%) and recreational opportunities in the area (39%). (Chapter 5.1.)

Indeed, it would be more accurate to conclude that both perspectives, the nuclear oasis and industry awareness, are correct, because the analysis of the data revealed that there is a latent social cleavage in the area. To call this cleavage latent means that there is a hidden division or dividing line of society into two factions or groups among which conflict potentially exists (see Choe 2003, 7). For instance, a more detailed study to identify those perceiving certain issues positively and negatively reveals a discrepancy between women and men. In issues such as 1) state of nature surrounding the final disposal facility, 2) own image of the area, 3) own image of Eurajoki in particular, 4) own satisfaction with the area as a place to live, 5) own expectations for the future in the area, 6) functioning environment / atmosphere in the area, 7) development of the area generally, 8) development of the education sector in the area, 9) rural non-farm livelihoods, 10) farming and forestry: a bigger share of women than men perceived the effects to be negative. The converse is also true i.e., more men than women perceive the effects of the repository to be positive. (Chapter 5.1.)

This social cleavage could also be found in the local political life. Quite often supporters of the National Coalition Party and the Centre Party of Finland shared the view that an SNF repository would have a positive effect on the socio-economic development of the area. Among the supporters of the National Coalition Party the repository project was most welcome, whereas among the supporters of the Centre Party there was also hesitation about the positive socio-economic effects. Nevertheless, among the supporters of these two parties one will most likely find positive attitudes. In some cases the supporters of the Social Democratic Party also agreed with the supporters of these first two parties. The orientation towards the Green League and the Christian Democrats is likely to predict more negative attitude towards social-economic effects of the repository. It is likely that the supporters of the Left Alliance are wavering between these two extreme positions. The findings suggest that those who have the most positive attitudes towards the effects are most likely supporters of the National Coalition Party and the Centre Party and in some cases also supporters of the Social Democratic Party. Negative attitudes are most likely found among the supporters of the Green League and the Christian Democrats. (Chapter 5.1.) These findings are also in line with

those of a survey among local policy-makers of candidate sites in the late 1990s (Ponnikas 2000, 37–39).

The analysis of the data also indicates that the attitudes of affluent people and more disadvantaged people can be quite extreme. For instance, in the cases of 1) own image of Eurajoki in particular and 2) own image of the area and 3) state of nature surrounding the final disposal facility this can be found (Chapter 5.1). Those with higher incomes tend to see the impacts of the repository to be more positive than those with lower incomes. This is also the case in assessing risks and acceptance of the project. For instance, in the cases of 1) health of future generations, 2) safety of future generations, 3) own or family's well-being, 4) own or family's health and 5) general well-being the perception of risk was the lowest among the two highest income groups (Chapter 5.2). People with higher incomes seem to deny or tolerate the risks of nuclear waste disposal or in some cases hesitate about the risks. These findings correlate with the findings of acceptance. People with higher incomes accept the disposal more easily than people with lower incomes. In the cases of statements 1) "Nuclear waste produced by TVO and Fortum should be disposed of in Finland", 2) "Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto" and 3) "I accept expansion of the repository also for the needs of other Finnish actors" more people belonging to the highest income groups expressed acceptance than people with lower incomes (Chapter 6.1).

This kind of social cleavage can certainly cause tensions inside the communities. It is difficult to know in what kind of situations this discord can manifest itself or if it is an issue which people prefer to "forget" in everyday interaction in order to maintain social cohesion and avoid social division. One might assume that incongruities like these can bring tension, for instance, to different social formations, such as families, workplaces, associations and clubs, where both women and men act and take part. It would be an interesting, new research theme to study this tension more, for instance, using qualitative methods. Are these differences of opinion discussed in everyday life and when? Are they causing any problems in running things? How are the families handling conflicting views in order to be able to live a normal, harmonious life? This social cleavage is certainly dividing people in small communities, but one has to remember that it has not raised any single issue social groups with this kind of collective identity. A local anti-nuclear group was organized last time in Eurajoki in 2000–2001 (see Kojo 2004, 236–237). Another kind of social division is documented at the European level. Among the Europeans the strongest socio-demographic factors predicting certain attitudes towards nuclear energy are gender and level of education. A more positive attitude towards nuclear energy is found among males and those with a high level of education (Eurobarometer 2007, 59).

Because the Finnish nuclear policy is currently at a state of flux, we asked the respondents about their willingness to accept the expansion of the repository not only for the new needs of established nuclear operators, TVO and Fortum, but also for the needs of possible newcomers.<sup>37</sup> Less than a half (40%) of the respondents (42% of the respondents in Eurajoki) were willing to accept expansion for the needs of TVO and Fortum, but newcomers were less well tolerated. When studying the willingness to accept the expansion of the repository, it was found that the more people value the final disposal facility as a positive part of the general wellbeing of their local district and its future, the more likely they are to accept the expansion for the needs of TVO and Fortum. This may even mean that among the residents there are

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<sup>37</sup> In May 2010 the Government took a decision-in-principle in favour of the NPP of the new nuclear power company Fennovoima. The decision was ratified by Parliament in July 2010.

people, who think that different kinds of nuclear activities are part of their community and its identity and are proud of them.

Kojo and Kari (2010) have further elaborated this finding arguing that the municipality of Eurajoki is entering a new phase in the nuclear community life-cycle. The relationship of the nuclear community and nuclear industry no longer seems to be defined through dependence, but instead through co-operation and added value for the contracting parties. Thus the once firmly rejected siting of the SNF repository is turning, at least partly, into a project of local pride. However, Kojo and Kari emphasize that a split in attitudes towards the siting of the SNF repository also has to be acknowledged as clearly not all residents view the repository with pride. Also, one has to keep in mind that not all nuclear operators are equally well tolerated. The findings suggest that the present owners of Posiva are

"...perhaps already part of the local culture and, thus, more readily regarded as a subject of local pride, whereas a newcomer is evaluated initially in terms of possible benefits. The outsider needs to earn its place and respect in the eyes of the local residents." (Kojo and Kari 2010, 12).

The newcomers are much less readily accepted than established actors. (Kojo and Kari 2010, 12)

### **8.3 Information issues**

The second main objective of the SEURA research project was to study residents' opinions in the municipality of Eurajoki and its neighbouring municipalities regarding information needs and ways of obtaining information regarding the final disposal. To summarize the findings concerning this second research task one could say that both the Finnish Radiation and Safety Authority (STUK) and the nuclear industry have succeeded in establishing a fairly trusted position as an information provider in the localities, but among the recipients of the information the very same social division as explained in Chapter 8.2 can be seen. This means that there are also local people who do not have confidence in these actors as sources of information.

The analysis of the information channels used and the satisfaction with the quantity of and confidence in the information provided by different actors (Chapter 4) revealed several interesting things. First, the nuclear industries' own information dissemination and briefing is both recognized and consulted actively by the local people even though the most important information channels are newspapers and television. To characterize those who are the readers of the nuclear industry's information leaflets, one can draw a caricature: affluent middle-aged or older males supporting the National Coalition Party or the Centre Party. Those who do not tend to consult these information channels seem to belong to following groups: youngest generations, small incomes, unemployed or doing domestic work, and supporters of the Green League and the Christian Democrats. (Chapter 4.1; see also Chapter 4.5.)

Second, both Internet and public meetings are not very much used ways of getting information about nuclear waste management. Even though the Internet is not so much used, there is variation in the population. Particularly younger generations and also people with lowest and highest incomes seem to use the Internet more as an information source. The most common ways of using the Internet, among the ways mentioned in the questionnaire, were

visiting the pages of the municipality of Eurajoki, the pages of the industry and the pages of the authorities, but it was also used in debating and changing opinions. (Chapter 4.1.) Regarding public meetings, these used to gather people, but there has been a decreasing trend of active participation in public meetings at the local level (see e.g., Säynäsallo and Borg 1992; Hokkanen 2007; Nurmi, Kojo and Litmanen 2009). A similar phenomenon can also be seen in our figures. This type of active participation in public debate seems to have changed to perhaps a more passive observation of the developments and also towards occasional change of opinions in the Internet.

In general the respondents tend to be fairly satisfied with the quantity of information provided by Posiva, TVO, Fortum, and STUK. On the other hand, the respondents were dissatisfied with the quantity of information provided by the political parties. (Chapter 4.2.) Regarding confidence in the information provided (Chapter 4.3) the greatest satisfaction was felt with information provided by STUK (43% satisfied/ highly satisfied), Posiva (32%), research institutes (31 %), TVO and Fortum (30 %), and universities (28%). Most dissatisfaction was felt regarding confidence in information provided by the political parties (58% highly dissatisfied/dissatisfied), NGOs (47%), other ministries than the MTI/MEE (41%), local authorities (39%) and the MTI/MEE (35%). Still, the general picture is more complex when we ask who are satisfied and who are not. For instance, among men more satisfaction is felt with information provided by Posiva and nuclear power companies than among women, as women tend to be more dissatisfied regarding confidence in information provided by these actors. Among different socio-economic groups those who are most satisfied regarding confidence in information provided by TVO and Fortum and also Posiva are white-collar workers and self-employed/employers. Least satisfied with information provided by these two nuclear power companies are unemployed people, those staying at home doing domestic work and farmers. Among the highest income groups (earning 60,000 euros a year or more) there was satisfaction with the information provided with TVO and Fortum, MTI/MEE and Posiva. Those with the smallest incomes gave a completely different answer. They were dissatisfied with the information of these actors. (Chapter 4.3.)

From the perspective of the development of nuclear waste management Eurajoki is in what we call "the post site selection phase". The site selection process started in Eurajoki in the mid 1980s and now the municipality has lived with the positive municipal decision for one decade. Nevertheless, after decades of determined planning and information disseminations residents request more information regarding the final disposal of SNF. According to our survey (Chapter 4.4), people need more information on environmental effects (72% of the residents indicating substantial or very great need for information), health effects (71%), and safety after closure (64%). Comparing the present findings to the findings from the survey of 1994 by Kurki (1995) one can say that the focus of the information needs seem to have changed from safety related issues towards environmental and health effects. Not so much information is needed on economic issues as it was in the 1990s. In the case of information needs, too, the analysis with socio-demographic background variables indicates clear differences among the different groups of respondents as to who needs what kind of information. For instance, women seem to demand more information than men on environmental and health effects and effects on everyday life.

The overall picture of how people think about the information regarding final disposal shows that the nuclear industry has succeeded in establishing a fairly trusted position in the localities when measured by how much its own leaflets are consulted and how satisfied people are with its information. The leaflets are frequently used information sources in Eurajoki and also in its

neighbouring municipalities. Although local people actively consult what newspapers, television and radio report on nuclear waste issues, the industry has its own well functioning direct messaging channel to residents. The industry is able to inform local communities without being interpreted by journalists in general. Presumably this can have an influence on residents' opinions and their ways of framing the issue in the long term. Nevertheless, on the grounds of the study of how local people value the information provided by the different actors, one can conclude that there seem to be rather distinct groups who appreciate the PR and information work of nuclear industry. More affluent people give their support to the work of the nuclear industry, but more disadvantaged people tend to reject or criticize the information produced and distributed by the nuclear industry. Another clearcut line is between genders. Women tend to be more reserved or critical towards the information from the industry, whereas among men there is more confidence to be found in the industry's information.

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## Appendix: Questionnaire [in Finnish]

Tässä kyselyssä vastaus sijoitetaan useimmiten valmiiksi annetulle asteikolle. Asteikoille on joko annettu ääripäät jolloin keskimääräinen vaihtoehto ei kallistu kumpaankaan suuntaan tai tarvittaessa jokainen kohta on selitetty erikseen. Ympyröikää mielestänne sopivimman kohdan numero.

### Hyvä vastaaja, olemme kiinnostuneita teidän näkemyksistänne Eurajoen Olkiluodon käytetyn ydinpolttoaineen (ydinjätteen) loppusijoitushankkeesta.

Olkiluodossa on muutakin ydinvoimaan liittyvää toimintaa kuin loppusijoitushanke (kuten uuden ydinvoimalaitoksen rakentaminen).

#### 1. Kuinka helppoa tai vaikeaa mielestänne on arvioida

loppusijoituksen vaikutuksia omana kokonaisuutenaan erillään tästä muusta ydinvoimaan liittyvästä toiminnasta? Erittäin vaikeaa 1 2 3 4 5 Erittäin helppoa

#### 2. Tietoa loppusijoituksesta voi saada eri tavoin. Missä määrin seuraatte eri tiedonlähteitä saadaksenne tätä tietoa?

Lehdet	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti
Televisio	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti
Radio	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti
Internet	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti
Tieteelliset julkaisut, tietokirjallisuus	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti
TVO:n Olkiluoto uutiset	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti
Posiva tutkii -tiedote	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti
Yleisötilaisuudet, keskustelutilaisuudet	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti
Oman työn tai koulutuksen kautta saatava tieto	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti
Järjestö- ja yhdistystoiminnan kautta saatava tieto	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti
Tuttavien, työtoverien, suvun ym. kautta saatava tieto	En seuraa ollenkaan	1	2	3	4	5	Seuraan aktiivisesti

#### 3. Internetin käyttönne loppusijoitushankkeeseen liittyvissä asioissa? Yleisesti ottaen

	En ollenkaan	Harvemmin kuin kerran kuukaudessa	Kuukausittain	Useita kertoja kuukaudessa	Viikoittain	Useita kertoja viikossa
Käyn viranomaisten sivustoilla (KTM/TEM, STUK)	1	2	3	4	5	6
Käyn Eurajoen kunnan sivustoilla	1	2	3	4	5	6
Käyn teollisuuden sivustoilla (Posiva, TVO, Fortum)	1	2	3	4	5	6
Käyn tutkimuslaitosten sivustoilla (VTT, yliopistot)	1	2	3	4	5	6
Käyn vaihtoehtoisia näkemyksiä tarjoavilla sivustoilla	1	2	3	4	5	6
Osallistun mielipiteiden- tai tiedonvaihtoon	1	2	3	4	5	6
Osallistun kampanjoihin tai poliittiseen/järjestötoimintaan	1	2	3	4	5	6

#### 4. Millainen on tiedontarpeenne loppusijoitukseen liittyvissä asioissa?

Loppusijoituksen yleinen turvallisuus	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Kuljetusten turvallisuus	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Kapseloinnin turvallisuus	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Laitoksen sulkemisen jälkeinen turvallisuus	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Terveysvaikutukset	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Ympäristövaikutukset	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve

Taloudelliset vaikutukset	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Vaikutukset jokapäiväiseen elämään	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Imagovaikutukset	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Laitoksen mahdollinen laajentaminen	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Kunnallinen päätöksenteko	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Valtakunnallinen päätöksenteko	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve
Euroopan unionin (EU) päätöksenteko	Ei tiedon tarvetta	1	2	3	4	5	Erittäin suuri tiedon tarve

5. Kuinka tyytyväinen tai tyytymätön olette eri tahojen tarjoaman tiedon määrään ja luotettavuuteen loppusijoituksesta?

	Tyytyväisyys tiedon määrään					Tyytyväisyys tiedon luotettavuuteen				
	Erittäin tyytymätön				Erittäin tyytyväinen	Erittäin tyytymätön				Erittäin tyytyväinen
TVO ja Fortum (ydinvoimalaitosten omistajat)	1	2	3	4	5	1	2	3	4	5
Posiva (loppusijoituksesta huolehtiva yhtiö)	1	2	3	4	5	1	2	3	4	5
Kauppa- ja teollisuusministeriö /Työ- ja elinkeinoministeriö	1	2	3	4	5	1	2	3	4	5
Muut ministeriöt (mm.ympäristö- sekä sosiaali- ja terveysministeriö)	1	2	3	4	5	1	2	3	4	5
Säteilyturvakeskus (STUK)	1	2	3	4	5	1	2	3	4	5
Paikallisiviranomaiset	1	2	3	4	5	1	2	3	4	5
Poliittiset puolueet	1	2	3	4	5	1	2	3	4	5
Tutkimuslaitokset	1	2	3	4	5	1	2	3	4	5
Yliopistot/korkeakoulut	1	2	3	4	5	1	2	3	4	5
Kansalaisjärjestöt	1	2	3	4	5	1	2	3	4	5

Loppusijoitushanke sijoittuu Eurajoen Okiluotoon. Olemme kuitenkin kiinnostuneita ALUEESTA, johon kuuluvat Eurajoen lisäksi sen naapurikunnat Eura, Kiukainen, Lappi, Luvia, Nakkila ja Rauma.

6. Miten loppusijoituslaitoksen rakentaminen alueelle mielestänne vaikuttaa seuraaviin seikkoihin?

Omaan mielikuvaanne alueesta	Kielteisesti	1	2	3	4	5	Myönteisesti
Omaan mielikuvaanne erityisesti Eurajoesta	Kielteisesti	1	2	3	4	5	Myönteisesti
Omiin tulevaisuuden odotuksinne alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Omaan tyytyväisyyteenne alueeseen asuinpaikkana	Kielteisesti	1	2	3	4	5	Myönteisesti
Ulkopuolisten mielikuvaan alueesta	Kielteisesti	1	2	3	4	5	Myönteisesti
Toimintaympäristöön/Ilmapiiriin alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Luonnon tilaan loppusijoituslaitoksen ympäristössä	Kielteisesti	1	2	3	4	5	Myönteisesti
Alueen kehitykseen yleisesti ottaen	Kielteisesti	1	2	3	4	5	Myönteisesti
Väestökehitykseen alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Työllisyyteen alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Taloukskehitykseen alueella	Kielteisesti	1	2	3	4	5	Myönteisesti

Palvelujen saatavuuteen alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Matkailuun alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Kulttuuriin alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Koulutussektorin kehitykseen alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Maa- ja metsätalouteen alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Luontaiselinkeinoihin alueella (kalastus, metsästys ym.)	Kielteisesti	1	2	3	4	5	Myönteisesti
Vapaa-ajan mahdollisuuksiin alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Kaupunki/kuntarakenteeseen alueella	Kielteisesti	1	2	3	4	5	Myönteisesti
Liikenneyhteyksiin alueella	Kielteisesti	1	2	3	4	5	Myönteisesti

7. Koetteko loppusijoituslaitoksen aiheuttavan uhkaa jollekin näistä?

	En koe	Koen lievää	Koen selkeää	Koen suurta	En osaa sanoa
Yleinen turvallisuus	1	2	3	4	0
Oma tai perheen turvallisuus	1	2	3	4	0
Tulevien sukupolvien turvallisuus	1	2	3	4	0
Yleinen terveys	1	2	3	4	0
Oma tai perheen terveys	1	2	3	4	0
Tulevien sukupolvien terveys	1	2	3	4	0
Yleinen hyvinvointi	1	2	3	4	0
Oma tai perheen hyvinvointi	1	2	3	4	0
Tulevien sukupolvien hyvinvointi	1	2	3	4	0

8. Seuraavassa esitetään joukko mielipiteitä/väittämiä, joista haluamme tietää mielipiteenne.

Ydinjätteet muodostavat jatkuvan uhan tulevien sukupolvien elämälle.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Ydinjätteen loppusijoituksen taloudelliset hyödyt eivät korvaa ei-taloudellisia haittoja.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Eurajoen naapurikuntien tulisi hyötyä taloudellisesti loppusijoituksesta, jos siitä aiheutuu niille haittoja.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
TVO:n ja Fortumin tuottama ydinjäte tulee loppusijoittaa Suomeen.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
TVO:n ja Fortumin tuottama ydinjäte tulee loppusijoittaa Olkiluotoon.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Hyväksyn loppusijoituslaitoksen laajentamisen TVO:n ja Fortumin tarpeisiin.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Hyväksyn loppusijoituslaitoksen laajentamisen muidenkin suomalaisten toimijoiden tarpeisiin.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Hyväksyn loppusijoituslaitoksen laajentamisen käytetyn polttoaineen tuontiin ulkomailta.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Mielestäni minulla on riittävästi tietoa loppusijoitushankkeesta.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Luotan Posivaan loppusijoitushankkeen riskien arvioinnissa	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Luotan viranomaisiin loppusijoitushankkeen riskien arvioinnissa.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Ydinjätteet voidaan turvallisesti loppusijoittaa Suomen kallioperään.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä

Ydinjätteen loppusijoituksen hyödyt ovat suurempia kuin haitat.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Eurajoen kunnalla on moraalinen velvollisuus hyväksyä ydinjätteen loppusijoitus, koska se on hyväksynyt ydinvoimalat alueelleen.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Suomeen tulisi rakentaa lisää ydinvoimaa.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä
Olkiluotoon tulisi rakentaa neljäs ydinvoimalaitosyksikkö.	Täysin samaa mieltä	1	2	3	4	5	Täysin eri mieltä

VASTAAJAN TAUSTATIEDOT valitkaa yksi tilannetta kohdallanne parhaiten kuvaava vaihtoehto

9. Sukupuolenne? 1 Mies 2 Nainen

10. Onko teillä alaikäisiä lapsia? 1 Kyllä 2 Ei

11. Syntymävuotenne?

Nelinumeroisena

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12. Siviilisäätyenne?

- 1 Naimaton
- 2 Avoliitossa
- 3 Avoliitossa tai rekisteröidyssä suhteessa
- 4 Eronnut, asumuserossa tai leski

13. Asuinkuntanne?

- |             |           |
|-------------|-----------|
| 1 Eura      | 5 Luvia   |
| 2 Eurajoki  | 6 Nakkila |
| 3 Kiukainen | 7 Rauma   |
| 4 Lappi     |           |

14. Asuinpaikkanne arvioitu etäisyys Olkiluodosta? Linnuntietä

- 1 Alle 10 km
- 2 10 - 30 km
- 3 Yli 30 km

15. Koulutuksenne?

- 1 Ei perusasteen jälkeistä tutkintoa
- 2 Lukio
- 3 Ammattikoulu tai kouluasteen ammatillinen tutkinto
- 4 Opistoasteen tutkinto
- 5 Ammattikorkeakoulututkinto
- 6 Yliopisto- tai tiedekorkeakoulututkinto

16. Koulutusalanne?

- 1 Yleissivistävä koulutus
- 2 Kasvatustieteellinen ja opettajankoulutus
- 3 Humanistinen, taide- ja kulttuurialojen koulutus
- 4 Kaupan, hallinnon ja yhteiskuntatieteiden koulutus
- 5 Luonnontieteen ja tietojenkäsittelyn koulutus
- 6 Tekniikan ja liikenteen alojen koulutus
- 7 Maa- ja metsätalouden koulutus
- 8 Terveys- ja sosiaalialan koulutus
- 9 Palvelu- ja suojelualojen koulutus
- 10 Jokin muu, mikä? \_\_\_\_\_

20. Henkilökohtaiset vuositulonne veroja vähentämättä? Arvio

1 Alle 10000€ 2 10000 - 19999€ 3 20000 - 29999€ 4 30000 - 39999€ 5 40000 - 59999€ 6 60000 - 79999€ 7 80000€ tai enemmän

17. Ammattiryhmänne?

- 1 Johtavassa asemassa toisen palveluksessa
- 2 Ylempi toimihenkilö
- 3 Alempi toimihenkilö
- 4 Työntekijä
- 5 Yrittäjä tai yksityinen ammatinharjoittaja
- 6 Maatalousyrittäjä
- 7 Opiskelija
- 8 Eläkeläinen
- 9 Kotiäiti/koti-isä
- 10 Työtön

18. Toimialanne?

- 1 Maa- ja metsätalous, kala- ja riistatalous
- 2 Teollisuus ja kaivostoiminta
- 3 Energia-, lämpö- ja vesihuolto
- 4 Rakentaminen
- 5 Kauppa
- 6 Majoitus- ja ravitsemustoiminta
- 7 Kuljetus, varastointi ja tietoliikenne
- 8 Rahoitustoiminta, kiinteistö-, vuokraus- ja tutkimuspalvelut, tietojenkäsittely ja muu liike-elämää palveleva toiminta
- 9 Julkinen hallinto ja maanpuolustus
- 10 Koulutus, terveydenhuolto- ja sosiaalipalvelut
- 11 Muut yhteiskunnalliset ja henkilökohtaiset palvelut
- 12 En ole mukana työelämässä

19. Mitä puoluetta äänestäisitte, jos eduskuntavaalit pidettäisiin nyt?

- 1 Suomen Keskusta
- 2 Kansallinen Kokoomus
- 3 Suomen Sosialidemokraattinen Puolue
- 4 Vasemmistoliitto
- 5 Vihreä liitto
- 6 Suomen Kristillisdemokraatit
- 7 Ruotsalainen kansanpuolue
- 8 Perussuomalaiset
- 9 Jokin muu, mikä? \_\_\_\_\_
- 10 En osaa sanoa
- 11 En halua sanoa
- 12 En äänestäisi iankaan



V

**NUCLEAR COMMUNITY CONSIDERING THREATS AND  
BENEFITS OF FINAL DISPOSAL. LOCAL OPINIONS  
REGARDING THE SPENT NUCLEAR FUEL REPOSITORY IN  
FINLAND**

by

Matti Kojo, Mika Kari & Tapio Litmanen 2012

International Journal of Environmental Technology and Management  
vol 15(2), 124-145

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## **Nuclear community considering threats and benefits of final disposal. Local opinions regarding the spent nuclear fuel repository in Finland**

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**Abstract:** This paper focuses on local opinion regarding the siting of a spent nuclear fuel repository in the municipality of Eurajoki, Finland. The research question is how the residents perceive the final disposal. The analysis showed that positive perceptions regarding spent nuclear fuel siting issues are more likely to be found among men and more affluent residents, which can be viewed as an indication of the 'white male effect'. Contrastingly, women and less-advantaged people are more likely to resist the disposal of spent nuclear fuel in 'their backyard'. Two approaches, 'nuclear oases' and 'industry awareness', are used to interpret the findings.

**Keywords:** spent nuclear fuel; repository; final disposal; expansion; local opinion; nuclear oasis; industry awareness; Olkiluoto site; Eurajoki; Finland.

**Reference** to this paper should be made as follows: Kojo, M., Kari, M. and Litmanen, T. (2012) 'Nuclear community considering threats and benefits of final disposal. Local opinions regarding the spent nuclear fuel repository in Finland', *Int. J. Environmental Technology and Management*, Vol. 15, No. 2, pp.124–145.

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## **1 Introduction**

Spent nuclear fuel management is a growing international challenge. Large volumes of spent nuclear fuel are already in existence, and more is continually accumulating. According to the Nuclear Energy Agency (NEA) report (NEA, 2008), in June 2008 there were 439 operating nuclear reactors and 41 nuclear power reactors under construction worldwide. However, so far no country has found a permanent solution for final spent nuclear fuel disposal or storage (NWTRB, 2009). Repository plans everywhere have to face the often-monumental task of gaining public support. The spent nuclear fuel repository project in Finland, however, appears to be an exception, as it is already approaching the construction phase as scheduled. In addition, expansion of the repository currently under excavation is also in preparation, in accordance with plans to construct more nuclear power capacity. The Decision-in-Principle regarding the spent nuclear fuel repository was ratified by the Finnish Parliament in May 2001. The first expansion of the spent nuclear fuel repository was ratified by the Parliament in May 2002 after the vote for the new nuclear power plant unit (Kojo, 2009a). In July 2010, Parliament ratified a second expansion of the spent nuclear fuel repository for the needs of the power company Teollisuuden Voima's (TVO) fourth nuclear power plant unit. The approved disposal capacity increased from an original 4000 to 9000 tons of uranium (Kari et al., 2010, p.8).

In many countries, the communities that have been more willing to consider acting as hosts for nuclear waste management facility projects are in fact those that already have a nuclear installation or installations within their territory. These communities are usually described as 'nuclear communities' or 'nuclear oases', but the NEA (2007, p.41) report suggests that "[t]hese may be called communities with 'industry awareness'".

The aim of this paper is twofold. First, the concept of a nuclear community and two different approaches to it are introduced. The purpose is to provide the reader with two distinct conceptual frameworks for interpreting the local opinions of a municipality hosting nuclear activity. The paper argues that the 'nuclear oasis' approach, emphasising unequal power relations and the dependency of a host municipality, is challenged by a new interpretation, the 'industry awareness' approach. This new approach focuses on the existing cultural capacity of a host municipality to understand and support nuclear activities. In the paper, the municipality of Eurajoki is seen as a possible example of a nuclear community with 'industry awareness'. Second, the paper provides updated information on local opinions regarding the siting of the spent nuclear fuel repository in the municipality of Eurajoki, Finland (comp. Litmanen, 1999). In 1993, the municipal report of Eurajoki included a clause expressly forbidding the siting in Eurajoki. However in 1998, only five years later, the local council approved a municipal vision including a positive statement regarding further construction of nuclear power, and the siting of the spent nuclear fuel repository in the municipality. The local council approved the siting in January 2000 by 20 to 7 votes. Direct geological disposal of spent nuclear



fuel and the location of the repository were subsequently approved at the national level. One explanation for the successful siting process is the local negotiations on compensation between the municipality, the nuclear waste management company and the nuclear utility (Kojo, 2009b, pp.177–185). The key question of the updated opinion study is how the residents of the municipality of Eurajoki perceive the siting of the repository at the present time, nearly a decade after local approval was granted. The question is of interest, as in December 2008 the local council decided unanimously to give a positive statement on the expansion of the spent nuclear fuel repository. The issue arises as to whether a contradiction exists between the attitudes of the local council and the local residents.

The data presented in this paper is founded on a survey conducted in June 2008. The respondents were selected from the residents of the municipality of Eurajoki and its neighbouring municipalities using stratified random sampling ( $N = 3000$ ). The survey was carried out as postal survey, with a response rate of 20% ( $N = 606$ ). 245 respondents reported to be residents of Eurajoki (Kari et al., 2010, pp.20–21).

The paper opens by introducing the concept of a nuclear community and two related interpretive approaches (Section 2). The sections following this (3–6) describe the results of the survey: local opinions on nuclear power (Section 3), perceived threats of the spent nuclear fuel repository (Section 4), acceptance of the final disposal (Section 5) and local opinions on the benefits of the spent nuclear fuel repository (Section 6). In Section 7, the results are discussed in light of the two approaches. Conclusions emphasising the role of well-being issues in understanding a nuclear community are drawn in Section 8.

## **2 Nuclear community as a framework**

A number of authors have previously sought to gain an understanding of the rationality of nuclear communities. Analysis has focused on how communities become nuclear sites, and what kinds of societal processes are behind the site selection procedure. For instance, Jacob (1990, p.43) has discussed how power dynamics play an essential role in the siting of a nuclear waste repository. The political-economy approach he applies assumes that institutions of the state and economy work hand-in-hand to solve the problem of locating the nuclear waste. In Jacob's framework, 'nuclear establishments', including pro-nuclear actors and institutions of state, economy and civil society, have sought to solve siting problems by targeting small rural towns and regions where nuclear facilities already exist, and where the local support for the industry is high because of, for instance, the ability of the nuclear industry to provide high-income jobs for the residents and to boost the local economy (see also Carter, 1987, pp.402–405; Murphy, 2009, p.137; Greenberg, 2009).

Eiser et al. (1995, p.x–xi) use the term 'nuclear neighbourhood' when studying the viewpoints of residents in small communities selected for a new nuclear power plant site. They emphasise the historical and geographical contextual factors behind the reasoning of local residents. These authors also identify that the strategy of the nuclear industry is "to make maximal use of existing sites and to avoid controversial developments where no previous power stations had been built" (Eiser et al., 1995, p.31). Both terms, 'nuclear establishment' and 'nuclear neighbourhood', state clearly that community support for a nuclear site is not purely a matter of cost–benefit calculations. Cultural factors and power relations are also of key importance; here, concepts such as 'internal colonialism'

have been applied, referring to a powerful core region exploiting those on the fringes. The concept of 'nuclear culture' describes a culture of fatalistic acceptance or cynicism about the morality of the project and the risks that are involved. The peripheral nature of many nuclear communities supports both these explanations (Blowers and Leroy, 1994; Blowers, 1999).

However, in this paper we are more interested in mapping the characteristic features of communities hosting nuclear-industry-related activities. Following the site selection process, the nuclear industry enters a community and a process of mutual adaptation begins. This long process of interaction may involve many different phases not only depending on the type of nuclear activities and internal developments of the industry, but also depending on varying social, political and economic circumstances in a certain community and its broader social context.

To provide a tentative explanation of a 'nuclear community', we refer to the following definition: nuclear communities can be characterised as "communities who host nuclear activities and are conscious of their nuclear identity" (NDA, 2007, p.89). A community's inhabitants are familiar with nuclear activity, which in turn is often seen as a mixed blessing, bringing not only economic advantages but also a psychological burden and potential problems for example with the community's image. Trusted community members with experience in the nuclear sector often occupy a bridging role between the ordinary citizens and the nuclear experts (NDA, 2007). Next, we outline two interpretations of a nuclear community emphasising very different explanations for the activities and local acceptance within a host community, referred to as 'nuclear oases' and 'communities with industry awareness'.

The 'nuclear oases' interpretation was introduced by Andrew Blowers and his colleagues (Blowers et al., 1991) at the turn of the 1990s. Blowers (1999, pp.245–247) categorises nuclear sites concentrating on rear-end functions of the nuclear cycle into two groups. The first group includes the existing bases of the industry where operations have been relatively long established. The second group is composed of 'greenfield' locations, places developing within the last two decades in areas with no previous experience of the nuclear industry. Blowers (1999, pp.247–255; see also Blowers and Leroy, 1994) introduces five dimensions, which illustrate nuclear locations, also referred to as 'peripheral communities'. The dimensions are as follows: remoteness, economic marginality, powerlessness, a culture of acceptance<sup>1</sup> and environmental marginality (Blowers, 1999). Blowers et al. (1991, p.xviii–xix, 19, 191, 235, 248, 323–324) point out that civil high-level nuclear waste repositories have been notably rejected by greenfield locations. Sites that already host waste sites or other nuclear facilities, and their adjacent communities, remain the only places where repositories may be welcomed. Blowers (1999, pp.241–254; 2002, pp.72–74) state that these sites may welcome nuclear waste partly owing to familiarity with the industry and growth within the nuclear culture, but primarily owing to an aspect of dependency. According to Blowers and his colleagues, nuclear oases are products of unequal power relations and processes of peripheralisation. From the outset, the nuclear industry operates from a position of advantage, owing to a dependent workforce, economic leverage and government support; alternately, communities themselves tend to be remote and economically and politically marginal. Subsequent dependence tends to render communities monocultural and subject to economic risk and relative powerlessness, their fortunes controlled by external influences (Blowers, 1999, pp.247–254, 2002, pp.72–75; Blowers et al., 1991, pp.xviii–xix, 235; see also Marshall, 2005, pp.3–4; Murphy, 2009).

Kuhn and Ballard (1998) also emphasise the aspect of economic dependency, noting that particularly in periods of economic downturn, residents are more likely to identify favourable consequences in hosting a hazardous facility. Chung and Kim (2009) describe a Korean case illustrative of this phenomenon; the paper revealed that among the residents of Gyeongju city, the most important factor in local acceptance of a radioactive waste facility was not risk perception, but perceived economic benefits. Greenberg (2009) has introduced the acronym CLAMP, “concentrating locations at major plants”, to support his analysis of the siting of new nuclear facilities in the USA. According to Greenberg, CLAMP describes a new phase in siting controversial facilities in the USA. It is a pragmatic policy shaped by landownership, national security issues, land-use controls, existing work forces and benefits of agglomeration economies.

The “communities with industry awareness” approach conveys a contrasting interpretation to that presented by Blowers. The NEA (2007) report claims that readiness to consider hosting a radioactive waste management facility should not necessarily be seen as a sign of dependency. Instead, in this approach ‘cultural integration’ is perceived to be a greater underlying factor. Communities that already have nuclear installations within their territory have an existing cultural basis for facility development; these communities have previously integrated the industrial activity and cognitive understanding into their culture. The NEA (2007, p.42) report states that “developing joint solutions consists of building on and adding to that existing cultural basis”. These communities, according to the report, understand nuclear facilities as a means of addressing a problem relating to a familiar energy source. From this point of view, the spent nuclear fuel repository could even be viewed as a point of local pride.

What we wish to emphasise here is the dynamic character of communal understanding. We share the view of Murphy (2009, p.134), who stresses the importance of understanding how different communities establish their own sets of moral norms and mores, and how they affect group understanding of risk and its acceptability. Still, it should be noted that the construction of shared understanding does not take place in a vacuum without the intervention of different parties, or in a necessarily consensual manner. For instance, Lidskog has documented the industry’s determined attempts to create ‘cognitive understanding’ among the local population. Lidskog (1994, pp.98–99) focuses on the information and PR activities of the industry, noting that the cognitive understanding promoted by the industry may not necessarily be taken up by the community. His analysis positions the siting conflict as a struggle between cognitive understandings.

Ultimately, communities that are existing sites of waste storage or production have a level of familiarity with the associated issues, some knowledge of the risks and impacts that nuclear facilities bring, and an interest in continued cooperation with industry. In addition, the nuclear industry is already a fixture within the community. It is hardly surprising that it is easier for the nuclear industry to develop a dialogue with these communities than non-nuclear communities and as “... experience worldwide shows... it is with nuclear host communities that progress in facility siting has been made quickest” (NEA, 2003, p.25). In keeping with this trend, Bergmans et al. (2008, p.62) note that radioactive waste management across Europe has adopted increasingly participatory and voluntary approaches, with a focus on existing nuclear communities. However, they also note that nuclear communities tend to develop various forms of ‘pragmatic acceptance’ (or tolerability) of their fate, rather than enthusiastically embracing the prospect of hosting the nation’s radioactive waste for eternity. ‘Tolerability’, following the

terminology employed by Blowers and Leroy (1994), could also be interpreted as a result of the vicious circle of powerlessness, in part contributed to by the organisational characteristics of the community involved. They note that within the host community a pervasive culture of support for the company may develop from its dependent workers, creating a defence against environmentalist opponents who are perceived to threaten their economic interests.

In this paper, we are interested in the Olkiluoto area in the municipality of Eurajoki<sup>2</sup> as the host of two nuclear power plant units, with a third being under construction and a fourth in the planning phase. TVO, the company that owns and operates nuclear power plant (including the unit under construction), was granted a Decision-in-Principle for the construction of a fourth nuclear power plant unit at Olkiluoto in July 2010 (Kari et al., 2010). TVO also has a pool-type interim storage on-site for spent nuclear fuel, and a low- and intermediate-level radioactive waste repository (where wastes are disposed in the bedrock) at the power plant site. The municipality is also clearly conscious of its nuclear identity, indicated by the municipality's former slogan, "*The most electric municipality in Finland*" and the current slogan, '*Energetic life*'.

### 3 Local opinions on nuclear power

Survey respondents were presented with two statements to gauge their attitudes towards nuclear power: "The construction of more nuclear power in Finland should be allowed" and "The fourth nuclear power plant unit should be constructed at Olkiluoto". Opinions to the statements were given using a five-step Likert scale (from totally agree to totally disagree).

According to our survey, 36% of the residents of Eurajoki and its neighbouring municipalities are in favour of more nuclear power in Finland and 43% are not; of the Eurajoki residents alone, 37% favour more nuclear power and 42% do not. The figures for both Eurajoki and its surrounds are, therefore, essentially the same (Table 1).

With the second statement regarding a fourth nuclear power plant unit, the situation remains very similar, with 36% of the residents of Eurajoki and its neighbouring municipalities favourable towards a fourth nuclear power plant unit being built at Olkiluoto and 45% opposed. Of the residents of Eurajoki, 38% approve of the building of a fourth nuclear power plant unit in Olkiluoto and 47% disapprove (Table 2).

**Table 1** Attitude towards the statement "The construction of more nuclear power in Finland should be allowed" (%)

	<i>Totally disagree 1</i>	<i>2</i>	<i>Neutral 3</i>	<i>4</i>	<i>Totally agree 5</i>
Residents of Eurajoki	32	11	20	18	20
All respondents	31	12	21	15	21

When siting nuclear (and other possible harmful or hazardous) facilities, Not-In-My-Backyard (NIMBY) or Locally-Unwanted-Land-Use (LULU) explanations are often considered to be driving factors (see, e.g., Kemp, 1990; Rabe, 1994). However, when the acceptance figures between construction in Finland and construction in Olkiluoto are compared, it is immediately obvious that there is little evidence of local protectionism

in this case. The suggestion of siting the nuclear power plant unit in the respondents' 'own backyard' in Olkiluoto seems to only slightly polarise opinions (although opposition does increase by a few percent). However, in the case of nuclear waste disposal by Finnish actors other than TVO and Fortum, the local acceptance rate is lower (see Table 7).

**Table 2** Attitude towards the statement "The fourth nuclear power plant unit should be constructed in Olkiluoto" (%)

	<i>Totally disagree 1</i>	<i>2</i>	<i>Neutral 3</i>	<i>4</i>	<i>Totally agree 5</i>
Residents of Eurajoki	36	11	15	14	24
All respondents	34	11	19	14	23

Opinions between men and women differ quite significantly. Almost half (48%) of the men living in Eurajoki agree with the statement "The construction of more nuclear power in Finland should be allowed", while only around a third (32%) disagree. For women, the balance is reversed, with half of women (50%) disagreeing with the statement and less than one-third (29%) agreeing with it. When those living in neighbouring municipalities are taken into the calculation, the gap between men and women becomes more pronounced. Amongst men, 51% agree and 30% disagree, and among women, 54% disagree and 23% agree (Table 3).

**Table 3** Attitude towards the statement "The construction of more nuclear power in Finland should be allowed", comparison between men and women (%)

	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>
Men living in Eurajoki	32	20	48
Women living in Eurajoki	50	20	29
All men	30	19	51
All women	54	23	23

Regarding the second statement, "The fourth nuclear power plant unit should be constructed in Olkiluoto", again almost half (in this case 45%) of men living in Eurajoki agree, whereas a high number (38%) disagree. Of the women, 54% disagree and 32% agree with the statement. When those living in neighbouring municipalities are taken into account, the gap between men and women again becomes slightly more distinct as the number of women agreeing with the statement diminishes. Amongst men, 48% agree and 34% disagree, and of women, 54% disagree and 26% agree (Table 4).

Since 2004, the market research company Taloustutkimus Oy has been conducting surveys for the Finnish broadcasting company YLE to gauge levels of support for additional nuclear power in Finland. According to the report (Taloustutkimus, 2008) carried out at approximately the same time as our survey in 2008, 34% of Finnish citizens approved of and 53% did not approve of more nuclear plants in addition to the plant already under construction. 19% of women and 50% of men supported more nuclear power and 68% of women and 39% of men did not. Compared with figures from our survey, it can be stated that overall support for additional nuclear power is approximately

the same level in Eurajoki and across the country as a whole, but that there is considerably less opposition in Eurajoki, the difference being 11%. The most important difference is with regard to women's attitudes, with 10% more favourable and up to 18% less opposed to the construction of additional nuclear power in Eurajoki than among Finnish women in general.

**Table 4** Attitude towards the statement "The fourth nuclear power plant unit should be constructed in Olkiluoto", comparison between men and women (%)

	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>
Men living in Eurajoki	38	17	45
Women living in Eurajoki	54	14	32
All men	34	18	48
All women	54	19	26

#### 4 Local opinions on threats and the repository

Data analysis of those Eurajoki residents who perceive a clear threat posed by the facility illustrates the magnitude of risk perception among those living in proximity to a spent nuclear fuel final disposal site.<sup>3</sup> In light of the data, we can observe that around one-third (35%) of residents perceive the threat to general safety imposed by the final disposal repository as being explicit or high, with only a slightly lower level of concern for their own or their family's immediate safety (32%). However, the present threat is not deemed as potent by the respondents as the threat to future generations. The final disposal repository is perceived to pose the greatest threat to the health of future generations (57%), the safety of future generations (56%) and the well-being of future generations (51%) (Table 5).

**Table 5** Perception of the threat posed by the nuclear waste disposal facility in Eurajoki (%)

<i>Threat to:</i>	<i>No threat/do not know</i>	<i>Slight threat</i>	<i>Explicit or high threat</i>
General safety	30	35	35
Own or family's safety	37	29	33
Safety of future generations	18	27	56
General health	32	22	46
Own or family's health	32	25	43
Health of future generations	20	23	57
General well-being	40	22	38
Own or family's well-being	40	22	37
Well-being of future generations	24	24	51

The findings of Table 5 show that many respondents do anticipate the final disposal facility to pose future problems. They understand the threat of spent nuclear fuel not only

from the perspective of contemporary generations, but also assess the issue from the view of future generations.

When analysing how safety, health and well-being issues affect acceptance of a spent nuclear fuel repository siting, either in Finland in general or within the locality of the respondent, we can clearly see from Table 6 that perceived threat correlates closely with opposition to the siting. The results of the survey are in line with previous studies (e.g., Easterling and Kunreuther, 1995). While this correlation is strongest with respect to siting the repository within the respondents' home community, it must be noted that this correlation also exists when the respondents are asked about siting spent nuclear fuel on a national level.

**Table 6** Correlations between perceived threats and opinions on final disposal in Finland and in Olkiluoto (Kendal's tau-b)

<i>Threat to:</i>	<i>The SNF produced by TVO and Fortum should be disposed of in</i>	
	<i>Finland</i>	<i>Olkiluoto</i>
General safety	-0.378***	-0.442***
Own or family's safety	-0.383***	-0.449***
Safety of future generations	-0.319***	-0.438***
General health	-0.345***	-0.402***
Own or family's health	-0.370***	-0.412***
Health of future generations	-0.366***	-0.435***
General well-being	-0.362***	-0.406***
Own or family's well-being	-0.348***	-0.407***
Well-being of future generations	-0.368***	-0.428***

\* $0.01 > p \leq 0.05$ .

\*\* $0.001 > p \leq 0.01$ .

\*\*\* $p \leq 0.001$ .

However, Table 6 demonstrates how serious concern for future generations is perceived differently when analysed in conjunction with local attitude towards the siting. People in Eurajoki primarily stress the importance of their own or their family's safety and general safety more than the safety of future generations, although the latter is still ranked highly as a concern in the context of siting the repository in Olkiluoto.

## 5 Acceptance of the final disposal

Analysis of the residents' acceptance of the final disposal and its expansion is based on the following five statements relating to the disposal: Statement 1 (St1) "The nuclear waste produced by TVO and Fortum should be disposed of in Finland"<sup>4</sup>; Statement 2 (St2) "The nuclear waste produced by TVO and Fortum should be disposed of at Olkiluoto"; Statement 3 (St3) "I accept expansion of the final disposal repository for the needs of TVO and Fortum"; Statement 4 (St4) "I accept expansion of the final disposal

repository also for the needs of other Finnish actors”<sup>5</sup>: Statement 5 (St5) “I accept expansion of the final disposal repository for the purpose of importing spent nuclear fuel from abroad”.

The five-step Likert scale used with these statements was changed to a three-step scale to obtain more distinct results. The reported correlation coefficients are Kendall’s rank correlation coefficients (Kendal’s tau-b). Kendall’s tau-b is a non-parametric measure of association that takes ties into account.

The general notion, which can be drawn from Table 7, is that the majority (52%) of Eurajoki residents accept the final disposal of spent nuclear fuel in Finland in principle (St1), but support for the disposal decreases by 10% units (to 42%) when asked whether spent nuclear fuel should be disposed of in their home community (St2). The share of those who accept the disposal at Olkiluoto (St2) is exactly the same as those who accept the expansion of the repository for the needs of TVO and Fortum (St3). In contrast to this, acceptance of the expansion of the repository is quite low (19%) when the respondents are asked to consider the possible needs of Finnish nuclear companies other than TVO and Fortum (St4). Acceptance is almost non-existent (4%) when the respondents are asked to consider acceptance of the expansion to support spent nuclear fuel imports from abroad (St5).

**Table 7** Acceptance of nuclear waste disposal among Eurajoki residents (%)

	<i>St1</i>	<i>St2</i>	<i>St3</i>	<i>St4</i>	<i>St5</i>
Agree	52	42	42	19	4
Neutral	24	22	19	19	6
Disagree	24	36	39	62	90

St1: “Nuclear waste produced by TVO and Fortum should be disposed of in Finland”.

St2: “Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto”.

St3: “I accept expansion of the final disposal repository for the needs of TVO and Fortum”.

St4: “I accept expansion of the final disposal repository also for the needs of other Finnish actors”.

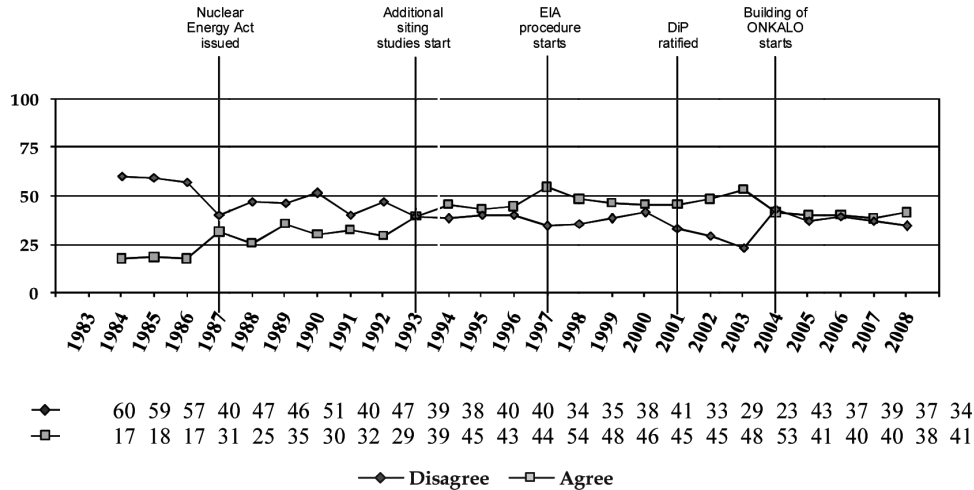
St5: “I accept expansion of the final disposal repository for the purpose of importing SNF from abroad”.

According to Litmanen (1999), ‘pro’ (37%) and ‘anti’ (38%) attitudes towards the siting of a high-level nuclear waste facility in Eurajoki were almost equally common in Eurajoki in 1994. There was also a large group of people (25%) who remained undecided about the siting. Thus, local attitudes towards the siting of a nuclear waste facility seem to be fairly stable, although over time local opinion in Eurajoki has become more positive towards the final disposal of nuclear waste in the Finnish bedrock as shown in Figure 1.

Correlation analysis findings indicate that normal demographic variables do not correlate strongly with the statements regarding acceptance of the spent nuclear fuel repository.<sup>6</sup> Instead, as can be seen from Tables 8 and 9, there are strong correlations between different disposal statements although the statement concerning nuclear waste from abroad (St5) has significant correlation only to the statement concerning expansion for new domestic actors (St4).



**Figure 1** Residents of Eurajoki disagreeing and agreeing with the view that final disposal in the Finnish bedrock is safe (%). Based on data from the annual Energy Attitudes of the Finns (1983) study (see online version for colours)



Source: Kari et al. (2010, p.9)

**Table 8** Correlation between certain background variables and acceptance of the final disposal (Kendal's tau-b)

	St1	St2	St3	St4	St5
Gender	-0.097	-0.190**	-0.159*	-0.132*	-0.092
Education	0.172**	0.145**	0.130*	0.168**	-0.042
Income	0.157**	0.172**	0.138*	0.115*	0.019

St1: "Nuclear waste produced by TVO and Fortum should be disposed of in Finland".

St2: "Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto".

St3: "I accept expansion of the final disposal repository for the needs of TVO and Fortum".

St4: "I accept expansion of the final disposal repository also for the needs of other Finnish actors".

St5: "I accept expansion of the final disposal repository for the purpose of importing SNF from abroad".

\*0.01 > p ≤ 0.05.

\*\*0.001 > p ≤ 0.01.

\*\*\*p ≤ 0.001.

In Table 8, the strongest correlation is between gender and Statement 2, measuring the acceptance of siting spent nuclear fuel at Olkiluoto. The cross-tabulation analysis (no table) reveals a contradiction or tension between the sexes in the local community. The majority of men (52%) share the view that the spent nuclear fuel of TVO and Fortum should be disposed of in their home community, whereas the majority of women (43%) do not approve of the disposal. Disparity between genders can also be found when Statement 3 and Statement 1 are analysed. In the cases of Statements 4 and 5, measuring the acceptance with respect to the needs of other domestic (St4) and foreign players (St5),

the figures are not so dramatic, although women remain more risk averse than men. This is in line with previous findings of social scientific and psychological risk research. The studies have documented well how gender impacts on risk perception (Gustafson, 1998; Finucane et al., 2009; Greenberg, 2009; Sjöberg, 2009). For example, Sjöberg (2009, pp.544–545) has noted that genders differed in precautionary principle attitudes, women being more likely to prefer a more cautious approach to decision making than men. Women tend to express higher levels of concern about environmental and technological risks than men.

The other statistically significant results in Table 8 are between level of education and Statements 1, 2 and 4. Analysis of the correlations show that acceptance of the disposal tends to increase in line with the level of education: from those with basic education only (e.g., 37% agree with Statement 1) to those with a university degree (e.g., 70% agree with Statement 1). Only in the case of imported waste, this does not hold true.

Income levels also show a correlation with attitudes towards nuclear waste disposal. Statistically significant correlations occur between incomes and Statements 1 and 2. An almost linear connection can be found among those who accept the idea of a final repository both in general terms and specifically at Olkiluoto: the proportion of those who agree increases in line with higher income. Of those earning less than EUR 10,000 per year, 35% (St1) or 27% (St2) agree, whilst among the prosperous groups the share increases to 70%. For instance, of those with annual incomes between the EUR 60,000–79,999 band, 78% agree with Statement 2 that the final disposal site should be in their own locality in Olkiluoto.

Correlation between political orientation and the statements is not shown in Table 8 because tau-b as measure of rank correlation was not a suitable method in this case. However, one can find a statistically significant correlation ( $\chi^2(12, N = 141) = 26.48, p = 0.009$ ) between political affiliation and Statement 2 measuring the acceptance of disposal at Olkiluoto. When looking in more detail at the share of affiliates for different parliamentary parties agreeing and disagreeing with Statement 2, a significant majority (65%) of those oriented towards the National Coalition Party<sup>7</sup> approved whereas a large majority of those oriented towards the Finnish Christian Democrats<sup>8</sup> (86%) and the Green League of Finland<sup>9</sup> (83%) disapproved. Jenkins-Smith et al. (2011) found that risk perception in particular was strongly related to political ideology, with conservatives perceiving less risk than liberals. In the case of Eurajoki, this finding appears to fit with those respondents oriented towards the National Coalition Party (generally seen as more conservative) and the Green League of Finland (generally seen as more liberal), but not with the Finnish Christian Democrats (generally seen as more conservative).

Our findings are in line with the observations reported based on a resident survey conducted in Eurajoki in 1994. In 1994, people with more education, more knowledge about the facility, higher incomes and higher occupational positions were significantly more likely to accept the waste facility. By contrast, more ‘anti’ attitudes were found among people with less education, less knowledge about the facility, lower income and a lower occupational status (Litmanen, 1999, pp.215–216). The same social phenomena can also be found in different cultural contexts. Finucane and her colleagues (2009, p.83) describe this as ‘white male’ effect, meaning that white males tend to occupy more positions of power and control, benefit more from a variety of technologies and institutions, are less affected by discrimination, and subsequently see the world as safer than women or non-white males do. Greenberg (2009) also identified a prominent white male effect – linked in the literature to feelings of power and control – in surveying

nuclear sites in the USA. White males are argued to be disproportionately individualistic (rather than communitarian) and hierarchical (rather than egalitarian). According to Greenberg (2009), white, affluent, formally educated males were also familiar with the nearby site, trusted authority and were not overly concerned about nuclear technologies or other local environmental issues.

The figures in Table 9 show how the correlation is greatest between different types of acceptance statements. When considering the statistical significance of the correlation figures, one can see that the only exception is Statement 5. The general notion is that the statements measuring different levels of acceptance towards domestic siting activities are interconnected; however, attitudes towards the idea of foreign imports do not correlate with statements other than Statement 4.

**Table 9** Correlation between different statements on acceptance of the final disposal (Kendal's tau-b)

	<i>St1</i>	<i>St2</i>	<i>St3</i>	<i>St4</i>	<i>St5</i>
St 1	1.000	0.707***	0.587***	0.272***	0.008
St 2	0.707***	1.000	0.684***	0.396***	0.077
St 3	0.587***	0.684***	1.000	0.500***	0.028
St 4	0.272***	0.396***	0.500***	1.000	0.280***
St 5	0.008	0.077	0.028	0.280***	1.000

St1: "Nuclear waste produced by TVO and Fortum should be disposed of in Finland".

St2: "Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto".

St3: "I accept expansion of the final disposal repository for the needs of TVO and Fortum".

St4: "I accept expansion of the final disposal repository also for the needs of other Finnish actors".

St5: "I accept expansion of the final disposal repository for the purpose of importing SNF from abroad".

\* $0.01 > p \leq 0.05$ .

\*\* $0.001 > p \leq 0.01$ .

\*\*\* $p \leq 0.001$ .

## 6 Local opinions on benefits of final disposal of spent nuclear fuel

According to Portney (1985), the theory of compensation assumes that public opposition towards, for example, the siting of a repository, stems from a basic imbalance in an individual's benefit/risk evaluation. Local opposition is assumed to be based on an imbalance between the high personal costs locals are asked to bear, relative to the benefits that accrue for the larger outside population. Thus, these individuals regard their personal losses as outweighing the benefits. The costs consist of various kinds of perceived risks and unwanted impacts (in the case of the Municipality of Eurajoki see: Kari et al., 2010, pp.53–66, pp.88–89, pp.94–95). According to the theory, 'benefit', either monetary or non-monetary, should be expected to redress the imbalance so that compensation given to residents would eventually outweigh the perceived risks. The expected outcome is that any imbalance would be redressed and public opposition

would abate (Portney, 1985). However, the theory of compensation has been criticised by, for example, Frey et al. (1996). They state that an economic theory of compensation is insufficient as it neglects the influence of moral principles; it is argued that a complete theoretical framework must focus on the interplay between moral considerations and market forces. According to the Frey et al. interpretation of the relationship between political and market behaviour, moral issues play a greater role in politics than in the market.

In the survey, two statements were presented concerning the cost/benefit ratio of the spent nuclear fuel repository. The statements were as follows: “The economic benefits of the nuclear waste final disposal will not compensate the non-economic harms” and “The benefits of the nuclear waste final disposal are greater than the harms”.

The figures in Tables 10 and 11 indicate that the majority of Eurajoki residents have a rather negative opinion regarding the benefits of the final disposal of spent nuclear fuel, despite the fact that the Municipality of Eurajoki negotiated a compensation package with Posiva and TVO before approving the repository siting in 2000 (Kojo, 2009b). Almost half of the respondents (47%) agreed with the statement that “The economic benefits of nuclear waste final disposal will not compensate the non-economic harms”. Only one in four (24%) disagreed with the statement. Of the women, 51% agreed with the statement whereas only 19% disagreed. The subsequent statement provided somewhat more positive figures as nearly one-third of respondents (31%) agreed with the statement “The benefits of the nuclear waste final disposal are greater than the harms”. Nevertheless, the majority (40%) of Eurajoki residents disagreed. The disparity of opinion between genders was again clear, with only 23% of female respondents agreeing with the statement against 41% of males. On the basis of these figures, it appears that many residents (particularly men) find that there are some additional benefits besides economic aspects. However, a peculiar element exists in these figures; 41% of men report that the benefits of the nuclear waste final disposal are greater than the harms, but simultaneously, 42% of men deny that economic benefits can compensate for non-economic harms. These figures indicate, first, that men consider benefits from beyond a purely economic perspective and, second, that men do pay attention to the non-economic consequences of final disposal. The question remains: what might these perceived consequences be? Is it possible to draw some conclusions from the figures of Tables 5, 6 and 12? These are questions requiring further research, and are unfortunately beyond the scope of this paper.

**Table 10** Attitude towards the statement “The economic benefits of the nuclear waste final disposal will not compensate the non-economic harms” among Eurajoki residents (%)

	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>
Women	19	30	51
Men	31	27	42
All	24	29	47

According to our survey, acceptance of final disposal is more closely related to the moral views and general well-being of a community, rather than to purely economic issues. Table 12 shows how residents’ estimates about the final disposal repository’s effects on “employment in the area” and “economic development in the area” do not correlate

as closely with acceptance of the final disposal as respondents' estimates about effects on "Own image of the Eurajoki in particular", "Own satisfaction with the area as a place to live" and "Own expectations for the future in the area". Compared with the correlations between aforementioned background variables and the acceptance of final disposal, these correlations are in an entirely different league, even slightly exceeding correlations between perceived threats and acceptance. These types of considerations appear to relate to an even-greater extent to the acceptance of other nuclear facilities; this can be seen, for example, in the strong correlation between the perceived effect on respondents' "own image of the Eurajoki in particular" and their opinion that new nuclear power unit should be constructed in Olkiluoto [ $0,609^{***}$ ,  $***p \leq 0.001$  (Kendal's tau-b)].

**Table 11** Attitude towards the statement "The benefits of the nuclear waste final disposal are greater than the harms" among Eurajoki residents (%)

	<i>Disagree</i>	<i>Neutral</i>	<i>Agree</i>
Women	45	32	23
Men	32	27	41
All	40	29	31

**Table 12** Correlations between certain perceived impacts and acceptance of final disposal (Kendal's tau-b) among Eurajoki residents (%)

<i>Perceived impact to</i>	<i>St1</i>	<i>St2</i>	<i>St3</i>	<i>St4</i>	<i>St5</i>
Own image of Eurajoki in particular	0.394***	0.455***	0.539***	0.343***	0.107
Own satisfaction with the area as a place to live	0.386***	0.442***	0.592***	0.384***	0.117
Own expectations for the future in the area	0.396***	0.424***	0.582***	0.356***	0.067
Economic development in the area	0.336***	0.302***	0.401***	0.250***	0.018
Employment in the area	0.304***	0.274***	0.378***	0.262***	-0.004

St1: "Nuclear waste produced by TVO and Fortum should be disposed of in Finland".

St2: "Nuclear waste produced by TVO and Fortum should be disposed of in Olkiluoto".

St3: "I accept expansion of the final disposal repository for the needs of TVO and Fortum".

St4: "I accept expansion of the final disposal repository also for the needs of other Finnish actors".

St5: "I accept expansion of the final disposal repository for the purpose of importing SNF from abroad".

\* $0.01 > p \leq 0.05$ .

\*\* $0.001 > p \leq 0.01$ .

\*\*\* $p \leq 0.001$ .

## 7 Discussion

It would be convenient to label Eurajoki a 'nuclear oasis'; in the early 1990s, in connection with the financial crisis resulting from the reform of the real estate tax

system, the municipality changed its stance and withdrew its earlier negative statement towards siting a repository for SNF (see, e.g., Kojo, 2009b). This suggests a classic example of economic leverage and highlights the dependency aspect, which the nuclear oases approach emphasises. After withdrawing its earlier statement in 1994 and signing a cooperation agreement with the utility in 1995, the local council of Eurajoki issued a positive statement on the repository siting in 1998 and formal approval in 2000.<sup>10</sup>

Furthermore, the local council has approved the expansion of the repository twice, in 2008 and 2009.<sup>11</sup> However, the positive statements by the local council regarding the applications for expansion cannot be seen as an expression of dependency on the nuclear industry in a straightforward sense; at the times approval for expansion was made, Eurajoki was in a much better economic position than during the 1990s. However, economic considerations almost certainly have a role in the positive attitude of the council, as the municipality is interested in hosting not only the expanded spent nuclear fuel repository, but also the new nuclear power plant units yielding more tax revenues than the sole repository. As such, the statements draw attention to the active partnership between the municipality and the established nuclear industry in Eurajoki.

The development of a partnership between the municipality and the nuclear industry since the mid-1990s (Kojo, 2009b) could be interpreted as a sign that Eurajoki may have an existing cultural basis and understanding for facility development, as the NEA report proposes (NEA, 2007; see also NEA, 2010). The municipality of Eurajoki, therefore, could be seen as an example of a 'nuclear community with industry awareness' as defined in the report. Still, there is complication with both interpretations, as the municipality of Eurajoki has not supported newcomer Fennovoima Oy's plan to dispose of its spent nuclear fuel at Olkiluoto, despite acting in line with the established companies, TVO and Posiva (Kari et al., 2010).

However, the main question of this paper remains how the residents of the municipality of Eurajoki perceive the siting. Is there an understanding towards the industry's aspirations among the local residents? Nuclear-related facilities are often viewed as extreme cases of LULU as nuclear risks are considered dreadful and unpredictable. Despite this, our data shows that while overall support for additional nuclear power is only a few percent higher in Eurajoki compared with the overall country, there is considerably less opposition compared with Finland as a totality. Additionally, opposition against the construction of additional nuclear power increased by only a few percent at the suggestion that Olkiluoto be the site of construction.

This also appears to be the case when measuring the general acceptance of siting spent nuclear fuel in Finland, particularly within the locality of existing, familiar nuclear utilities. At the general level, acceptance of final disposal of spent nuclear fuel in Finland is 52% among Eurajoki residents. Support for the disposal decreases by 10% units (to 42%) when respondents were asked to consider disposal in their home community. Thus, although in Eurajoki there is significant support of the final disposal of spent nuclear fuel, this understanding is challenged when one needs to consider one's home community as a host. This kind of reaction does not accord easily with an industry awareness approach. However, the decrease seems quite incredible considering how many of the respondents felt that repository poses explicit or high threat (see Tables 5 and 6). Acceptance of the expansion of the repository to accommodate the new needs of the power companies TVO and Fortum is also at the same level as the acceptance of the general idea of disposing spent nuclear fuel at Olkiluoto.

In contrast to local acceptance of new nuclear construction by the established 'local' actor, the introduction of both new domestic actors and in particular the idea of importing spent nuclear fuel are certainly resisted. Despite the acceptance appearing to be based on familiarity with the existing actor in the locality, not all domestic<sup>12</sup> nuclear companies are as welcome. This understanding towards the actors already present in the community implies that the industry awareness approach may provide a suitable explanation in this case. However, it seems that this understanding or 'industry awareness' in the municipality cannot be considered as a guarantee of automatic acceptance for the entire nuclear industry's pursuits. Interpreted through the lens of industry awareness, this would imply that acceptance within nuclear communities cannot be automatically attained with respect to all nuclear activities, as the cultural basis of these communities only provides receptiveness to certain actors.

Considering the arguments raised by Wester Herber and Sjöberg (2008), it could be argued that local attitudes in Eurajoki and its neighbours are perhaps more characterised by social trust on existing actors, rather than by epistemic trust on a technological model for final disposal itself. This challenges the scope of cognitive understanding proposed by the industry awareness approach. Thus, it could be interpreted that local attitudes in Eurajoki are based on local relations characterised by a kind of pragmatism suggested by Greenberg (2009) and Bergmans et al. (2008, pp.61–64).

In addition, analysis of the correlations shows that economic considerations alone are not as closely related to the acceptance of the final disposal as outlined by the nuclear oases approach. In this sense, the Finnish case appears to differ from the Korean case (Chung and Kim, 2009), although one must pay attention to the differing research questions and conceptual approaches employed.<sup>13</sup> In the case of Eurajoki, it was verified that there existed some kind of added value brought by the final disposal repository besides economic benefits.

This idea is of key importance, as when framed to include a broader range of benefits, more people determined that benefits brought by the repository outweighed the harms. Research has also shown elsewhere that localised benefits may outweigh perceived risks (Jenkins-Smith et al., 2011, p.12). Regarding the correlations between perceived impacts of the final disposal repository, and opinions about siting and expanding the repository, it is clear that purely economic considerations (economic development and employment, Cronbach's alpha 0.922) are not as closely related to local acceptance of the repository as more a holistic notion of community well-being (e.g., residents' own image of Eurajoki, satisfaction with the area as a place to live and expectations for the future in the area, Cronbach's alpha 0.922). As such, the nuclear industry (or at least its currently present industry actors) is seen as contributing to or being part of the community's well-being. This is consistent with the industry awareness approach's notion of cultural integration, or what NEA describes as a 'sustainable relationship' or 'integrative local partnership'. The NEA report (2007, pp.9–10) refers to "added cultural and amenity value to the local community and beyond", "direct gains in quality of life" and how "making a facility into an important, positive part of its community may be vital for making sure that the facility is understood".

One must also note that understanding for final disposal seems to be more pronounced among certain social groups, even if such correlations are not overly strong. The same social divisions in risk perceptions among the residents of Eurajoki were reported in the 1990s (Litmanen, 1999). The data indicates that a tension or even a contradiction exists between men's and women's attitudes. This does not, however,

alter the fact that economic considerations are not as closely related to the acceptance of final disposal as community well-being; this finding remains true for both genders.<sup>14</sup> Rather, for example, women's perceptions of benefits contributing to the well-being of community are less favourable than men's. As noted in Section 5, Sjöberg (2009, pp.544–545) has argued that women tend to be more precautionary in their attitudes than men in relation to risk. The phenomenon of gendered nuclear waste attitudes is clearly evident in the municipality of Eurajoki.

In addition, there is also disparity of opinion between economically well-off and less prosperous residents. The 'white male' effect (Finucane et al., 2009, p.83; Greenberg, 2009) revealed in our data implies that prosperous people have a more positive attitude towards the siting of spent nuclear fuel, the idea of expanding the repository for the new needs of TVO and Fortum (and to some degree for the needs of other domestic players), and even towards the suggestion of importing spent nuclear fuel. Correlations between economic considerations and acceptance of final disposal are indeed stronger among those earning more; nevertheless, in the cases of disposal of (St2) and expansion for (St3) nuclear waste produced by the established actors, the correlation with general well-being of the community remains stronger than with purely economic concerns.<sup>15</sup> Of note is the finding that more affluent people appear to relate community well-being more closely to economic factors than other groups. For example, among those earning 40,000 euros or more a year, correlation between economic development in the area and residents' own image of Eurajoki is as high as 0.654\*\*\* (Kendal's tau-b) while correlation among those earning less than this amount is 0.444\*\*\* (Kendal's tau-b).

## **8 Conclusions**

In this paper, two different approaches interpreting a nuclear community and its acceptance of the nuclear industry's local activities were introduced. Applying these two different conceptual frameworks to an analysis of survey results yielded interesting findings. It appears that while economic and employment considerations are closely connected to community acceptance of nuclear industry, the straightforward application of the predominant nuclear oases approach may be incomplete in key respects. NEA (2007) raises the concept of well-being: quality of life, and added cultural and amenity value. Indeed, in the case of Eurajoki and its surrounds, acceptance or understanding of the nuclear industry's aspirations appears to be more closely related to well-being than purely economic considerations. This said, the industry awareness claim that acceptance does not depend, or does not primarily depend, on economic considerations (NEA, 2007, pp.41–42) is far from proven, as community well-being indicators are closely related to economic factors.

We acknowledge that focusing on cultural issues over economic factors may be perceived as an attempt to diminish the politically sensitive aspect of dependency, and to adopt a critical stance on the nuclear oases approach. However, we also argue that concentrating on strictly economical necessities and dependency is insufficient in scope; a more holistic approach is required. Following this, our analysis provides an investigation of the presumptions behind the nuclear oases and industry awareness hypotheses, offering scope for future study of nuclear communities. Additionally,



the ‘white male effect’ and its relationship to social acceptance is an area requiring further investigation.

### Acknowledgements

The authors want to acknowledge the anonymous reviewers for their valuable comments and the Finnish Research Programme on Nuclear Waste Management (KYT2010, [www.ydinjatetutkimus.fi](http://www.ydinjatetutkimus.fi)) for funding. The conclusions presented in the paper are solely those of the authors.

The first version of the paper “Threats and benefits. Updated information on local opinions regarding the spent nuclear fuel repository in Finland” was presented and published in the Proceedings of the 12th International Conference on Environmental Remediation and Radioactive Waste Management (ICEM2009) October 11–15, 2009, Liverpool, UK, paper number 16128 (copyright the American Society of Mechanical Engineers, ASME).

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## Notes

- <sup>1</sup>Blowers (1999) describes this as “culture of fatalism, defensiveness and acquiescence” brought by dependence and powerlessness.
- <sup>2</sup>In 2008, Eurajoki had about 5900 inhabitants. The size of the municipality is 459 km<sup>2</sup>.
- <sup>3</sup>The Olkiluoto site is located approximately 15 km away (straight line) from the municipal centre of Eurajoki. The centres of the neighbouring municipalities are located from approximately 15–35 km away (straight line) from the site.
- <sup>4</sup>TVO and Fortum were the operators of the existing four NPP units in 2008.
- <sup>5</sup>The newcomer Fennovoima, which was granted a Decision-in-Principle for an NPP unit in July 2010 (Kari *et al.*, 2010), was already established at the time of conducting the survey in June 2008. However, the name of the company was not brought up in the questionnaire.
- <sup>6</sup>In the case of gender, there is correlation, but only statistically significant correlation (Sex and St2 only 0.192\*\* ( $p = 0.002$ ); see Table 8).
- <sup>7</sup>Liberal conservative political party. The second largest party in the Finnish parliament at the time of the survey.
- <sup>8</sup>Traditional Christian-democratic conservative party. The sixth largest party in the Finnish parliament at the time of the survey.
- <sup>9</sup>Environmentalist party. The fifth largest party in the Finnish parliament at the time of the survey.
- <sup>10</sup>It should also be noted that the local council's approval of the repository in 2000 was already for a larger disposal capacity (6500 tU) than the capacity (4000 tU) approved by the government later in the same year. The additional disposal capacity of 2500 tU was approved by the government, in connection with approval of construction of the OL-3 nuclear power plant unit, in 2002.
- <sup>11</sup>The statements concerned spent nuclear fuel, which would be produced by the OL-4 nuclear power plant unit planned by TVO and Loviisa-3 nuclear power plant unit planned by the power company Fortum. Fortum's unit was rejected by the government in May 2010, and the expansion application by Posiva regarding spent nuclear fuel of that unit alongside it.
- <sup>12</sup>Fennovoima is a Finnish company, however 34% of it is owned by E.ON.
- <sup>13</sup>In the Korean case, economic benefit covered locally perceived image, property value, employment change, cultural, educational and medical facility change and income change (Chung and Kim, 2009, p.12).
- <sup>14</sup>For example, highest correlation between Statement 2 and the questions connected here to community's well-being was 0.483 among men and 0.412 among women, whereas, highest

correlation between St2 and the questions connected here to economic considerations was 0.356 among men and 0.248 among women.

<sup>15</sup>For example, the highest correlation between Statement 2 and the questions connected here to economic considerations was 0.535 among those earning 40,000 € or more and 0.236 among those earning less, whereas, the highest correlation between St2 and the questions connected here to community's well-being was 0.616 among those earning 40,000 € or more and 0.403 among those earning less.