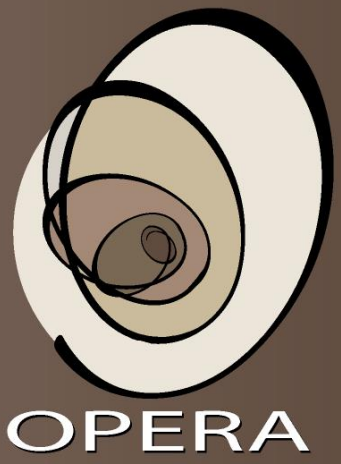

Report on communicating Safety Case results

OPERA-PU-NRG131

Radioactive substances and ionizing radiation are used in medicine, industry, agriculture, research, education and electricity production. This generates radioactive waste. In the Netherlands, this waste is collected, treated and stored by COVRA (Centrale Organisatie Voor Radioactief Afval). After interim storage for a period of at least 100 years radioactive waste is intended for disposal. There is a world-wide scientific and technical consensus that geological disposal represents the safest long-term option for radioactive waste.

Geological disposal is emplacement of radioactive waste in deep underground formations. The goal of geological disposal is long-term isolation of radioactive waste from our living environment in order to avoid exposure of future generations to ionising radiation from the waste. OPERA (OnderzoeksProgramma Eindberging Radioactief Afval) is the Dutch research programme on geological disposal of radioactive waste.

Within OPERA, researchers of different organisations in different areas of expertise will cooperate on the initial, conditional Safety Cases for the host rocks Boom Clay and Zechstein rock salt. As the radioactive waste disposal process in the Netherlands is at an early, conceptual phase and the previous research programme has ended more than a decade ago, in OPERA a first preliminary or initial safety case will be developed to structure the research necessary for the eventual development of a repository in the Netherlands. The safety case is conditional since only the long-term safety of a generic repository will be assessed. OPERA is financed by the Dutch Ministry of Economic Affairs and the public limited liability company Electriciteits-Produktiemaatschappij Zuid-Nederland (EPZ) and coordinated by COVRA. Further details on OPERA and its outcomes can be accessed at www.covra.nl.

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Summary

At the end of the OPERA research programme, the scientific outcomes will be shared with the wider Dutch public by the publication of the *OPERA Safety Case* report that synthesizes the outcome of OPERA. However, the long-term safety disposal of radioactive waste is a question of public concern and comes with controversial views of different stakeholders. Public perceptions regarding this topic are also influenced by the larger public debate on nuclear energy.

In the OPERA project CIP (Communication In Perspective), a communication strategy has been developed to effectively present the outcomes of OPERA to the public. Information needs to be communicated in a clear and comprehensible way, taking into account the complex and technical nature of the results, the sensitivity of the issue and existing public perceptions and frames. Aspects of science communication, perception of risk and geological time scales, and (re)framing are considered. To this end, four case studies were performed to learn from previous experiences in Europe and the Netherlands. Additionally, three communication experts were interviewed about challenges and pitfalls on public communication about radioactive waste disposal.

The findings of the literature review, the case studies and interviews form the basis of a stepwise communication strategy, which is documented in the present OPERA report M1.3.1. It recommends a timely, broad set-up of communication, consisting of a technical safety case report and a condensed version to address a broader public, supported by sufficient background information on the overall context. A corresponding communication toolbox (OPERA Milestone M1.3.1.B) provides concrete guidelines for the implementation of the communication strategy.

Samenvatting

Op het eind van het OPERA onderzoeksprogramma zal het *OPERA Safety Case* rapport gepubliceerd worden, dat een synthese bevat van de verschillende onderzoeksinspanningen binnen OPERA. De veilige opslag van radioactief afval op lange termijn is echter een gevoelig thema met uiteenlopende visies bij verschillende belangengroepen. De publieke perceptie hiervan is bovendien vaak gekleurd door het grotere publieke debat over kernenergie.

In het kader van het OPERA project CIP (Communication In Perspective) is een communicatiestrategie ontwikkeld, om de uitkomsten van de *OPERA Safety Case* op een heldere en inzichtelijke wijze met het brede Nederlandse publiek te delen. Dat betekent dat complexe technisch-wetenschappelijke informatie effectief gecommuniceerd moet worden, rekening houdend met de gevoeligheid van het onderwerp en bestaande percepties en denkkaders bij het publiek. Voor de opzet van de communicatie strategie zijn aspecten als wetenschapscommunicatie, risico-perceptie en *framing* meegenomen. Vier casestudies zijn uitgevoerd om van eerdere ervaringen in Europa en Nederland te kunnen leren, en aanvullend zijn drie communicatie deskundigen geïnterviewd, om uitdagingen en valkuilen in de publiekscommunicatie nader te verkennen.

De conclusies van het literatuuronderzoek, de casestudies en de interviews vormen het fundament van een stapsgewijze communicatiestrategie, die in dit OPERA rapport M1.3.1 is vastgelegd. Aanbevolen wordt om tijdig te beginnen met breed opgezette communicatie, met als hoofdelementen een technische safety case rapport en een gecondenseerde versie voor een breder publiek, ondersteund door voldoende achtergrondinformatie over de

context van de safety case. Een bijhorende *communication toolbox* document (OPERA Milestone M1.3.1.B) biedt concrete handvatten en richtlijnen voor de uitvoering van de communicatiestrategie.

1. Introduction

1.1.Background

The five-year research programme for the geological disposal of radioactive waste – OPERA- started on 7 July 2011 with an open invitation for research proposals. In these proposals, research was proposed for the tasks described in the OPERA Research Plan [2]. This report (M1.3.1) summarizes the results of the OPERA research project *Communication in practice* (CIP), as part of OPERA Task 1.3.1: *Communication Safety Case results*.

1.2.Objectives

In the OPERA research programme, all safety relevant aspects of a given generic reference disposal concept for radioactive waste [1] are evaluated and assessed in order to evaluate the long-term safety of such a facility [2]. The programme follows in general terms the methodology known as '*Safety Case*' [3, 4, 5, 6]. Results of all assessments and their scientific basis will be published in the end of the OPERA programme as a (set of) public accessible OPERA Safety Case report(s), containing a clear safety statement supported by a full set of arguments. The safety case report(s) should contain all necessary information to allow an in-depth review by independent national or international experts, but equally important is that the outcomes of the OPERA Safety Case are communicated in a proper way to a broad range of interested stakeholder and the general public.

There are interesting challenges to address when informing the public about the safety case results. The communication is characterized by the complexity and technical nature of the topic, where messages and information concerning very long-term risks have to be conveyed, in combination with public concerns on radioactive waste, and often superimposed by the discussion on nuclear energy use. In order to address the public in a clear and comprehensive matter, not only the knowledge gap between the laymen and the scientists need to be closed, but also the existing communication frame and public perceptions of radioactive waste disposal has to be taken seriously.

The CIP project explores the possibilities and challenges of the communication of the OPERA Safety Case outcome to the general public. The project seeks an answer to the question '*What is the most effective and responsible way to communicate the Safety Case results of the OPERA project to the general public*'? The main objective of the CIP project is therefore to elaborate a communication strategy that can be used to successfully increase the public's understanding of the safety case outcomes.

1.3.Realization

This report represents Milestone M1.3.1, *Report on communicating Safety Case results* and is the result of the cooperation of a communication professional (Sherpa & De Fries) and a radioactive waste management consultant (NRG). The present report is accompanied by the Milestone M1.3.1.B, *Communication Toolbox* report that provides a concise description of communication tools as a practical stand-alone report for later reference.

In order to formulate a communication strategy that covers all aspects of project presentation and presentation of the safety case outcomes, the study started with a literature study on general aspects of communicating with the public about radioactive waste. Special attention was given to the main challenges such as the current radioactive

waste frame, public perception and communicating complex scientific data. Where appropriate, several aspects were elaborated in more depth. Four case studies were performed, selected on their resemblance with the communication challenges of the safety case. The chosen case studies cover different topics such as trust in scientific results, framing of messages, and direct communication with the public. Interviews with communication experts in the field of public communication, framing and science communication were performed to provide an insider view of the steps that can be taken to obtain the desired communication results.

Building on the solid basis of conclusions and recommendations from the literature study, the case studies and the expert interviews, as central outcome of this study a communication strategy for the OPERA Safety Case is outlined that addresses the challenges and objectives indicated in the previous section. A stepwise approach is proposed, covering aspects as communication objectives, target groups, or key messages and frames, and is combined with a toolbox that supports the implementation of the communication strategy.

1.4.Explanation contents

The present interim report gives a description of the stepwise communication strategy developed in the CIP project. The communication strategy is supported by the outcomes of the literature study, the case study and the expert interviews that present relevant background information to be considered when developing a communication plan. The main target group of this report are communication experts, not per definition familiar to the topic of radioactive waste disposal. Therefore, care is taken throughout the report to provide sufficient explanatory content and background information to allow communication expert to develop a communication plan and to actually perform 'communication'.

Chapter 2 presents the outcome of the literature study and addresses different aspects of and ideas on communication. In Section 2.1, aspects related to the communication of the safety case, as envisaged in IAEA and NEA documents, are summarized. Section 2.2 discusses the role of perception in communication and elaborates public perception on the topic of nuclear topic in general and radioactive waste disposal in particular. Section 2.3 addresses the use of so-called '*frames*' in communication, and Section 2.4 gives a short overview on the communication of complex, scientific issues. In Section 2.5, the perception of risk, radioactive waste and geological timescale is addressed.

Chapter 3 consists of four case studies on communication related to radioactive waste or associated themes, including an analysis of a media campaign of the non-governmental organization (NGO) Greenpeace, the online communication of safety cases by three waste management organizations (WMOs), the offline communication of the Finnish WMO and regulator, and the public debate on the exploitation of shale gas in the Netherlands, as occurred in the autumn of 2013.

Chapter 4 summarized the main lessons learned from interviews with the Dutch communication experts Patricia Osseweijer, Sarah Gagestein and Remco de Boer (an extended summary of the interviews can be found in Appendix 2 - 4).

Chapter 5 outlines the proposed stepwise communication strategy, based on what is learned in Chapter 2 to 4. A *Communication Toolbox*, that provides practical guidelines for the implementation of the communication strategy, can be found in a separate document (M1.3.1.B).

The appendices provide additional information on the interviews performed (Appendix 1 - 4), some observations and lessons learned from the OPERA expert meetings (Appendix 5), a set of target-tool-matrices (Appendix 6), and a short summary of the media monitoring performed within CIP (Appendix 7).

2. Literature study and general aspects on communication on radioactive waste

In the past decades, extensive research has been conducted in the areas of science communication, framing, risk perception and communicating about radioactive waste related topics and related areas to a broad public. In this chapter, the results of a concise review of the literature and scientific research regarding the role of communication about radioactive waste are discussed. A selection of appropriate literature, articles and existing reports on the following topics has been made:

- Risks and challenges of communication on the topic of nuclear technology and radioactive waste. What are the common challenges and pitfalls? What is the current opinion of the Dutch public on these topics?
- Framing and reframing of information. Nuclear technology and radioactive waste is already firmly framed. How does this frame work? What can be done to avoid an existing frame and how do you reframe?
- Science communication. What can be learned from the field of science communication when it comes to communicate the scientific and complex outcomes of the safety case?
- Radiation related risk perception and perception of geologic time scale. What are the working forces behind the risk perception of the public? What effect can they have on the success rate of the communication?

In the next section, aspects related to the communication of the safety case, as envisaged in IAEA and NEA documents, are summarized. Section 2.2 discusses the role of perception in communication and elaborates public perception on the topic of nuclear technology in general and radioactive waste disposal in particular. Section 2.3 addresses the use of so-called '*frames*' in communication, and Section 2.4 gives a short overview on the communication of complex, scientific issues. In Section 2.5, the perception of risk, radioactive waste and geological timescale is addressed. Each section contains a short subsection with conclusions and recommendations.

2.1. Safety Case & communication

The 'Safety Case'-methodology is developed at the end of last century, based on the shared belief that confidence building in the long-term safety is a key aspect in the implementation of geological disposal for radioactive waste. One of the first documents on the safety case methodology published by NEA in 1999 was called "*Confidence in the Long-term Safety of Deep Geological Repositories. It's Development and Communication*" [3], and a safety case is defined in here as

> *"a collection of arguments, at a given stage of repository development, in support of the long term safety of the repository. A safety case comprises the findings of a safety assessment and a statement of confidence in these findings. It should acknowledge the existence of any unresolved issues and provide guidance for work to resolve these issues in future development stages."*

In the last decade, several long-term safety studies were presented, that follows in major lines the methodology described in [3] and [4], e.g. the French '*Dossier 2005*' [7], the Swiss '*Opalinus Clay*' report [8], and the Swedish '*SR-Can*' report [9]. Although the Belgian '*SAFIR 2*' rapport may follow a slightly different approach [10], it can be seen as an informative early example of safety case communication, because it involves besides

technical aspects related to the safety assessments, also safety statements and reflections on uncertainties and remaining open questions[1]. This public report was also reviewed by the NEA ([11]).In this context also the generic safety case report of NDA [12] may be of interest.

Role of communication in the Safety Case

Because communication plays an important role in confidence building in the safety case, statements on communication can be found in several international reports on radioactive waste management. In this section these statements will be briefly discussed in order to reflect common views and expectations on this matter.

In general, access to information is seen as a measure to enhance confidence (e.g. [3]). Not much guidance could be found on *how* to communicate the content; however, it is recognized that different target groups exist that need to be addressed by communication, e.g. expert reviewers, licencing entities, (expert) stakeholders and decision makers or the general public.

Most discussion on the communication of a safety case is related to general notions on the (technical) content and structure of the safety case documentation and that may be taken as first guidelines. In [3], two main parts of a safety case are defined:

- "*A safety assessment, which includes:*
  - *the establishment of an assessment basis in which there is confidence, i.e. the strategy for the building of a safety case, the selection of a site and design, and the assembly of all relevant information, models and methods;*
  - *the application of the assessment basis in a performance assessment, that explores the range of possible evolutions of the repository system and tests compliance of performance with acceptance guidelines;*
  - *the evaluation of confidence in the safety indicated by the assessment and modification, if necessary, of the assessment basis.*
- *The documentation of the safety assessment, a statement of confidence in the safety indicated by the assessment, and the confirmation of the appropriateness of the safety strategy, either in anticipation of the next stages of repository development or in response to interaction with decision makers.*"

and with respect to the documentation, further on in the same document is stated:

"...a successful safety case should, in general, include:
- *a description of the status of development of the assessment basis and the performance assessment findings and an evaluation of confidence in the safety margins indicated by the findings;*
- *a description of the approaches adopted to achieve confidence and a formal statement of that confidence;*
- *feedback to the assessment basis for future development stages and a confirmation of the safety strategy;*

within a system of documentation that is adequate in terms of:
- *completeness;*
- *transparency; and*
- *traceability of the results, via a chain of decisions and calculations, to their sources.*

[1] It is planned to publish a renewed Belgian Safety Case report ('SFC1') somewhere around 2015, which may be revisited in an update of this interim report.

Such a system of documentation facilitates the evaluation of confidence (e.g. by peer review and review by regulators) and thus promotes acceptance by the scientific community and by stakeholders, including the politicians and the public."

NEA [3] also advises to keep the document structure constant over time:

"Interaction with reviewers can be assisted by adopting a system of documentation, the structure of which remains constant with time. The aim is to give reviewers a "historical perspective", enabling them to understand the reasons for the changes that occurred during successive development stages."

Furthermore, it is states with respect to the communication to a broader audience, that it

"*can also be useful to place the findings of a performance assessment in a wider context, and express them in a form that is tailored to the intended audience, that may include laymen and technical audiences outside the waste-disposal field. For example, in the Kristallin-I safety assessment of a high-level waste repository in Switzerland, a "Results in Perspective" report was prepared, in which the doses and associated risks arising from the repository were compared with doses and other forms of radiation (e.g. terrestrial, cosmic, man-made), and with risks associated with toxic materials (e.g. from smoking), ordinary illness and disease, and everyday behaviour that has associated hazards (e.g. flying or driving)."*

Presentation to different target audiences

Generally, the safety case documentation can consist of a main report, a number of underlying technical reports, and additionally, more condensed documents used for public communication, with "*the most extensive and detailed documentation*" aimed at the "*technical audience*", and shorter summaries and brochures for a wider audience [13]. The use of other than printed media (e.g. computer graphics, video) is considered by some organisations ([13]; see Chapter 3.2 and 3.3 for examples on safety case communication by other organisations).

Also the NEA Integration Group for the Safety Case (IGSC) recommends to tailor communication to the different audiences, keeping in mind the importance of confidence building [14]:

"Although the primary audience when presenting a safety case is often considered to be the regulator, there are also other stakeholders with an interest in the safety case. These include political decision makers and members of the public (such as local stakeholders), as well as technical specialists advising external groups and organisations, or the personnel of the implementing organisation itself.

At all stages, however, in order to build confidence on the part of the various stakeholders, a safety case needs to be presented in a style that is understandable and useful to its intended audience. Multiple levels of documentation may be required, ranging from detailed technical reports designed to record all key assumptions and data in a traceable manner to more accessible forms such as brochures and video presentations. All of these documents and presentations describe aspects of only one safety case. The style,

level of detail, arguments and time frames emphasised can, however, be tailored to the target audience [...]. This may require consulting with different audiences in order to understand and clarify their interests, concerns and level of technical knowledge. Their concerns can be different for the different time frames considered in a safety case."

A need for breaking down complexity of results for public communication

As a specific challenge the high complexity of the topic need to be recognized, partially related to the fact that the safety case is a stepwise process, that in case of the early stage of the OPERA Safety Case will contain several unresolved topics and uncertainties. To show that communicating the outcome even in case of a single scenario[2] can be quite complex, the following set of potential (favourable or unfavourable) example conclusions are given [3]:

*"**(a) Consequences are not expected to occur before a given time**.*

There is confidence that the consequences of a scenario will not be encountered within a certain time interval (e.g. those associated with glaciation within 10^4 years and those associated with severe geological disruption within 10^6 years).

***(b) There is confidence that the consequences and likelihood remain below (or within) acceptance guidelines across the ranges of model and parameter uncertainty**.*

Understanding of the scenario is judged to be adequate to bound the consequences. The calculated consequences comply with acceptance guidelines.

***(c) Consequences at or above acceptance limits have been identified, but there is confidence that the likelihood of such a scenario is very low**.*

Understanding of the scenario is judged to be adequate to bound the consequences and to assess likelihood. In some cases, the consequences are above certain acceptance limits, but, due to the low likelihood of these cases, the corresponding risk is acceptably low (e.g. the instantaneous release of ^{129}I - for most system concepts, this would require the unlikely failure of several safety functions; furthermore, in this particular case, the consequences would constitute only a limited hazard to human health).

***(d) Consequences at or above acceptance limits have been identified, but consequences unrelated to the presence of the repository are deemed to be the more important**.*

Understanding of the scenario is judged to be adequate and high potential consequences may occur, but the presence of the repository does not dominate the overall consequences to human health (e.g. meteorite impact, nuclear war).

***(e) Consequences at, or above, acceptance limits have been identified; the likelihood of such a scenario is not known at present**.*

Either understanding of the scenario is judged to be inadequate or models and data are known to be unreliable in some circumstances. Such "open issues" may, in some cases, be addressed by changes to the assessment basis (e.g. further R&D work). In other cases, the uncertainties in completeness, models or data

[2] In order to address uncertainties of the future, several future scenarios will be assessed in OPERA.

may be concluded to be irreducible and are treated, for example, by simplified, stylised representations that are agreed upon by implementers, regulators and other stakeholders (e.g. human intrusion, future lifestyles, and other "what-if" events and the discovery, at later times, of new laws of science that would falsify current models).

(f) Consequences at, or above, acceptance limits have been identified and the likelihood of such consequences is judged to be significant.

Understanding of the scenario is judged to be adequate and there is, therefore, confidence that the problem can be bounded. Performance calculations based on this understanding give results that do not comply with acceptance guidelines. Changes to the assessment basis are required to improve the performance of the system concept."

Conclusions and recommendations

The cited literature gives sufficient hints on the structure, style and content of a safety case's main technical report(s). Together with outcome of OPERA WP2.1, OSCAR, (e.g. [6]), this should provide appropriate guidance for the structuring and publication of the main technical report(s) and their underlying supporting topic reports: this will not further be discussed in this report.

The relevance of proper communication to a broader public is clearly recognized, too, as essential part of "confidence building", and although not much guidance is given on that point, it clearly pinpoints to a broader set of "tailored" communication activities that allow the target audience to understand the safety case outcome and put them into context. Examples of communication activities in other countries can be found in Section 3.2 and 3.3.

2.2. Public perceptions of radioactive waste

In this section we will determine the risks and challenges of communicating about radioactive waste in general and more specifically in the Dutch social context. When dealing with the topic of communicating on the long-term safety of deep underground disposal of radioactive waste, or in this case, the results of safety case, communicators are often confronted with a public that is anxious or worried about nuclear technology, radiation and radioactive waste. At the same time the public is often confused or discouraged by the complexity of the topic. For laymen radioactive waste is associated with long-term, life-threatening hazards for current and future generations. The combination of anxiety with respect to radiation and the attitude towards nuclear power are important determinants of the risk perception. The management of radioactive waste has become one of the major issues with regard to nuclear energy production or other applications of nuclear technologies [15]. Nuclear accidents, the climatic change and discussion on worldwide energy shortage influences the public opinion about the use and risks of nuclear technology while at the same time environmental and other critical movements warn the public about risks and threats. Nuclear technologies are scientifically complex and subject to numerous safety regulations, standards, recommendations and guidelines from national and international sources. Nevertheless, in most countries the general public is largely unaware of the mechanisms to assure nuclear safety [16].

General perceptions on radioactive waste

In a Eurobarometer inquiry in 2008 [17], 89% of the Dutch respondents agreed with the statement that a "*solution for high level radioactive waste should be developed now and not left for future generations.*" 39% totally agreed with the statement that there "*is no safe way of getting rid of high level radioactive waste*", another 24% 'tend to agree', while only 27% 'tend to disagree' (10% did not know). 43% of all Dutch respondents totally disagreed with the statement that deep underground disposal represents the most appropriate solution for long-term management of high-level radioactive waste. 45% of the respondents are most concerned about possible environmental and health effects of a deep underground disposal facility in the neighbourhood, and 26% worry about radioactive leaks during operation. Two-third of the Dutch respondents feels they are not adequately informed on radioactive waste.

The Eurobarometer of 2010 [18] states that "*European citizens are still extremely sensitive to the unknown factors raised by the effects of radioactive waste, whose management and disposal remain a complicated issue.*" The survey results showed further that one of the concerns, responsible for the lack of trust of the interviewees was the hazards related to disposal and management of radioactive waste. It was further concluded that "*knowledge and information are crucial in determining attitudes. While Europeans mainly obtain information about nuclear issues from the mass media, they consider this information to be insufficient. Not surprisingly, citizens would like to know more about radioactive waste management and environmental monitoring procedures*". It was also noted that there is a widespread public demand for better understanding of the decision-making processes concerning the management of radioactive waste disposals [18].

Concerning the information demand the Eurobarometer concludes:

> *"Radioactive waste management and environmental monitoring procedures are the main aspects citizens would like to know more about. Scientists, followed at a distance by national nuclear safety authorities and international organisations working on uses of nuclear technology, are the three most trusted sources of information."*

In 2010, at the request of the Dutch Ministries of Housing, Spatial Planning and the Environment (VROM) and Economic Affairs (EZ), the Netherlands Institute for Social Research (SCP) produced a report on the public perception of nuclear energy, changes in the perception and potential relationships with other topics were anxiety of a larger public plays a relevant role [19, p.14]. The report shows how different events and economic, political and social situations influence the public opinion on nuclear energy and management of radioactive waste.

One interesting aspect of that report is the observation that the decrease in public trust in nuclear technology cannot be accounted for by severe nuclear incidents occurs in the past alone, but that the environmental movement played a relevant, active role in influencing the public perception of nuclear energy. Dekker et al. [19] identified this as the '*minority influence*', where a minority convinces a majority of their '*right*' or their '*preferences*' by being consistent, persistent and forcing the majority to take a position on the topic. The environmental movement has done so by first starting to emphasize the hazards of the nuclear energy production and the emerging waste. Later they also became vocal in their sceptical view on the economic profit of nuclear energy. At that time, shortly after the Chernobyl accident, the environmental and anti-nuclear movements were better informed than the majority of the public. What followed was a public debate that moved from safety issues to economic issues and finally also to ethical issues. The last one includes the disposal and management of the radioactive waste generated by nuclear energy production.

A survey carried out by SmartAgent [20] in 2009 showed that when they confronted a focus group with the word 'nuclear energy', the first association people had with the word was '*danger*' and '*hazard*'. Asked to write down the five words that spring to mind when thinking of nuclear energy the score was:

- '*dangerous*',
- '*waste*',
- '*clean*',
- '*danger*', and
- '*radiation*'.

In a public presentation of the SmartAgent report, one of the authors, M. Wolters, recalled the sessions he witnessed where the interviewees were asked to give their opinion on several future scenarios on nuclear energy in the Netherlands. He noticed that people struggled to form an opinion when confronted with all the different figures and facts and that more than once an interviewee sighed that he or she would rather not think about the problem at all because it was so complicated.

An obvious but not entirely correct conclusion would be that opponents or critics of nuclear technology and radioactive waste storage are misinformed or lack the proper information. According to Dekker et al. [19], a large part of a person's opinion is formed by his or her perspective on a particular topic. The perspective of opponents of nuclear technology focuses on topics like radioactive waste, nuclear terrorism, accidents and uranium mining. Proponents of nuclear see things through an economic-, energy- or climate perspective where they focus on CO_2 emission, secure long-term supply of energy, and economic advantages. The perspective of the public affects how they inform themselves or what information they use in forming an opinion.

Perception and trust

The perception of a topic can be related to trust:

> *"One way people cope with this lack of knowledge is to rely on social trust to reduce the complexity they are faced with [...]. A number of studies showed that for complex technologies trust is related to perceived risks and benefits. Trust influences, for example, perception of gene technology. Trust in companies and scientists performing gene manipulation had a strong effect on the benefits and risks perceived [...]. Although there is broad consensus on the importance of trust, there is no agreement among social scientists on how to conceptualize trust [...]."* [21]

The trust people have in the sender of the message influences the acceptability of that message. In [22], it is stated that:

> "*People's trust in organizations that are responsible for the management of hazardous activities and complex technologies may depend upon several factors, including whether organizations are perceived to be accurate and objective, concerned with the public interest, consistent and predictable, honest and fair, and to have expertise relevant to the issue at hand*".

In Europe, the public considers science as the most reliable source of information on the topic of radioactive waste, in contrast with the nuclear industry, which is considered the least reliable [18]. Furthermore, the Dutch people, in comparison with the average European, have more confidence in the government as a communicator on nuclear topics. In an investigation on carbon capture and storage (CCS), Terwel et al. [23] showed that

Dutch citizens have more trust to environmental NGOs than industrial organizations. In a closer look they found that inferred organizational motives (i.e. organization-serving motives vs. public-serving motives) accounted for this. However, it was also shown in the context of CCS, that the degree of congruence between inferred organizational motives and organizational communications are relevant and that trust cannot be built by simply communicating that their position is based on more positively valued public-serving motives. According to the Eurobarometer 2008 [17], the highest trust on information about the way radioactive waste is managed is given to scientists (51%), while 40% would trust the government or NGOs and only 38% would trust the national agency on radioactive waste management. However, as was shown in [24], the largest trust might be gained when a 'composite body' gives information. On the following question:

> "*The control of the disposal of hazardous wastes requires the involvement of many companies, authorities and government departments. Who would you trust the most to oversee that wastes are disposed of properly:*
> *(a) a government department?*
> *(b) the manufacturer of the waste?*
> *(c) scientists?*
> *(d) environmentalists?*
> *(e) a composite body that includes government, industry, environmentalists, scientists, doctors and academics."*

81% selected option (e).

In [25], Terwel et al. distinguished between two different types of trust in organizations: competence-based trust and integrity-based trust. They showed that people's risk and benefit perceptions and their subsequent acceptance of CCS were more strongly affected when competence-based trust was high. In contrast, the organizational position had a greater impact on people's level of CCS acceptance when integrity-based trust was low rather than high.

In contrast with the general public fear of nuclear technologies, the current storage of radioactive waste at COVRA receives little criticism [13]. COVRA maintains a proactive communication policy towards the local public. Involving the local community by hosting art exhibitions, offering guided tours in the facilities, sponsoring local projects and activities and offering a free of charge museum depot space for local museums are examples of this open communication strategy. Every year, around 3,000 people visit COVRA, about half of which are pupils and students [26].

Conclusions and recommendations

Radioactive waste is one of the major issues for the public regarding the use of nuclear energy or other application of nuclear technologies. Along the same line it is evident that for the Dutch public, '*hazard*' is the first thing that comes to peoples mind when thinking of '*nuclear*' topics. The active approach of the environmental movement and the individual perspective with respect to nuclear technology influence the public perception and opinion relevantly. The public is divided into different perspectives following their own personal interests and concerns. When addressing the public, the communication message should be streamed in accordance with the perspective of the public in order to be accepted or believed.

The perception of communication about radioactive waste has often more to do with trust (message and sender) than with actual facts and figures. Reliable sources of information for the Dutch public are research institutes, universities or the government. The industry is

considered one of the least trustworthy and biased information sources. Most trust is given to 'composite bodies' that represents different societal groups like government, industry, environmentalists, scientists, doctors and academics. It is recommended to perform further research into the sources of information on which people form their opinions about radioactive waste and to what extent they trust these information sources. This will help to identify information gaps or trust issues that need to be addressed in order to take more informed decision about the deployment of resources for the communication strategy. It is recommended to initiate such a survey as soon as possible.

2.3.Framing and reframing of information

Frames are the mental structures that shape the way people view, interpret or valuate the world around them. Incoming information provides cues about where to '*file*' it mentally. People get most information about public affairs from the news media, which, over time, creates a framework of expectation, or a dominant frame. Over time, we develop habits of thought and expectation and configure incoming information to conform to this frame [27].

Language is used as a tool to these conceptual frameworks that are taught while learning language, but can be later shaped by experience and context or modified. The strategic use of words and language influences the way people view and judge reality; words will evoke associations and connotations. Over time, frames are formed. George Lakoff, professor at UCBerkely defines frames and the use of frames as follows [28]:

> "*The elements of the Communication Frame include: A message, an audience, a messenger, a medium, images, a context, and especially, higher-level moral and conceptual frames. The choice of language is, of course, vital, but it is vital because language evokes frames - moral and conceptual frames.*"

A frame thus influences the perception of communication, and sensible usage of frames is essential in order to communicate successfully. Hans de Bruijn [29] gives an example of an unfavourable frame in the communication around the CO_2 storage at the Barendrecht district: by consistently calling the project a '*pilot project*', an unfavourable negative connotation arose among the citizens of Barendrecht where they considered themselves the '*guinea pigs*' of the government. Logically, this didn't help building public confidence and makes communication less effective.

Characteristics of a favourable frame

A favourable frame has the following three characteristics [30]:

- *It's sticky*. This means that the words or the image that the words evoke stays in the mind of the public. A concrete, understandable and meaningful frame will be memorable in the public consciousness.
- *People are willing to agree with the frame*. A good frame appeals to the people. Nobody is against the environment, responsible behaviour or freedom and justice.
- *The frame incites the opponent to react within the frame*. It pulls the opponent into the line of reasoning of the frame. This can even lead to the need for a sequence of reasoning in order to get out of the frame.

In the rhetorical framing used in politics there is also a fourth characteristic in the form of the designation of a '*villain*' or '*loser*' in the frame, most notably the other political party.

Repetition is key in framing. Frames are not generic; people react differently to frames, depending on their background, prior experience or bias. But frames that are used

frequently will anchor themselves in the brains of people, provided they are consequently used and the listener is open for the frame. The chance of this happening is greatest when the frame meets the characteristics mentioned above.

Reframing

Framing is a very effective communication strategy. However, often topics are already linked to an existing frame, making it difficult to introduce a favourable frame successfully. Section 2.2 shows that the communication on radioactive waste management is already firmly framed in the Netherlands, for the most part with negative connotations like '*waste*', '*danger*' and '*problems*'. This frame has been formed over decades and is strongly linked into the publics' conscious and subconscious minds. As is the case with most frames, the public is receptive to information that confirms this frame whereas at the same time they distrust information that doesn't fit the frame. A frame often provides an opportunity to pull the public in a polarized discussion where one is either in favour or against something. This leads to an ideologically charged debate as is often seen in the nuclear energy debate.

Reacting or answering within the frame of your opponent is one of the most common pitfalls in communication. Mistakes are:

- Repeating a negative frame. By using the (negatively charged) words of your opponents, one thus confirms its value;
- Denying the frame ('we are not liars', 'we do not lobby', 'we operate safely'), this only draws the public attention to the frame;
- Giving a solution for a problem that is propounded by the opposition, will only make people aware of the fact that there may be a problem in the first place;
- Repeatedly saying something is '*alarming*'. This has been done in the case of the global warming debate. This can lead to a paradox where the public becomes '*immune*' for the message and will even reach a state of denial when repeatedly confronted with the '*alarming*' news. So instead of inducing a sense of urgency they induce apathy or fatalism.

The Frameworks Institute [27] distinguishes three levels of understanding for people to interpret and evaluate the world around them. The first contain major ideas on societal values like 'freedom', or 'responsibility'. The second level is related to the kind of issue, e.g. 'the environment' or 'health care'. And the third level is related to specific topics like the rainforests or, more close to home, radioactive waste. By appealing to the higher-level values when reframing, it is possible to signal to people how to think about various social issues.

How do you reframe? When put into a frame by an opponent it is important not to go along with the frame or to use the same words. De Bruijn [29] compares the verbal art of reframing with the martial art Aikido: go along with your opponent's move and then reframe it using your own words inducing a change in perspective by using words or views that have emotional or value judgement. A strong example is Martin Luther King's speech "*I-have-dream*" where he reframed his criticism of the discrimination of black residents of the United States to a deeply felt emotion of desire and hope. In the business sector you can see a change of emotion and perception whenever a problem is considered a challenge and failure becomes a learning opportunity.

When building your own (re)frame it is essential to include an emotional appeal, this can be seen as the '*ignition mechanism*' of a frame. Emotions are fuelled by a moral judgement, both negative and positive. By failing to include emotions in your frame, you are giving away an opportunity to positively influence your public in making thoughtful decisions. Using a personal involvement, referring to commonly shared societal values or

using storytelling rather than relying on statistics or proven facts will increase the likelihood of reframing the debate. When including a personal approach in building a frame, it can also be used to unveil a dilemma to the public. By doing so, it is possible to step out of a conflict frame with contradictory viewpoints and move away from a polarized debate to show that a situation or issue is not as clear-cut as it seems. In politics this method is used when a politician is confronted with a perceived inhumane policy. By sharing their personal dilemma (for instance, choosing between evicting asylum seekers or protecting the economy) they compel their discussion partners into their dilemma-sharing frame that leads to the conclusion there is no such thing as a linear reasoning or simple answer. This is a frame that is seldom used in the nuclear debate but could be very useful.

The use of large numbers or calculations in a frame can be tricky. Large numbers tend to enlarge a topic, making it look too big or too scary. When using numbers or calculations in the message or reasoning of a frame it is important to include context or effects. For complex issues like radioactive waste management it is recommended to provide the meaning first, then the numbers. Metaphors[3] and models should be used to support a frame while at the same time numbers should be used sparingly. Numbers are hard to judge or interpret and fail to create '*pictures in our heads*'. In addition, metaphors are highly quotable for news media.

Conclusions and recommendations

The topic of radioactive waste management is already firmly framed over the past decades. The results of the safety case of OPERA will automatically be perceived from the perspective of that existing frame. Section 2.2 shows that the existing frame for radioactive waste includes negative connotations as '*hazard*', '*danger*' or '*problems*'. The case studies in Section 3.1 and 3.4 give further examples which frames are used by an NGO, and what frames are used in discussions on a comparable topic. When forming the communication frame it is the key to steer away from the words and phrases used by the opponents.

The results of the safety assessment part of a safety case will consist of a lot of data and numbers, and the underlying models of a lot of equations. When informing the public it is advisable to avoid using too large or too many numbers but instead focus on personal approach and use of metaphors or stories. Within radioactive waste management, it is recognized that indeed communication of numerical outcomes should be limited to few, meaningful and general understandable indicators that, if possible, can be related to a reference values [31, 32, 33]. Besides, numerical outcomes should be accompanied by a verbal interpretation of the calculation outcome in light of the underlying scientific and experimental support, the so-called '*safety statements*' [34]. Additionally, other communication means that not directly falls into the current content of the OPERA Safety Case are recognized, e.g. so-called '*natural analogues*', comparison with outcomes of alternative assessment approaches, or comparison with familiar risks from everyday live [3, 35, 36, 37].

When building a frame to communicate the results of the safety case, one should make sure the frame appeals to all levels of understanding. In general the high level of social values should be included in all messages, where the lower levels of issue-type, specific issues should be tailored to the audience.

[3] Potential metaphors in this context could be provided by comparison of outcomes with so-called '*natural analogues'*, e.g. studies of archaeological and historical artefacts, ancient buildings, or anthropogenic sources of radionuclides such as nuclear weapons fallout.

2.4. Science communication

Science communication is the art of disclosing knowledge to the public, directly or indirectly. Communicating science and research outcomes to the layman can be done for various reasons. E.g., increasing the public understanding of science in order to progress as a nation or to enlarge the economic market, ensuring a science supported public policy, increasing people's ability to make better personal decisions, adding to the understanding of everyday life or understanding risks.

Previous chapters have shown that the Dutch public considers science as a reliable source when it comes to informing the public about radioactive waste and radioactive waste disposal. The combination of science institutes as a credible sender or a reliable source of information and the complexity of the message concerning the results of the safety case (see examples given in Section 2.1) justify a deeper consideration of the challenges and opportunities of the field of science communication. In the following sections, the opportunities and challenges in the field of science communication are evaluated, focussing on how to convey a complex message. That topic is examined from four different angles that, although somewhat overlapping, highlights different aspects of science communication. Special attention is given to the communication of controversial sciences, and on the issue of information gap and public trust.

Communication models

Science communication is traditionally based on the scientific literacy model, also known as '*Deficit Model*' [38]. The Deficit Model was based on the idea that people need science in order to function in a democratic society. According to that model people lack knowledge. By giving people access to science, this cognitive deficit can be replenished, thus enlarging the scientific literacy of the people. However, if the public does not accept or recognize certain '*facts*', then the failure in transmissions is often blamed on inadequate journalism or '*irrational*' beliefs of the public or both. Because the Deficit Model left out important factors like the context of the targeted audience or the role of framing as discussed in the previous sections, new models were proposed that focus on a more interactive '*audience-based*' approach. These new models acknowledge that other factors like social environment, cultural context, trust and credibility all play a role in the forming of public understanding. The alternative interactive science model, also known as '*constructivist model*' best suits the current science communication. Rather than considering the transmission of knowledge as a linear process, as is characteristic for the Deficit Model, the constructivist model follows a more social process where there is room for uncertainties and the importance of the social and societal context of the audience. The focus moves from transmission to transaction and from a sender-receiver model towards a dialogue with different actors. As a result in the current science communication models, the communicator takes on the role as facilitator and moderator. Nisbet [39] describes this shift in paradigm as follows:

> *"Left behind is the assumption that simply 'informing the public' of scientific facts will meaningfully alter the perceptions of either policy makers or citizens. Instead, one can detect a growing recognition that communication is not simply a translation of facts – it is a negotiation of meaning. In this light, science and its policy implications need to be communicated in ways that address an intended audience's values, interests, and world views."*

The key assumption, that additional knowledge automatically improves the public's attitude towards a technology or subject is proven to be too straightforward. In May 2010 and November 2011 ECN performed a study examining the influence of the scores on a CCS Knowledge Test on attitudes towards CO_2 capture and storage [40]. The report concludes that

> "*it cannot be said that the role of knowledge is unimportant. However, it will also be clear that to improve societal attitudes towards a technology more needs to be done than improving knowledge and correcting misconceptions […]. The present study demonstrates that the role of knowledge in shaping public opinions on transition technologies is limited and that perceptions play a much more important role.*"

Since science communication is not operating in a vacuum but in a context of expert-citizen interaction, companies, environmental organisations and patients groups have established themselves as legitimate sources and providers of science communication in the current society context, all with their own agenda or interest in mind.

The above given considerations lead to the development of more complex communication models, including the 'Multi-model Framework' of Trench [41], combining several different models addressing different aspects of communication (Table 2-1). Although the limitations of the Deficit Model are evident, it still has a place for it in Trench's framework, emphasizing that communication should take place on different levels.

Table 2-1: Trench Multi-model framework (adapted from [41], p.69)

Communication model	Emphasis	Dominant versions in science communication	Aims	Ideological context
Transfer Popularisation (One-way, one-time)	Content	Deficit	Transferring knowledge	Scientism Technocracy Rhetoric of the knowledge economy
Consultation Negotiation (Two-way, iterative)	Context	Dialogue	Discussing implications of research	Social responsibility Culture
Knowledge Co-production (Multi-directional, open-ended)	Content and context	Participation	Setting the aims, shaping agenda of research	Civic science Democracy

In Trench's framework model, three types of expert-public interaction models are presented: the '*Transfer Popularisation model*', the '*Consultation-Negotiation model*' and the '*Knowledge Co-production*' model. The '*Transfer Popularisation model*' is seen as the most traditional communication route where the scientific results are presented to a passive audience without public interaction or dialogue and the focus lies on the content of results rather than the context of the research or the results. At the other end there is the '*Knowledge Co-production*', where the public is actively participating in the entire scientific process, including shaping the agenda of the research and setting of the scientific aims and thus involved in the results. The outcomes of these scientific investigations can be seen as a co-production between the public and scientists. In between these models is the '*Consultation-Negotiation*' model where the public is involved in the discussions about the context and implications of the research, but is not given a decisive role in the research agenda. For each of the models, an ideological context can be defined as basis of the models; a technocratic society will follow a *Transfer Popularisation model*, a culture that aims for social responsibility will most likely follow

the *Consultation-Negotiation* model and a true '*Civic Science Democracy*' will follow a *Knowledge Co-production* model.

Other social conditions that influence the science communication are the degree of public salience of a certain science issue, the visibility and credibility of science institutions and actors involved (see Section 2.2) and the degree of controversy or disagreement among science experts. Emerging trends in popular discourse can also change communication models and the interaction between the public and experts can change over time. Sensitive topics like nanotechnology may start with deficit-like communication in a '*Transfer Population model*' and evolve in dialogue or the other way around.

It should also be noted that true public participation in science and technology could only be achieved when the communication patterns and the aims and ideological contexts match[4]. Trying to establish a dialogue with the audience while at the same time operating in a theocratic context or only focussing on transferring knowledge will not work. Bucchi [41] summarized:

> *"Unlike deficit configurations, participation is also, by definition, multidirectional, open-ended and potentially subject to conflict. Some degree of apprehension for this open-endedness may be regarded as a key factor accounting for the sometimes resurgent temptation, on the part of research bodies and other institutions, to 'tame' unruly public participation through formal initiatives, or bluntly preaching dialogue and participation while practising deficit."*

Science in public media

In the '*Handbook of public communication of science and technology*', Bucchi and Trench [41] name the role of the media as one of the conceptions of public communication of science where the media is seen "*as a channel to convey scientific notions. Often failing because of a lack of competence and/or predominance of other priorities.*" In his paper "*Research shows*" [42], Chris van der Heijden seeks an answer to the question how media and journalists interpret scientific results by analysing 250 articles in three national newspapers that include the common term '*research shows*'. He presents a series of cases where newspapers run articles on scientific results that are incomplete, not sufficiently well explained or just plain wrong. One of the conclusions of this small-scale research is the observation that the newspapers rarely try to get to the bottom of the scientific results, in spite the common journalist practice of hearing both sides. According to Van der Heijden, this can be caused by: lack of public interest, low level of knowledge by the journalist or a lack of time. But also public trust in science and the presumption that everything '*science*' says is true plays a role.

The Young Academy, a forum for young scientists and an independent division of the Royal Netherlands Academy of Arts and Science (KNAW), also mentions the lack of time and effort the media put into the scientific topics that they run in their papers in their report *Between research and Society, recommendations for optimal science communication* [43]. They stress their point that greater attention needs to be paid to the scientific process rather than – as is currently the case – merely focussing on the results of research. Their recommendations concern all the actors: media, scientists, communication departments and science administrators. Integrating the value of science and research into the

[4] Note there is a relevant resemblance of the communication models discussed here with the level of stakeholder participation to be discussed in OPERA W1.2 (ENGAGED/RESTAC). The outcomes of ENGAGED and RESTAC will be considered in a later update of this document (M1.3.1).

programmes for students of journalism and communications as well as an open interaction between scientists and public are recommended. They concluded:

> "*Anyone who wishes to communicate about the effects and value of science must bear in mind its essential features: science develops by asking questions; it is varied and increasingly interdisciplinary, practised by teams, and driven by fascination; and it is not infallible but usually has the capacity for self-improvement. Finally, science is valuable in numerous ways – not merely economically – for individual citizens and for society as a whole.*" [43]

Communicating complexity of science

> *For every complex problem, there is a solution that is concise, clear, simple and wrong. – Twentieth-century journalist H.L. Mencken*

Science communication can traditionally be seen as a continuum where gradual differences can be discerned in the diverse contexts and styles of communication or the reception of the communication. The communication moves from an academic intraspecialist level (empirical, scientific journals) through the interspecialist level (publications in *'bridge journals*', papers) to the pedagogic level ('*textbook science*') and the popular level (daily press, popular science). Typically the communicative path from specialist to popular science removes subtleties and shades of meaning from the knowledge along the way, reducing it to simple facts and certainty, leading in certain cases to public presentations of scientific results that are plainly wrong (see previous subsection). The model can be depicted as a funnel; its narrowest point being the popular level. However, in some cases the discourse does not follow the usual trajectory but passes directly at the public level and influences the academic level [41].

Deviation from the typical communicative path - from specialist publications to popular science - can be done on purpose, e.g. to reach colleagues rapidly or draw academic attention to a specific topic. In these cases non-filtered information is provided to the general public that can help to explain or clarify the topic but they find themselves in "*the centre of the dynamics of scientific production*" [42]. In these situations scientific facts can be dissolved, deconstructed or simply manipulated by social groups for their own purposes.

A widespread conception in the field of science communication is the assumption that science is principally too complex to communicate directly from scientist to laymen. The idea that science is '*too complicated*' for the general public to understand became established particularly as a result of advances made in physics during the early decades of the 1900's. The labelling of science as 'too complicated' can lead to a view where the public is seen as a passive audience with default ignorance, one of the main characteristics of the traditional Deficit Model.

From this conception stems a suggested need for mediators that 'translate' science for the general public. Science journalists, museums and science centres can be seen as mediators in this context. Although mediators play an important social and professional role in the process of bringing science and scientific results to the attention of the public, it can also widen the gap between scientists and the general public. Bucchi [42] warns for the possible implications of this:

> "*It also authorises scientists to proclaim themselves extraneous to the process of public communication so that they may be free to criticise errors and excesses – especially in terms of distortion an sensationalism.*"

By doing so, the 'media' can be blamed as being unable to properly reflect and filter scientific facts. In order to gain control over the communication and to avoid 'deficit communication' the public scientific institutions have make use of public relation communication tools.

Trust in science and scientists

Although scientists are considered a trustworthy source of information compared to e.g. industry or environmental groups as discussed in Section 2.2, the *Special Eurobarometer 2010 Science and Technology Report* [44] also shows that Europeans feel most strongly that scientists cannot be trusted to tell the truth about controversial scientific and technological issues because they depend more and more on money provided by the industry. For the Netherlands 60% of the respondents agree with this view, which is slightly above the European average of 58%. However, there is also a feeling that "*scientists do not put enough effort into informing the public about new developments in science and technology*". From the respondents 54% of the Dutch agree with this statement. The majority of the people think that scientists working at a university or government laboratories are the best qualified to explain scientific and technological developments (73% of the Dutch respondents agrees).

The Eurobarometer shows a need for information and clarity from the public as well as a gap in information where their interest in science and technology issues is not adequately met by the information supply:

> "*The message about science and technology is therefore not adequately communicated, neither to those with knowledge and interest nor to those who have no real science and technology understanding.*"

In 2013 the Royal Academy of Arts and Science explored how trust in science is created and the role of scientific integrity and other factors within that context in response to a request for advice by the Dutch State Secretary for Education, Culture and Science [45]. The Advisory Committee conclusion in this report is that the level of trust in science is still relatively high in the Netherlands when compared to trust in other institutes: science is a '*strong brand*':

> "*There is no evident or serious problem with trust regarding science. The Netherland is still a high trust society. But this conclusion is by no means a reason for complacency […]. Out of precautionary considerations it is important to keep asking ourselves how we can avoid the risk of a decline in public trust.*"

Conclusions and recommendations

There is a need for information and clarity from the public as well as a gap in information supply on the topic of radioactive waste disposal. However, people will base their opinions and decisions not on their knowledge of a particular topic only. Providing rational and factual information alone will not effectively change the level of knowledge of the public nor will it increase its trust or change their view on that subject. Other factors play a role, more specifically social and societal context, trust and credibility as discussed in Section 2.2.

The traditional Deficit Model of science communication still has its use but only when context and perception of the public are applied as well. Scientific results like the results of the OPERA Safety Case will only contribute to acceptance, understanding or support of the radioactive waste topic when the context and backgrounds of the research are

understood. It is advisable to look at the communication of the safety case not in terms of filling in a deficit in knowledge but in offering the public involvement or participation in a dialogue. The Multi-model Framework provides a model for communicating science to a broad public, with the public an interactive actor rather than a passive audience. Following the objectives (discussing implications of the research) and ideological context (social responsibility and culture) of communicating the results of the safety case, the emphasis of the communication should be on the two-way, interactive dialogue as opposed to the Deficit Model or the Participation Model. Given the trust Dutch audience has in science, it is advisable to involve scientific organisations and scientists in the communication.

2.5.Perception of radiation related risk and perception of geologic timescale

In this chapter we evaluate the literature specific related to the perception of risks in general, risk related to radioactive waste, and to the perception of geological time scales.

Risk perception

In recent decades, the enormous development of chemical and nuclear technologies has been accompanied by the potential to cause catastrophic and long-lasting damage to the earth and the life forms that inhabit it. The mechanisms underlying these complex technologies are unfamiliar and incomprehensible to most citizens. Their most harmful consequences are rare and often delayed, hence difficult to assess by statistical analysis and not well suited to management by trial-and-error learning. The elusive and hard to manage qualities of today's hazards have forced the creation of a new intellectual discipline called risk assessment, designed to aid in identifying, characterizing and quantifying risk. Whereas technologically sophisticated analysts employ risk assessment to evaluate hazards, the majority of citizens rely on intuitive risk judgements, typically called '*risk perceptions*' [46].

There are two competing definitions of risk: the objectivists' vision and the constructivists' vision. Objectivists see '*risk*' as the traditional statistic definition of risk as an objective entity, i.e. the probability of an event multiplied by the estimated severity of consequences. In the past decades, the constructivist risk has been on the rise. Constructivist's definition of '*risk*' mainly constitutes by and depends on societal perception. This constructivist turn brought about numerous new studies in sociology and psychology of risk perception, putting emphasis on subjective, qualitative factors [47].

David Ropeik, in his book "*How Risky is it, really?*" [48], warns against the '*perception gap*', the potential dangerous distance between our fears and the facts. The gap can be dangerous because it can cause risky personal behaviour, stress or social policies that don't maximize the protection of public and environmental health. He uses the example of nuclear power to explain how the perception gap shows up in policies that protect people from one risk while at the same time ignore other risks:

> "*For example, our worries about radiation led to regulations that limited the use of nuclear power. So instead we use more coal and oil. But that creates other risks. Burning fossil fuels produce carbon dioxide gas, which is changing the climate of the earth. And it produces microscopic air pollution particles, which contribute to lung and heart problems that kill tens of thousands of people around the world each year.*"

Risk perception research has found that there are several consistent characteristics of risk that form the basis of our perceptions [49]:

- Trust: The less we trust the people who are supposed to protect us, or the people, government or corporate institutions exposing us to risk in the first place, or the people communicating to us about the risk, the more afraid we will be. The more we trust, the less fear we feel.
- Dread: A risk that kills you in a dreadful way evokes more fear than one that kills more benignly. This explains why cancer, an often slow and painful way to die, evokes more fear than heart disease, an equally relevant cause of death. Consequently, hazards that might cause cancer, such as radiation and industrial chemicals, evoke strong concerns.
- Control: If people feel they have some control over the process determining a risk that they will face, the risk will probably not seem as threatening as if it was determined by a process over which you felt you had no control.
- Natural or man-made: Anthropogenic risks evoke more fear than '*natural*' risks.
- Choice: A risk that people choose seems less dangerous to them than a risk that is imposed on them.
- Children: Risk to children evokes more fear than the same risk if it affects only adults.
- Uncertainty: The more uncertain people feel, the more they protect themselves with precaution and fear. If scientific answers are not at hand, or hard to understand or poorly explained, people are left uncertain and, as a result, more afraid.
- Novelty: New risks tend to be more frightening.
- Awareness: The more aware of a risk, the more likely people are to be concerned about it.
- Personal suffering: Will it harm me or my loved ones? Any risk seems larger if one thinks he/she or someone close to him/her could be a victim. This helps to explain why statistical probability is often an ineffective form of risk communication and why the only acceptable level of risk to many people is zero.
- The risk-benefit trade-off: If people perceive a benefit from a behaviour or choice, the risk associated with it seems smaller. If there is no perceived benefit, the risk seems larger.
- Catastrophic or chronic: Hazards that kill a group of people at one time in one place evoke more fear than hazards that may take more lives, but over space and time.

All these characteristics of a risk can either raise or lower people's fear and usually more than one characteristic is involved in the overall perception of a risk. And although the characteristics as listed above appear to be universal perceptions also depend on personal experience, education, lifestyle and other factors.

Risk perception related to radioactive waste

According to Slovic [46] people's deep anxieties related to nuclear technologies in general are

> "*linked to the reality of extensive unfavourable media coverage and to a strong association between nuclear power and the proliferations and use of nuclear weapons. Attempts to 'educate' or reassure the public and bring their perceptions in line with those for industry experts appear unlikely to succeed because the low probability of serious reactor accidents makes empirical demonstrations of safety difficult to achieve. Because nuclear risks are*

perceived as unknown and potentially catastrophic, even small accidents will be highly publicized and may produce large ripple effects."

More specifically related to the topic of radioactive waste, research shows that specific radiation risk, attitude to nuclear power, and the severity of consequences all play an important role in the risk perception of radioactive waste [50].

In 2007 a survey was done of 1351 residents who lived near six American former nuclear weapon sites. The study was one part of an effort to explore what people who live near nuclear weapons facilities worry about regarding the site and other local risks. As it turned out, respondents' greatest concerns were threats to their drinking water, transportation accidents, and worker exposures. Their strongest worries were related to their concern about the quality of the local environment and the feeling that the federal and state governments were not doing enough to protect it [51].

Starting from 2002, the Belgian Nuclear Research Centre SCK·CEN conducts periodical large-scale public opinion surveys ($N > 1000$) among representatives of the Belgian population. The large sample size of the survey allows highlighting general trends and conducting detailed analysis of subgroups of the population. The survey of 2011 [52] showed that the perception of risks related to radioactive waste (or nuclear accidents) is very similar to comparable risks associated to the chemical industry. In 2011 41% of the respondents perceived the risks from radioactive waste as high or very high.

Even more close to home, the Eurobarometer 2008 [17] asked respondents which things would worry them the most in the hypothetical situation that a disposal site for radioactive waste was built in the area where they live. Results showed that are primarily two things that worry the Dutch public: the possible effects on the environment and health (45%) and the risk of radioactive leaks (26%). On the whole, eight in ten Europeans on average confirmed that one of these two issues would worry them the most. Meanwhile, relatively low proportions of the Dutch respondents say that they would be worried about the transport of radioactive waste to the disposal site (16%), the risks due to a terrorist attack (3%) or a drop in property value (7%).

It is worth noting that the phrasing of the question "*which things would worry you most in the hypothetical situation that a disposal site for radioactive waste was built in the area where you live*" would trigger the risk perception characteristics '*personal*' and '*control*'. The situation would affect the respondents personally and they would have had no control in the matter.

The Eurobarometer showed a strikingly unanimous result when the respondents were asked as to what they considered the most worrying aspect of having a disposal site for radioactive waste near one's home. In all countries the potential effects on the environment ranked first, followed by the risk of radioactive leaks [17].

From the socio-demographic variables it can be concluded that females tend to be more concerned about the effects that a disposal site for radioactive waste could have on the environment and on health than males, while the latter group would be slightly more worried than the former group about the transport of radioactive waste and the negative effects that such a disposal site could have on local property prices [56]. Younger groups of respondents and people who see themselves as politically oriented towards the left furthermore seem to find the effects that it would have on the environment and health of greater concern than the group of respondents aged 55+ and those on the right side of the political spectrum, showing that indeed differences in perceptions exists that might be worth to consider when defining a communication strategy. Not surprisingly, respondents

who do not feel well informed about themes related to radioactive waste and those who are opposed to nuclear energy are more likely to worry about the environment and health in the event of a disposal site for radioactive waste being built in their area, that those who are in favour of nuclear energy and those who perceive themselves to be well informed about the issue.

Perception of geologic timescales

A safety case need to address and assess the safety of a repository design over very long periods, '*geological timescales*' (>100,000 years). The Nuclear Energy Agency (NEA) identified a number of topics that can be related to geologic timescales [14]:

- Ethical principles
- Evolution of hazard over time
- Uncertainties in the evolution of disposal system
- Stability and predictability of geological environment

With respect to communication, key findings in [14] were:

- *"limits to predictability concerning the evolution of behaviour of the repository and its environment need to be acknowledged in safety cases;*
- *doses and risks evaluated in safety assessments must be interpreted as illustrations of potential impact to stylised, hypothetical individuals;*
- *arguments complementary to dose and risk are necessary, especially at timescales beyond which quantitative safety assessments can be supported;*
- *the period of a few hundred years following emplacement of the waste may deserve particular attention in information aimed at the general public."*

In [14], it is noted that

> *"time frames can be a central element when structuring the presentation of the safety case. In the interests of clarity, it can be beneficial to discuss each time frame in turn, including the characteristics of the system and how they evolve within a given time frame, uncertainties, and performance with respect to waste isolation and radionuclide containment and releases. When discussing the consequences of releases, related arguments (including, but not limited to, the presentation of safety indicators vs. time) can be presented for each time frame in turn as an alternative to presenting a curve of dose or risk spanning the entire period covered by an assessment.*
>
> *The level of detail of discussion may vary between time frames. This can reflect the level of understanding that is available, the complexity of the events and processes that operate or the interests and concerns of the target audience."*

In [14], it is emphasized that in geological disposal

> *"any releases of radioactivity to the human environment are expected only in the distant future. Most engineered barrier concepts for spent fuel and vitrified high-level waste, for example, are designed to provide an initial period of complete containment over a time frame of at least a thousand years and often considerably longer. Any releases from the engineered barriers that do occur will be limited in magnitude, for example, by the stability of the waste forms, by low solubilities, by slow transport within the engineered barriers and contained by, or greatly reduced by, slow transport through the geosphere."*

However, in [24] it was pointed out that the lay community holds a perception of time not commensurate with the timescales involved in geological disposal. In a student poll it appears that 92% of the respondents have an outer time horizon of 100 years or less when asking how far forward they would think when considering the future welfare of themselves and their family. The same timescale was given when asking after the environmental welfare of the home township. In [24], it was therefore recommended that in communication, attention to the first hundreds of years after waste emplacement should be given.

Geological time scales covered by the safety case should be placed in perspective by comparison with more familiar processes on the surface and subsurface (e.g. duration of glacial periods, see for more examples Fig. 5.12 in [24], p.83). However, this should be done with care to avoid the impression that assessing safety in time frames much beyond other human activities is '*over-ambitious*' [24].

Conclusions and recommendations

It is too simple to just consider the high risk perception of the public with regard to radioactive waste management as '*irrational*' or '*caused by a lack of knowledge*'. Other factors play an important role in the risk perception: lack of control when it comes to siting, perceived catastrophic effects of nuclear accidents, association of radiation with the dreaded disease cancer, risks to children because of the longevity of the waste, man-made nature of radioactive waste, uncertainty about the results and finally trust in government and institutions. With 45% of the Dutch public worried about the possible effects of radioactive waste management on the environment and health it is important to address all these topics because they are often the underlying reasons people are reluctant of fearful when it comes to radioactive waste disposal.

With respect to the communication of geological timescales, it should kept in mind that the time horizon of public perception is in general limited to the first 100 hundred year or less. Although the OPERA Safety Case will look at much larger timescales, concerns over the first hundred years should be carefully addressed. When addressing geological time scales, it should be placed in perspective by comparison with more familiar processes on the surface and subsurface of the earth. It should be explained how uncertainties related to future evolutions (the "predictability" of the future) is addressed by the OPERA Safety Case.

3. Case studies: 'Learning from others'

The challenges in communication described in the previous chapter are not exclusive to OPERA Safety Case, but are of more common nature. Other countries and organisations have faced challenges similar to the ones that will be encountered when communicating with the public on the outcomes of this safety case. In order to profit from prior experiences, four case studies were conducted, and lessons learned are summarized in this chapter.

The first case study (Section 3.1) addresses the communication of anti-nuclear non-governmental organizations (NGOs). The Netherlands has a number of anti-nuclear NGOs that proactively inform the public about nuclear technology and radioactive waste, most notably Greenpeace and the NGO 'Landelijk Kernenergie Archief' (LAKA), that hosts a website that is a frequently used source of information for press, students, researchers and public. Schröder mentions in 2012 in [13], "*the Netherlands has a rather emancipated civil society in general, and an environmental movement that has proved its strength not in the least in the framework of anti-nuclear campaigning.*" Because these organisations have been very active in the framing of the topic of radioactive waste, a campaign of Greenpeace on radioactive waste disposal is chosen as a case study.

In a second case study (Section 3.2), the online communication tools of three European waste management organizations (WMOs) are summarized to get an impression on their presentation of their safety case and supporting information.

The third case study (Section 3.3) analyses non-internet based (or 'offline') communication tools and strategies used by the Finnish WMO Posiva Oy and the Finnish regulator STUK. It focuses on their communication about the siting and the accompanying Environmental Impact Assessment (EIA) of the future geological nuclear waste disposal facility *ONKALO*.

The last case study evaluates the public discussion on shale gas, as came up in the media in the summer of 2013 (Section 3.4). Although not directly related to radioactive waste, this case study was found useful, because it is centred around the publication of a risk evaluation study related to deep underground activities that was intended to be used as input for further decision making. That study was judged to be more relevant to be analysed within this project than the case of CO_2 disposal in Barendrecht, where local opposition was the dominant factor.

3.1. How to win a megaton, anti-nuclear campaign by Greenpeace

In the fall of 2011, Greenpeace Netherlands launched a large campaign against the underground storage of radioactive waste. The campaign was aimed at making people aware of the fact that "*the land they were living on*" could eventually be used as a site for a radioactive waste disposal facility. They targeted the public through direct mailing, social media and a website but also approached all the councils of the municipalities whose underground was assumed to be suitable for deep geological storage. Yellow plastic bags of '*radioactive waste*' were placed on the steps of city halls and councils were asked to vote against siting a disposal facility for radioactive waste in their municipality. An interactive online website was made by Greenpeace, where they presented the Minister of Economic Affairs, Agriculture and Innovation as a '*game host*' who was giving away a free jackpot of '*megatons*' of radioactive waste. In November 2011 dozens of Greenpeace

activists placed warning signs in 64 municipalities in central and southern Netherlands. These signs warn people of the danger of an underground radioactive waste repository.

The message on the website and in the mailings and press releases accompanying the campaign, contained several messages in order to alarm the public [53]:

- the amount of radioactive waste: this concerns thousands of tonnes of waste;
- the government is actively trying to keep the location for a future underground waste disposal secret;
- the geological disposal of radioactive waste is risky.

At the same time the campaign emphasised a strong randomness of site selection by the government, in analogy to a lottery: everybody was able to 'win' the radioactive waste. The public was portrayed as victims that were kept in the dark and being confronted with a policy that takes place behind their backs.

The communication frame can be seen as a 'villain and hero' frame. The working elements of this frame consist of:

- a personal approach: '*see if you are the lucky winner of the radioactive waste*'
- government as villain: '*government and industry won't tell the location*''
- green movement as hero: '*we are unveiling the locations that are kept secret by the government*'

The frame appeals on a high societal level to basic values like responsibility and safety. On a more personal and issue-specific level they appeal to personal health and local activism (be part of the solution).

The fears and concerns that Greenpeace addresses with this campaign were the fear of radiation (underground disposal as a leaking time bomb), a fear of the amount of radioactive waste (thousands of tonnes of radioactive waste) and a fear of losing control (the location of an underground storage is kept secret by the government). The exact nature of the risk (sickness or death related to radiation) is not explained. The feeling of a lack of control strongly influences the risk perception.

At the same time the Greenpeace campaign offered the public an easy solution. On the special designed webpage of the campaign *www.wineenmegaton.nl* [5] people could enter their zip code and see if they were eligible to '*win*' the megatons of radioactive waste. This was based on a map that the consultancy company T & A Survey made on request of Greenpeace [54]: they mapped out the regions where the Boom clay layer satisfies generic conditions for a disposal design in Boom Clay, comparable to what was stipulated in the previous research programme on radioactive waste disposal, CORA (1996-2000, [55, 56]), i.e. regions where the Boom Clay layer has a minimum thickness of 100 meters and the depth of the top of the Boom Clay at least 500 meters[6]. When the '*contestant*' turned out to be living in a municipality fitting the criteria they could sign a petition against radioactive waste and send a public message to their council and government indicating that they were firmly against a radioactive waste disposal facility in their community.

Greenpeace stated in their letters and on their website that the only solution to radioactive waste problem was abandoning nuclear energy. Greenpeace also indicated that there was no public support for underground disposal in the Netherlands. They based this

[5] no longer online
[6] note that CORA assumes a disposal in 500 m depth, in a 100 m thick layer of Boom Clay

on the results of an online survey carried out by Synovate on request of Greenpeace [57].The survey was conducted online between 3 and November 10, 2011 among a representative group of Dutch people aged 20 and older in the provinces of North Brabant (*n* = 479) and Gelderland (*n* = 500).

Keywords and messages used in this campaign

- Life threatening waste
- Megatons of nuclear waste
- Underground storage as a ticking time bomb
- Waste disposal is risky and unnecessary
- There is no public support for radioactive waste disposal

Results of the campaign

Out of the 121 '*suitable*' municipalities that met the Greenpeace criteria for underground storage, 81 councils made an official statement that they didn't want a radioactive waste storage facility in their municipality. By successfully targeting the municipalities on a local level the news focus was stretched over a period of time. Every time a council voted against having a radioactive waste storage in their community, it generated local media attention.

Conclusions

Although the Netherlands is nowhere near the process of siting, Greenpeace choose this angle to engage the public in a national protest against deep underground radioactive waste disposal facilities. The results of the campaign are debateable. There is no information on the amount of visitors, reactions or results of the campaign on the Greenpeace website, nor in their annual reports. The only '*real*' result was that 81 councils officially voted against having a radioactive waste disposal facility in their community. Since the process of choosing a site or building a disposal is still very far away it is questionable that this local government decision will hold up over several decades. What was effective however was the framing of the radioactive waste as "*a problem*" concerning "*megatons of waste*" that "*nobody wanted*" and what was referred to as a "*ticking time bomb*". Given the fact that this frame already existed, the campaign was successful in reinforcing this existing frame.

3.2.Presentation of safety case studies in other countries

A scan of the presentation of safety cases in other countries on the Internet, performed in October-November 2013, learned that the main attention is not given to the safety case reports, but emphasis lies more on the overall implementation process where the safety case report is only one component. The information provided on internet by the Swiss *National Cooperative for the Disposal of Radioactive Waste* (Nagra), the *Belgian agency for radioactive waste and enriched fissile materials* (NIRAS) and the Finnish *Posiva Oy*, the organisation that manages the final disposal of the spent nuclear fuel produced by the nuclear power plants Olkiluoto and Loviisa, is summarized below to give an impression on their presentation of their safety case and supporting information.

Nagra (Switzerland)
On the Nagra site (*www.nagra.ch*), a wealth of information on and around their safety case could be found, under which

- a 6-page brochure '*entsorgungsnachweis HAA auf der basis des projekts opalinuston*', containing two cover pages; one page describing the role of an exploration drill, one page on seismic research in a region foreseen for siting; one page on the host rock, its isolating properties, and the timeline up to date; and one page on research in a Underground Research Laboratory (URL)
- a 24-page summary report on the safety case, '*Projekt Opalinuston. Entsorgungsnachweis für abgebrannte Brennelemente, verglaste hochaktive Abfälle sowie langlebige mittelaktive Abfälle. Zusammenfassender Überblick*' containing five pages of information on the projects background; two pages on the selected host rock and the region where it can be found; two pages on the properties of the host rock; one page with a map of the target region, including geological features; four pages on the disposal concept and the waste to be disposed of; three pages on the safety assessment and its conclusion; a one page conclusion; and a one page list of references on relevant technical background documents
- 24 other public information leaflets and brochures (without counting different language versions) about a variety of topics related to disposal (e.g. about radioactivity, about the effects of regional earthquakes on a disposal, about the selection procedure for the candidate region, about radioactive waste, about common uses of clay)
- three main technical safety case reports (in total 1350 pages), and numerous underlying technical report (not counted, list of reports is 52 pages long)
- newsletters
- about 40 films and animations on different subjects related to radioactive waste disposal
- leaflets about information materials for schools
- reports over themes related to radioactive waste disposal, made by school pupils as part of school projects

NIRAS (Belgium)
Not much reference is found to the SAFIR-2 report, dated 2001, on the NIRAS site (*www.niras.be*). Information directly related to SAFIR-2 consists of:

- technical overview report (278 pages)
- NEA/OECD technical peer review (79 pages)
- several technical background documents

A search on the site for the term '*SAFIR*' results only in a link to the above mentioned reports. A search on "SFC-1" delivered ten reports (but no additional explanatory content). Several other brochures or reports are presented, covering a variety of issues including financial aspects, radioactivity in general, transport, information on public consultations, the national waste management plan, including a updated "strategic environmental assessment report" including a non-technical summary report.

Posiva Oy (Finland)
The English part of the Posiva Oy site (*www.posiva.fi*) has one page dedicated to their safety case submitted in 2012. It contains however only out-dated information:

- four technical interim reports on the safety case dated from 2006 and 2007 (>1100 pages)

- a '*safety case plan*' from 2008 (88 pages) describing the development of the safety case

On the Finnish part of the website ('*Turvallisuusperustelu*'), a more up-to-date list of documents (2012-2013) was found, consisting of

- nine technical safety case reports
- one technical '*synthesis report*' (324 pages)

Other information in support of the safety case communication was comparable to what is already mentioned before, under which five brochures, 41 other publications, 1281 '*working reports*', 216 '*Posiva reports*', two video's, and a quiz for school children. Noteworthy is also the cooperation of Posiva Oy in the awarded documentary "*Into Eternity*" [58] about the Posiva Oy's ONKALO repository, raising fundamental questions on long-term geological disposal, joined with emotive pictures of the *ONKALO* underground disposal facility.

Conclusions

The above examples show that in practice a variety of communication tools are applied in order to inform an interested public on topics related to radioactive waste disposal. The communication aimed to provide information to target audiences of all ages, and different level of knowledge. The use of internet allows to make an overwhelming amount of information available to an interested audience in a very efficient way, supporting traceability of evidences and arguments underlying a safety case's safety statements, and may help to disprove assertions that there is something to hide (see other case studies).

A feature of the Dutch OPERA Safety Case is that it is not initiated by the government as part of a clear stepwise implementation process, with a specific future decision in mind for which the safety case is intended as direct input. In that sense, the publication of the OPERA Safety Case will take place in a more complex societal context: on the one hand it may be helpful when the OPERA Safety Case is not perceived as a report that is 'used' to support an existing policy (see Section 3.4), on the other hand is the societal 'need' behind the safety case more difficult to explain. It will be important to present the necessity and scope of the OPERA Safety Case clearly.

3.3.ONKALO, nuclear fuel repository at Olkiluoto

In this small case study, we investigated the use of offline communication tools. However, the information is limited to communication about the siting and the accompanying Environmental Impact Assessment (EIA) of the future nuclear waste disposal facility *ONKALO*, and not on their recently submitted safety case (see previous section).

The *ONKALO* spent nuclear fuel repository at Olkiluoto was selected in 2000 to become the first European deep geological repository for spent nuclear fuel. It will store solely radioactive waste of the NPPs of Olkiluoto and Loviisa. The managing organization, Posiva Oy, is a joint venture company of the owners of the NPPs (Teollisuuden Voima Oy (TVO) and Fortum Corporation).

The site selection of the Final Disposal at Olkiluoto

The nuclear power programme of Finland consists currently of four NPP units at the before mentioned sites, providing nearly 30% of Finland's electricity, and one reactor under

construction. A survey commissioned by Finnish Energy industries in 2010 showed that 48% of Finns had a positive view of nuclear power and only 17% were negative [59].

Preparations for the final disposal of spent nuclear fuel in Finland began at the same time as the commissioning of the first nuclear power plants in the late 1970s. The schedule for the final disposal was set in 1983, when the Government decided on the objectives and programme for radioactive waste management. The original intention was to dispose of the spent nuclear fuel "*abroad*" and "*in an irreversible manner*" but in 1994, the Nuclear Energy Act entered into force, according to which all nuclear waste must be treated, stored and disposed of in Finland, and no nuclear waste from other countries shall be imported into Finland. After this, Posiva Oy was established to take care of the implementation of the final disposal of spent nuclear fuel and the associated research [60]. From 1993 to 2000, detailed site investigations were carried out at four candidate sites [61], with two of them close to the NPPs Olkiluoto and Loviisa:

- Romuvaara in Kuhmo,
- Kivetty in Äänekoski,
- Olkiluoto in Eurajoki,
- Hästholmen in Loviisa.

All four locations were technically suitable. 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*" [62]. In 1999, Posiva applied for a decision in principle for the final disposal facility to be sited at Olkiluoto. The decision in principle was issued by the Government at the end of 2000 and ratified by Parliament by a 159 to 3 vote in May 2001. 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 [63]. The proposal of Olkiluoto as disposal location has strong local community support, and the Eurajoki Council – which had the right to veto the decision – voted 20:7.

Communication with municipality residents by Posiva Oy

The involvement of the public was an important part of the EIA procedure of Posiva Oy. It was aimed at "*increasing the availability of information to citizen and the possibility to be involved in the matter at a stage where no binding decisions have yet been made.*" [64, p.24*f*]. Posiva considered it important to get as many municipal residents to participate as possible involved in the project discussion and to activate them in respect of current issues concerning the project.

Methods of communication used:

- *Interaction:* public meetings and municipal participation
- *Information:* newsletters, exhibitions, video, newspaper supplements

Public meetings: People were invited to the public events through newspaper ads, letters of invitation sent to each household, invitations in EIA newsletters and invitations to the municipal councils, authorities and environmental board. An outside party chaired the events and kept record. Press representatives were also invited to the public events as well as to discussion working group meetings. The meetings drew media attention on local and regional level but not on national level. When the programme was being drafted, two public events were organized in each municipality. Discussion working groups convened twice in each candidate municipality in the autumn of 1997 and once when the EIA programme was being heard.

Municipal participation: Representatives from the municipalities and Posiva took part in the activities of cooperation and follow-up groups. Each group included a separately appointed EIA contact person. The groups met approximately once every month. The main officials in regional administrations were informed and negotiations were held with them during the drafting stage of the programme.

Newsletter: four EIA newsletters were published in 1997, two in 1998. Approximately 20.000 newsletters were delivered door-to-door. The first newsletters in 1997 included a feedback form. The conclusion was:

> "*Many people found it hard to accept that Posiva makes the investigations required in the EIA-program and informs the citizens, but there were also people who trusted on Posiva's and different authorities' objectivity. Open discussion and impartial informing were considered very important, and inhabitants wanted information besides Posiva also from such organizations who have a critical view towards the project.*" [65]

Exhibitions: With the intent to provide better access and lower the threshold for participation, a touring-bus exhibition was set up in the autumn of 1998. The touring exhibition presented the survey site and the technique to be used in final disposal. A total of 48 locations in 30 municipalities were visited. Interest was poor: in total some 1,500 persons visited the exhibition. Posiva participated with a portable exhibition container in various fairs, exhibitions and public events. Some 65,000 people visited the container exhibition. During summers of 1996 to 1998 the radioactive waste transport vessel Sigyn was used as a floating exhibition: in total some 15,000 people visited the vessel.

Other communications: A video of the final disposal project was produced, a total of 3,500 cassettes were distributed. In 1997 and 1998, local newspapers appearing in the areas neighbouring the investigated locations published Posiva's 4-page informational supplement three times a year.

Trust in the regulator: STUK's communication strategy

Finland's Radiation and Nuclear Safety Authority (STUK) was actively involved in the public communication. STUK considered important that "*especially the local people and decision makers have correct information, understand that information and their attitudes would willingly emphasize safety*" [66]. STUK initiated a study at the Helsinki University to clarify and understand what the local public and decision makers expected from STUK. The study showed that more information was expected about everyday aboveground operational safety issues and problems in a time span of 1 to 100 years and that the public expected STUK to take on an active and visible role:

> "*The results also revealed how differently from experts the local public viewed risks, how local people and media were interested in very pragmatic everyday safety related issues rather than the long term safety challenges that kept experts occupied.*" [67]

STUK developed a strategy for public communication with the basic objective to gain public confidence in the decision-making process and to support local decision makers by improving their factual knowledge base in safety issues. The objective was not public acceptance to the waste disposal as such. Key principles were a pro-active approach, a focus on technical issues related to safety and no views on energy policy, a clear distance from the nuclear industry and the explanation to the public that STUK acted on municipalities' side and was there to promote confidence in the process. Management and experts of STUK toured the four candidate sites and spoke to local media, civic organizations and local decision makers. They participated in events organized with

municipalities such as seminars, high school lectures, panel discussions and media interviews. Press conferences and meetings with journalists were held to give background and information about issues.

Conclusions

While siting is often envisaged as the most challenging part of a disposal implementation, the Olkiluoto case can be seen as a successful example for siting strategy and communication. A timely approach, a transparent process, a profound research into the needs and expectations of the public and the active involvement of the regulator are keys to the successfully siting of the final disposal facility at Olkiluoto. Finland's process for the siting of the repository has specifically been designed to build trust over a very long period of time. By giving the local communities legal right to veto the final decision and by inviting all representatives of the possible locations to present their concerns and perspectives early in the process, the public was actively involved in the process. At the same time the regulator stepped up and took their role as an impartial 'referee' and actively provided factual knowledge and promoted confidence in the decision making process. Thus trust was built in the government, the two organisations involved in the implementation, as well as in the process and evaluation of safety related issues.

It should however be noted, that opposed to the communication of the results of a safety case, the communication tools used in this specific case are focussed on the siting process, with the main target group very localized and clearly defined, as their specific benefits and concerns. Besides, compared to the Dutch public, Finns have a more positive attitude in general when it comes to nuclear power.

3.4.Discussion on the exploitation of shale gas

The public discussion on shale gas, as came up in the media in the summer of 2013, is subject of another short case study. The case study was found useful, because it centred on the publication of a risk evaluation study related to deep underground activities, which was intended as input for further decision making. The public reflection on that risk evaluation study was judged to be more relevant to be analysed within this project than the case of CO_2 disposal in Barendrecht, where local opposition was the dominant factor.

The risk evaluation study report, initiated by the Ministry of Economic Affairs, investigating the potential risks and effects of exploration of shale gas in The Netherlands [68] was published on 26 Augustus 2013. For the present limited case study, special attention was given to the public reactions/discussion in newspapers both in advance and after the publication of the report.

As starting point, a manifest of 55 professors in the national Dutch newspaper *Trouw* was taken [69], published on 23 June 2013, about two month in advance of the publication of the risk evaluation study. In that public letter, the undersigned opposed the use of shale gas, and argued that exploitation of shale gas in the Netherland will lead to "*unavoidable damage to the environment and unacceptable societal risks*"[7], based on research reports of the English Tyndall Centre and the German Wuppertal Institute. It was argued that there is a risk that with the shale gas, a mixture of "*toxic, corrosive, carcinogenic and*

[7] translation by the author. Original quote: "...*onvermijdbare milieuschade en onaanvaardbare maatschappelijke risico's*"

radioactive compounds, like benzene, mercury, arsenic and radon"[8] might contaminate shallow and deep groundwater. Moreover, due to local circumstances, the Dutch shale gas resources are deeper and more difficult to win, production would require a dense network of drilling holes, resulting in a "*very intensive fossil industry*"[9]. The result will be the presence of high drilling towers, heavy traffic, production at day and night, millions of cubic metres of water and thousands of litres of toxic chemicals at each well, resulting in local air pollution, noise, "*landschapsvervuiling*"[10] and an increased risk of earth quakes. They expected the environmental damage to be much larger than the economic benefit.

In August, local stakeholders call the unpublished (draft) report beforehand "*incomplete and unreliable*" [70]. It was criticised that the research was conducted by consultancy companies that have links with gas- and oil industry, and would profit from potential test drillings, and the objectivity of the report was therefore questioned. Furthermore, it was proposed that these companies might handle different criteria on what is safe than the local population would do. In the same issue of the newspaper, the director of a drilling company was cited [71]: "*A test drilling is not meant to assess risks of shale gas exploitation. Based on our geological knowledge and seismic expertise we already know that it is safe.* [...] *The test drilling is neither a research drilling: it is not smaller in scale nor less in depth than a regular drilling.*"[11] In an analysis in [72], it was stated that a commercial TV station reported a few days before publication of the report, that they had insight in a '*secret*' report, and a NGO without any insight in the report classified it as "*broddelwerk*"[12].

Once the report was published, the public reaction was diverse [73]: A water supply company judged the safety assessment as incomplete, because the specific situation in the Netherlands was not addressed. It was mentioned that the risks for the drinking water supply were insufficiently looked at. Jan Rotmans, professor of Transitions and Transition Management, called the report "*not scientific*", and pointed out that the assessment was made by engineers. The statement that risks related to exploitation can be controlled is not been supported by the report, and the statement that risks related to human errors can be avoided by proper training is not scientific sound, because human and technical failures can never be totally excluded. A mayor of one of the communities selected for potential test drilling said that he had heard no new arguments, and an alderman stated that the Minister was acting "*unemotional*", treating the question in a procedural manner, which is not the way to reassure people and create local support. A member of the Parliament criticised that the consultancy companies that prepared the report are not independent, but regularly work for the oil and gas industry [74].

In an editorial comment after publication of the report on 27 Augustus [75] it was mentioned that different stakeholders feared that by following a trail of small procedural steps, on a certain moment exploitation of shale gas will become fact, without ever raising

[8] translation by the author. Original quote: "...*toxische, corrosieve, carcinogene en radioactieve stoffen, zoals benzeen, kwik, arseen en radon,...*"

[9] translation by the author. Original quote: "*zeer intensieve fossiele industrie*"

[10] the Dutch term "*landschapsvervuiling*" describes the depravation of the scenic values of a landscape by pylons, road bridges, high-rise tower blocks, etc.

[11] translation by the author. Original quote: "*Een proefboring is er niet om de risico's van schaliegaswinning in kaart te brengen. Op basis van onze geologische kennis en seismische expertise weten we dat het veilig is. [...] De proefboring is ook geen onderzoeksboring: niet kleiner van opzet of minder diep dan een reguliere boring.*"

[12] poor, sloppy work

the question whether shale gas should be exploited at all. Also the term "*test drilling*"[13] was called misleading, because it actually marks the beginning of exploitation.

Two days after publication of the report the scientific quality of the report was criticized in a letter to the editor [76]. The cited literature was said to be selective, omitting relevant research on harmful effects related to shale gas drillings. Very often, cited literature originates from the oil and gas industry. Translation of results from other countries was judged deficient, because in case harmful effects were found, it was always mentioned that 'this not necessarily has to be the case in the Netherlands'. Potential harmful effects were played down, and the term "*uncertainty*" was mentioned only once in the report. The used fracking chemicals contain toxic, corrosive, carcinogenic and radioactive compounds, but are addressed in the report as an "*auxiliary compound*"[14]. It was also noted that the report argued that by minimizing human and technically errors, risks of groundwater contamination are "*controllable*"[15].

In a letter to the editor one day later [77], it was remembered that also in the discussion about the expansion of Schiphol Airport, a lot of technically discussions were performed, while the need for the expansion was never discussed: it seemed as if this was decided already before the decision-making process was engaged. The author recognized the same pattern in the discussion on shale gas: the question how the exploitation of shale gas relates to sustainable energy supply is neglected, and he expect a "report war" due to which after a few years nobody will be able to see the wood for the trees, and in the end the one report supporting the position of the Minister will be picked out.

In a reaction on a report of the Rathenau Institute on shale gas, a visitor commented on the website [78], that questions of citizens were neglected by the Minister, the public information was poor, and opposing opinions were ridiculed.

Conclusions

The public discussion about the risk evaluation study on shale gas exploitation shows a pattern that is of importance for developing a communication strategy for the publication of the OPERA Safety Case report:

- It is important that the target audience is aware of the role in the overall implementation process of radioactive waste disposal. The public needs to be reassured, that the OPERA Safety Case reports is not just a legitimation of what is already decided in advance. The openness and stepwise character of the implementation process should be emphasized, as well as the openness and continuity of the safety case methodology. Emphasis should also be given to the main objectives of the OPERA Safety Case, i.e. what is the scope and what topics are covered by the current safety case.
- It should also be clarified what topics need to be covered by future safety cases, in order to reassure the audience that their potential questions and concerns are taken serious, even if these are not covered by the current OPERA Safety Case.
- The main assumption that geological disposal is the only solution that is currently considered as safe on the long term, because it does not require human surveillance and intervention, should be explained carefully.

[13] "*proefboring*"
[14] "*hulpstof*"
[15] "*beheersbaar*"

- It is important to avoid the impression that there are '*secrets*', i.e. it must be emphasized that all reports underlying the OPERA Safety Case report's arguments are public (and will remain so in future), a clear timeline exists for the review and publication process, and who is involved in it.
- It should be explained how questions and concerns from stakeholders and the general public will be addressed, in order to assure that this safety case is not a 'one-way' process. Insights from the projects ENGAGED and RESTAC might help to be integrated in such a communication.
- It should be explained what the scientific and societal basis is for judging whether a concept is considered safe or not.
- It should be openly communicated which scientists and scientific organizations are involved, their roles and stakes, and it should be clarified how independence and scientific quality of the safety case results are ensured.
- Public concerns should be addressed and answered proactively, using input from media monitoring or reactions on communication activities before and after publication of the OPERA Safety Case.
- Wording that can be perceived as '*misleading*' should be avoided.
- Potential risks and the existence of uncertainties should be addressed proactively.
- The public should be reassured that siting will not happen in near future, and certainly not without their active involvement. Examples of successful siting procedures could be given, including visualisation on what this means for the communities involved, in order to support the argument that siting should be seen as a question of lower urgency for the current stage of implementation, emphasizing the main objectives of the OPERA research programme.

Summarizing, although a lot of the public concerns are already addressed by the principal structure of the safety case methodology, the above bullets show that the challenge will be to communicate these efforts effectively to the target audience(s).

4. Views and advice from experts

The conclusions and recommendations of the literature study and the case studies provide a basis for the communication strategy of the OPERA Safety Case results. To broaden the view on the communication challenges before drafting the communication strategy, three communication experts have been interviewed on the topic of radioactive waste and safety case communication.

The experts were chosen based on their experiences in the field of framing, public communications and science communication and the following criteria:

- their field of work relates to the communication strategy of OPERA-CIP,
- they have a extensive experience in their field of work,
- they have basic knowledge of the nuclear industry (this was ensured by the provision of background information prior to the interviews),
- they are able to provide a clear advice on the matter, and
- it is expected that insights from their work area will provide a valuable contribution.

The interviewees were asked in a one-on-one interview by telephone to comment on current challenges, possible solutions and pitfalls identified. The open questions are formulated in such a way that they lead to an advice or opinion. Before the interview they were sent one page with background information on the OPERA project, radioactive waste management in the Netherlands and OPERA-CIP (see Appendix 1). A (Dutch) summary of each interview, approved by the interviewees, can be found in Appendix 2 - 4.

In the next sections, the experts are briefly introduced, and a bulleted overview of the most important conclusions of each interview is provided.

4.1.Patricia Osseweijer, professor Science Communication

Patricia Osseweijer is Professor of Science Communication and holds a master's degree in molecular biology (Utrecht University). In 1999 she was appointed Managing Director of the Department of Biotechnology and Executive Secretary for the Research School Biotechnological Sciences Delft Leiden at the Delft University of Technology. She initiated a new research and education group on societal issues related to biotechnology, which led to the establishment of the Section on Biotechnology and Society at the Delft University of Technology. In 2002 Osseweijer was involved in the establishment of the Kluyver Centre for Genomics of Industrial Fermentation and appointed as its Managing Director. She developed the Genomics and Society Programme and became Programme Manager responsible for the coordination of the social scientific research projects. Currently, her research interests focus on the integral and societal sustainability for a bio-based economy, opinion forming and the role of scientists in interaction with the public. She initiated the Imagine Life Sciences Foundation, which she chairs. Osseweijer is the author of *'A Short History of Talking Biotech: fifteen years of iterative action research in institutionalizing scientists' engagement in public communication*'.

The complete interview with Patricia Osseweijer: "Involve others by sharing your problem." can be found in Appendix 2. The main conclusions of the interview can be summed up as follows:

- Communication needs to start early on; the majority of the people have little to no interest in the topic at the outset, but their lack of knowledge and involvement may lead to protest and opposition in a later stage.

- Use entertainment and playful activities to attract the public's attention and approach them on their own perception level. By making a topic tangible the matter is easier to discuss.
- Cooperate with NGO's and point out their responsibilities. Share the problem and let them be a part of the solution.
- Find alternative points of view for the debate, in which not potential risks are leading but the consequences of idleness, e.g. how to deal with the global growing demand for energy or how to handle medical radioactive waste.
- Preferably let the scientists explain the outcomes and backgrounds of their scientific research to the public themselves. Find enthusiastic scientists who are willing to convey the message and facilitate or support them if necessary.
- Involve youngsters as a specific target group in the communication process. This focus is also important because eventually they will have to face the consequences of the choices being made today.

4.2. Sarah Gagestein, framing specialist

Sarah Gagestein is the owner of the language agency *Taalstrategie*. She gives advice to political parties, social organizations and companies on how they can use framing to make their communication clear, persuasive and tempting. She has worked for various political and social organizations and companies like: GroenLinks, Rijkswaterstaat, Reclassering Nederland and Police Rijnland. She graduated *cum laude* from the University of Leiden with an MA in Rhetoric, and holds Bachelor's degrees in Languages and Cultures of Japan and in Communication and Information Sciences.

The complete interview with Sarah Gagestein: "*Lack of knowledge is the problem but definitely not the solution*" can be found in Appendix 3. The main conclusions of the interview can be summed up as follows:

- A negative frame '*sticks*' faster than a positive one. When hearing ten positive facts and one negative fact, people tend to remember the negative one.
- '*Nuclear*' is stronger associated with military applications and nuclear energy, than with innovation or health. This biased association is part of the nuclear frame.
- A dialogue on radioactive waste is impossible without a general debate on nuclear and nuclear energy. The radioactive waste frame is inextricably linked with the bigger nuclear frame.
- A lack of knowledge is part of the problem but knowledge improvement alone is definitely not the solution. Careful explanation is not equivalent with convincing people.
- Framing means letting somebody see things from your point of view and offering a different perspective. To do this, you need to look deeper into why people think the way they do and to examine your own influence on the public.
- As an advocate of your own message you are often 'blind' to the (lack of) knowledge of the public; the so-called '*curse of knowledge*'. Inductive research into existing frames can offer a way out.
- An attempt to reframe only the word '*radioactive waste*' will not work, because the existing frame is too strong. A concrete and illustrative perspective needs to be sketched out, that offers an attractive alternative for the existing frame.

- The complexity of the message can be an advantage when using science as a messenger. Science is viewed by the Dutch as very reliable, this can be a major advantage compared to messengers like politicians and spokesmen of the industry.

4.3.Remco de Boer, engineer and communication advisor

Ir. Remco de Boer studied Engineering at TU Delft. During his studies, he specialized in the marketing of consulting and engineering firms, particularly in the U.S. and Britain. After graduating, he worked for several construction consultancies before he started '*De Boer communications*' in 1996. He works mainly for technical and scientific organizations, governmental authorities and research institutes. De Boer regularly writes about the role of communication in engineering and science. He is a columnist for the engineering magazine *De Ingenieur* where he comments on the topical news coverage of technology and engineering. In the period 2009-2013 he wrote a fortnightly column in *Cobouw*, the newspaper for the construction industry. The Boer is also guest writer for the science magazine of TU Delft. In 2012 he published two books: *'Over communicatie en ander ongemakken'*[16] *en 'Verloren vertrouwen – Lessen uit de Utrechtse asbestzaak'*[17]

The complete interview with Remco de Boer: "*Communication with the public is hard work in the trenches*" can be found in Appendix 4. The main conclusions of the interview can be summed up as follows:

- The term '*public acceptance*' threatens to overshadow the democratic majority if that term is not clearly defined. In that way the debate is captured by opponents and not based on content and democratic principles.
- People are becoming ever more critical and outspoken and more apt to protest. Action groups or resident committees are quickly formed and have a large range.
- Higher availability of information does not automatically lead to more knowledge or understanding of a certain topic.
- In the Internet, one can find documentation and information in support of every argument or reasoning. There is always a report to support one's position.
- During public meetings, the organizers or speakers should be confident enough to appeal to the public when their behaviour or language is inappropriate.
- Public participation will only work when the public is informed in a clear and honest way on the extent of their potential participation, no matter how small this might be.
- Goodwill and sympathy can be achieved by also addressing the negative or disadvantageous aspects in your story.
- Successful public communications starts by deploying self-confident staff members not afraid to take vulnerable positions and willing to enter in debate.

[16] in Dutch. Translation of the title (by the author): '*About Communication and Other Discomforts*'
[17] in Dutch. Translation of the title (by the author): '*Lost Confidence – Lessons learned from the Utrecht asbestos case.*'

5. Communication Strategy for OPERA Safety Case Results


consequences
discussion
management
outcome
programme
information
organisations
competence
long-term
presentation
approach
perceptions
stepwise
implementation
disposal
model
repository
tangible
offline
perception
literature
development
interaction
environmental
safety
OPERA
tools
industry
issues
knowledge
target
background
questions
interest
summarised arguments
stakeholders
environment
roadmap
awareness
report
science
topic
documentation
structure
storage
respect
support
technology
website
honest
assessment
dialogue
perspective
communication
debate
factors
early
field
safe
monitor
analysis
research
media
time
decision
strategy
technologies
efforts
content
result
possible
experts
waste
opinion
basic
site
level
concerns
involved
power
news
question
public
interim
toolbox
focus
facts
key
results
matrix
OSC
fear
challenges
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effects
existing
attitude
geological
cooperation
successful
risk
openness
participation
community
process
frames
publication
citizens
case
study
online
specific
groups
moral
values
objective
personal
local
objectives
campaign
radioactive
acceptance
responsibility
audience
nuclear
chances
message
messages
attention
activities
interview
future
analogues
complexity
confidence
monitoring
understanding
timeline
characteristics

5.1. Introduction

In the previous chapters, a variety of communication related aspects were reviewed. Those chapters aimed at offering information on the many facets of communication to the implementer of the communication strategy, and providing references and a general outline on the specific topic of safety case communication to the communication expert not familiar with the topic. For each topic, a summarizing conclusion was provided that can be used as reference when the actual communication is implemented.

The current chapter concludes this report by presenting a communication strategy for the OPERA Safety Case, consisting of six steps. In the next section, some general considerations are discussed. Section 5.3 gives an overview of the overall approach, and the remaining sections of this chapter describe the different steps in more detail.

5.2. General considerations

The OPERA research programme evaluates and assesses all safety relevant aspects of a given generic reference disposal concept for radioactive waste in order to demonstrate the safety of such a facility. The final OPERA Safety Case report will contain a clear safety statement supported by a full set of arguments. To effectively communicate the outcomes, it is crucial to increase the public's knowledge and understanding of the topic of radioactive waste disposal: from public inquiries and the general coverage of the topic by media it is evident that in the Netherlands the public knowledge about this complex and controversial topic is generally low. This includes not only the understanding of scientific-technical, safety-related aspects, but there is also generally little awareness about the Dutch policy on radioactive waste disposal, the current status of its implementation, the main actors, the purpose of OPERA, and the overall roadmap to disposal implementation.

Proper communication to a broader public is expected to contribute to the overall goal of "confidence building". To increase confidence and trust in the implementing organisation, the public needs to know and understand not only the results of OPERA but also the process and steps that were taken to obtain those results. A need for information and clarity is recognized, and open, clear and meaningful communication to the public about the safety case, the backgrounds, the process and the results is important to attain this objective.

This report strives to offer a communication strategy to effectively present any outcomes of the OPERA Safety Case to a general public. It is acknowledged that the implementation of a communication strategy that allows proper communication needs relevant efforts, larger than what was committed in the past, and most likely involves expertise and manpower currently not available at COVRA. However, in the light of the long interim storage period with a geological disposal facility foreseen not before the 22th century, one of the key questions is: what efforts are necessary and sensible now, and what communication goals should be realized in the next five to ten years? That question is complex, and different visions exist on how much progress has to be achieved in general in the next years. It was already noted in [79] that the lack of a detailed political roadmap for the next decades goes along with a low interest in this matter of most stakeholders and the public in general, which imposes no obvious societal or logistic urgency to develop the topic further, and encourage the tendency to keep the topic of geological disposal 'low profile'.

On the other hand, the OPERA programme creates a noteworthy opportunity to start communication with the general public, and its open structure and methodological

approach allows to provide appropriate answers to many critical voices and concerns (see e.g. Section 3.4). Proper communication in support of the publication of the OPERA Safety Case report can avoid the impression that this report is only part of "*a 'report war' due to which after a few years nobody will be able to see the wood for the trees, and in the end the one report supporting the position of the Minister will be picked out*" (Section 3.4). An active, timely and broad approach to communication avoids misunderstanding and misconceptions, and allows guiding the public discussion on radioactive waste management and geological disposal better than just 'reacting' afterwards, aiming at "damage control". It also offers the opportunity to COVRA to actively work on the public perception as trustable organisation responsible for implementing geological disposal, with a consistent 'story' from the very beginning.

However, the communication strategy elaborated in the remainder of this chapter follows closely the main question of the research plan, i.e. defining what is necessary to successfully communicate the outcome of the OPERA Safety Case, following the objectives explained in Section 5.4, from the point of view of a communication expert. It must be noted that the elaboration of concrete communication activities was beyond the scope of this report, also because no budget and human resources available, or the implementing organisation for the communication strategy was defined: these are crucial elements when developing a communication plan. Therefore, a broad approach on the subject was chosen in order to provide a sound basis for a communication strategy. This way the report provides guidance and advice that allows the implementing organisation to make the necessary choices when designing their communication strategy.

Table 5-1 gives an overview of the main challenges for communication that are identified for the specific context of the OPERA Safety Case. It also proposes approaches to address these challenges and references to the related sections in this report.

Table 5-1: Main challenges identified for communication the OPERA Safety Case, proposed approach and references to the related sections in this report

Challenge	Proposed approach	Reference
A decision on the communication efforts and scope has to be made.	Develop several scenarios for communication with accompanying risk analysis. Develop a roadmap for the next decade: how will COVRA be perceived by the public?	Section 5.1 Section 5.8
The public has little awareness of the current status of radioactive waste management.	Start public communication timely. Define target groups and tailor messages. Focus on the context and applications that lead to radioactive waste management by using the frames.	Section 2.2 Section 3.2 Section 3.3 Section 5.6
The public has insufficient knowledge of the scientific and/or technical aspects.	Commit to public involvement and participation. Focus on the implications of the research and ideological context.	Section 2.4 Section 4.1 Section 5.6
The public considers the question 'too complex'.	Use key messages and frames that appeal to the audience.	Section 2.3 Section 5.6 Section 4.2
There is insufficient trust in the communication source.	Consider a composite body or cooperation with other scientific or governmental organisations when communicating with the public.	Section 2.2 Section 2.4 Section 4.3
The public has little to no interest in the topic.	Use proposed frames to find a perspective that follows the personal interest and concerns of the public.	Section 2.2 Section 4.1 Section 3.1

The elements summarized in this report can be used as building blocks: implementing all tools and activities would require relevant human and financial resources, and of course doing the bare minimum would make it very hard to achieve any objectives. Using the message frames and key messages, the implementer can narrow down their strategy and choose which tools and activities to use, depending on the available resources. Top priorities for building an effective communication strategy would be:

1. Timing: It is important to perform clear and comprehensive communication with the public not only at the end of a research programme but also during the research period or even at the start of a program. Even if the public seem to have little to no interest in the topic, it is foreseeable that a lack of knowledge and involvement will lead to protest and opposition in a later stage of the process. Lessons on this can be learned from public communication on biotechnology (Chapter 4.1) anti-nuclear information campaigns (Chapter 3.1), and the effects of a successful public dialogue (Chapter 3.3). Although OPERA itself is currently in its final phase, it is at the same time the onset for the next iteration of the safety case and accompanying research activities. It is therefore advisable to start communication as soon as possible.
2. Effective frames: When developing the communication strategy following the six steps of the roadmap as will be outlined in the remainder of this chapter, it is advisable to use one or more frames (Section 5.6) to engage the public, especially when the public is not involved or even uninterested in the topic. All external communication tools (Appendix 6) like graphic designs, videos, public website, public events or other activities should be expressed in these frames, and all three frames defined in Section 5.6 can be applied right now, independent from the actual outcome of the OPERA Safety Case.
3. Building trust: When communicating to the public, not only the message but also the source of information plays a crucial role in the perception of the public (Chapter 2.2). A timely and proper communication to a broader public is an essential part of confidence building. COVRA has a good track record when it comes to communicating with the local communities and would be well equipped to take the lead in the public communication, preferably in close cooperation with other parties involved in the research. This does require a clear communication about the roles and responsibilities of the different organisations.

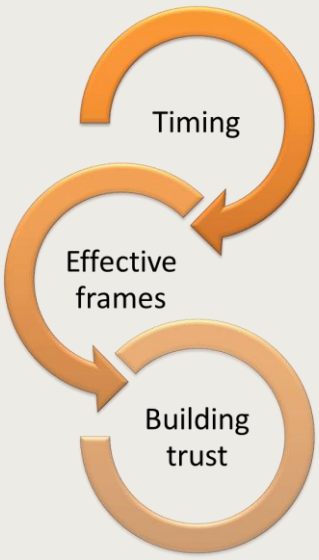

Figure 5-1: Top priorities for communicating the OPERA Safety Case

5.3.A stepwise approach

Providing comprehensible information on the context and background of the OPERA research programme and the underlying radioactive waste policy is an important foundation of the proposed communication strategy provided in this chapter. The proposed strategy is based on the lessons learned of the literature study (Chapter 2), the lessons learned from the case studies (Chapter 3), and takes into account the advice of the interviewed experts (Chapter 4). The communication strategy is presented in a stepwise manner, and focuses on a pro-active communication approach in which communication activities will be performed long before the actual publication of the OPERA Safety Case report, and the use of a variety of communication tools is recommended. The main elements of the communication strategy are outlined in a way that allow to develop and execute a communication plan, based on existing financial resources, staff competence and other logistic choices. The main ambition of the communication strategy is to successfully increase the public's knowledge and understanding of the safety case's outcomes. More detailed objectives for the communication strategy are formulated in the next section.

The following stepwise scheme towards the set-up a communication plan and the actual performance of communication is proposed:

Step 1: Determine communication objectives
Formulate and prioritize the quantifiable goals of the communication strategy of the OPERA Safety Case Results. Focus questions are:

- What do we hope to gain by the communication plan?
- What do we want to change in the public, behaviour, knowledge, and understanding?
- What are the underlying reasons for these objectives?

Expected result: One or more clearly formulated objective(s); specific, measurable and with timeframe.

Step 2:Determine target groups
Dividing the general audience into several target groups will help focus the communication efforts. Focus questions are:

- Who are we talking to and how?
- Which target groups are both manageable and effective when communicating with a large general audience?
- What specific characteristics do we have to take into consideration?

Expected result: Two or more target groups defined by their characteristics that will enable focused and effective communication.

Step 3:Determine key messages
Formulate the key messages based upon the previously determined communication objectives taking into account the acquired knowledge from the literature and experts' advice on framing and strategic use of language. Focus questions are:

- What are the pitfalls we need to avoid?
- How can the message appeal to the target groups?
- How do we frame the message?

Expected result: A set of clearly formulated key messages for the previously defined target groups with substantiated arguments.

Step 4:Determine tools and activities
Constructing a 'target-tool-matrix' based upon the target groups and objectives. Analyse the possible or desired messengers and representatives of the key messages taking into account the regulatory and societal framework. Focus questions are:

- What are the best communication tools for the key messages and target groups?
- What are the requirements for successful implementation?

Expected result: Target-tool-matrix, the basis for the Communication Toolbox.

Step 5:Assess risks and chances of communication
Further consideration of the potential risks and challenges related to the chosen strategy. It is advisable to make a complete assessment in conjunction with a communication plan. Focus questions are:

- What internal or external factors could negatively affect the communication strategy?
- How does it impact the objectives?
- Under what circumstances is it advisable to revise the communication strategy or its objectives?
- What internal or external factors can positively affect the communication objectives?
- How can we make optimal use of them?

Expected results: A basic analysis of the risks and chances and opportunities.

Step 6:Evaluate the communication
Consider timely possible evaluation methods and moments after and during the communication to gain insight into potential areas of further research. Focus questions are:

- How and when do we measure the effect of the communication strategy?
- What are the preferred moments in time for adjusting the communication strategy?
- What other research can or should be done in the future?

Expected results: A recommendation on how and when to evaluate the communication strategy and further research opportunities.

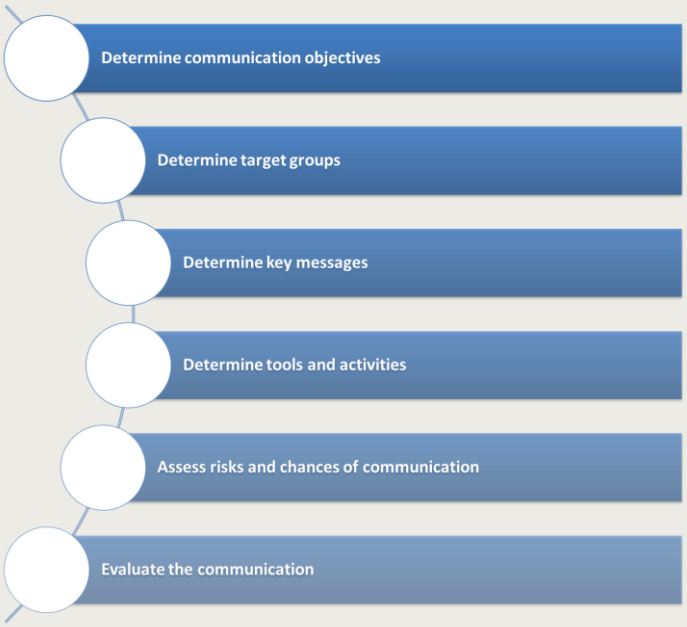

Figure 5-2: Stepwise approach for communicating the OPERA Safety Case

These six steps are summarized in Figure 5-2 and described in more detail in the next sections.

5.4. Communication objectives

The primary objective of the communication strategy is to inform the public on the results of the OPERA Safety Case. This is a responsibility more specifically; the goal is to ensure that the public understands not only the outcomes but also the role of the safety case in the disposal implementation process in the Netherlands and the context of the OPERA Safety Case (see conclusions of Section 3.4). As discussed in Chapter 2, the objective is not a change in opinion or a change of attitude towards radioactive waste management of the public, but imparting knowledge and understanding of the topic of the OPERA Safety Case, the context in which it has taken place and its role in the overall process. Scientific results like the results of the OPERA Safety Case will only contribute to acceptance, understanding or support of the radioactive waste topic when the context and backgrounds of the research are understood.

When effective, the communication strategy will lead to public trust in the results of the safety case and inform the public well enough to allow them to form their own opinion on the topic. The public then will be aware of the stepwise process of a safety case and have a basic knowledge of radioactive waste. They will be aware of the objective of the OPERA Safety Case, which is to provide input for further research rather than presenting a final statement on the long-term safety. They will have a sense of the timescales associated with the disposal of radioactive waste and the safety case scenarios.

Based on the above considerations and on basis of the information provided in the previous chapters, we propose three communication objectives that can be scaled as follows:

1. Create awareness on the topic of the OPERA Safety Case and the results;
2. Inform the public on the context of the OPERA Safety Case and its role in the implementation process; and
3. Impart knowledge on the specific results of the OPERA Safety Case.

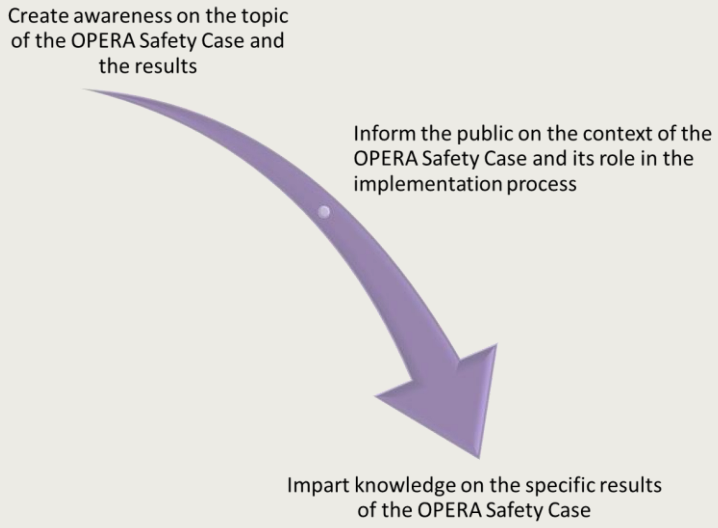

Figure 5-3: Communication objectives for the OPERA Safety Case

Dependent on the level of interest and background knowledge of the topic, for each specific target group (see next section), communication objective 1 or 2 can be omitted.

It should be noted that if the communication objectives change over the course of time, e.g. due to political, environmental or societal developments, all consecutive steps discussed in the next sections need to be reconsidered, too, because this will automatically influence e.g. the message-frames (Section 5.6). Consequently, the selection and implementation of the communication tools will change as well, which may influence the followed approach. It is therefore wise to keep a focus on the ambition and goals of those that are responsible for the implementation and results of the communication strategy and to review and adjust the strategy when the ambition changes.

Basic information to be provided on the OPERA Safety Case

The following list of topics on the context of the OPERA Safety Case form the foundation for all public information and can be seen as the basic essential information needed by audiences to put the results into perspective:

- argumentation of the necessity of geological disposal on the long term;
- information on the timeline of the implementation process;
- information on preceding and following steps/research programmes;
- clarification of the purpose of the OPERA Safety Case, what it will be used for in future, and what decision(s) will be based on it;
- clarification of how the OPERA project is managed, and what provisions are made to gain an unbiased OPERA Safety Case report;
- clarification of who is involved in carrying out the research tasks, and how scientific quality and unbiased results are guaranteed;
- provision of context of the role OPERA plays in the general debate on nuclear energy and other applications of nuclear technology.

The following basic information on the safety case methodology should be provided:

- The safety case comprises the technical findings of a safety assessment and a statement of confidence in these findings;
- The safety case acknowledges the existence of any unresolved issues an provides guidance for future work to resolve those issues/ The safety case reflects on uncertainties or open questions that need to be addressed in future;
- The safety case is a stepwise process, with the OPERA Safety Case as a first of a series of future safety cases;
- The safety case assesses several scenarios with generalized features.

With respect to communication of the outcomes, the following general recommendations can be given:

- When informing the public it is advisable to avoid using too large or too many numbers but instead focus on personal approach and make use of metaphors or stories;
- Numerical outcomes should be accompanied by a verbal interpretation thereof in light of the underlying scientific and experimental support;
- Additionally, other communication means that not directly fall into the current content of the OPERA Safety Case should be considered, e.g. the use of so-called ‘natural analogues’ and transparent logical reasoning;

- It is important to avoid the impression that there are ‘secrets’, i.e. it must be emphasized that all reports underlying the OPERA Safety Case reports are public (and will stay so in future), a clear timeline exists for the review and publication process;
- It should be explained how questions and concerns from stakeholders and the general public are (or will be) addressed, in order to assure that this safety case is not a ‘one-way’ process. Integration of insights from the projects ENGAGED and RESTAC (OPERA WP 1.2) might help such communication;
- It should be explained what the scientific and societal basis is for judging whether a concept is considered safe or not;
- Public concerns should be addressed and answered proactively, using input from media monitoring or reactions on communication activities before (and after) publication of the OPERA Safety Case;
- Potential remaining risks and the existence of uncertainties with respect to the analyses performed and the outcome should be addressed openly and proactively;
- Wordings should be chosen carefully, keeping in mind that the public may conceive them as ‘trivializing’ or ‘secretive’.

5.5. Target groups

In order to achieve that the results of the OPERA Safety Case are brought to the attention of a wide public and are properly understood, it is necessary to divide the public into different target groups so the communication tools can be tailored to their needs [80]. Chapter 2.1 concluded that identifying target groups and streaming the message according to their characteristics and preferences is the key to a successful communication. The general public is therefore divided in subgroups, based on age. A further subdivision is made based on their level of knowledge: informing a broad public audience on the results of the OPERA Safety Case was identified a primary objective of the communication strategy, and because the communication objectives are focussed on raising the level of awareness and knowledge, the primary target groups are formed accordingly. Following the hierarchy of the communication objectives, different levels of knowledge of the target audience can be distinguished:

- Level 1 (low knowledge): the audience is not familiar with the topic and has no knowledge of the OPERA research project, the safety case methodology or radioactive waste disposal
- Level 2 (medium knowledge): the audience has basic knowledge about radioactive waste and geological disposal
- Level 3 (high knowledge): the audience understand the process, the context and the content of the OPERA research project and is aware of the OPERA Safety Case.

In Chapter 2.2 it was concluded that when communicating on the topic of radioactive waste or waste disposal, the public could also be divided into different perspectives following their own personal interest and concerns. However, because the OPERA Safety Case communication is directed to a large public - the entire Dutch population - no further distinction is made on basis of different perspectives of the target audience in order to keep the communication strategy transparent and manageable. Instead, a tailormade division of principal target groups for the OPERA Safety Case is designed, including their characteristics (Table 5-2).

Table 5-2: Principal target audiences of the OPERA Safety Case, their basic characteristics and level of knowledge

Target audiences	Basic characteristics	Level of knowledge
Children 6 - 12	• primary schools • preference for visual communication • smaller frame of reference • learning and playing	1 – low
		2 – medium
Students 13-18	• junior high school • use of online & social media • interest in games, competition & fun-factor • personal profiling and career opportunities	1 – low
		2 – medium
Adults 19≥	• use of online & social media • firm frame of reference • diversity of education, social status and gender • use of hardcopy information	1 – low
		2 – medium

The level-3-audience is not included in the table of target groups since their level of knowledge shows there is no need to develop a specific communication strategy for that particular group. Furthermore, many members of that audience may be qualified as "stakeholder", asking for a broader approach than covered by the present project, where communication is only part of a broader participation approach. For more information on the involvement of stakeholders in the implementation of radioactive waste disposal we refer to OPERA WP1.2 (projects *ENGAGED* and *RESTAC*).

In order to make the implementation of the communication strategy both manageable and realistic the communication should be focussed in the start-up phase on the largest target audiences:

- Children 6-12 with no knowledge of the topic (level 1);
- Students 13–18 with a basic level of knowledge (level 2);
- Adults 19 ≥ with a basic level of knowledge (level 2).

If the communication strategy proves effective, in time this focus can be shifted to include Students and Adults with a high level of knowledge (level 3) and eventually, communication can become part of a broader participation approach.

5.6.Key messages and frames

In general a communication strategy includes key messages. The nature and content of the key messages depend on the outcomes of the OPERA Safety Case. The key messages should focus on the objective of enhancing the knowledge on the topic and conveying the results. Depending on the knowledge-level, the message can be tailored to the specific target audiences.

However, in this particular case, the OPERA results are not known at the time this communication strategy was developed, although it is likely that the outcome will be comparable to one of the statements or a combination of the statements as listed as examples at the end of Chapter 2.1. Consequently, presently no literal key message can be formulated, however, it is possible to formulate key frames for the future key messages. The literature study in Chapter 2 and the case studies in Chapter 3.1 and 3.4 have shown that existing and new communication frames will be key elements in the acceptance and understanding of the results. Therefore, deviating from the traditional communication strategies, we choose to develop a set of communication frames specifically tailored for the communication of the OPERA Safety Case results. The frames are building upon the conclusion and findings of the literature study in Chapter 2 and the case studies of Chapter 3 and provide a framework for the future key messages. Their names are derived from the different communication angles and the perspectives that go with them.

The dominant Dutch frame on the topic of radioactive waste disposal identified focuses on the fear for radiation and radioactive waste, the ethical aspect of long-term waste management, and the feeling of a lack of control and uncertainty among the public. With this existing frame in mind, three frames are drawn that should be used as building blocks to form a frame that is suitable for the future message, in accordance with the target audience and appealing to all levels of understanding:

- The Context Frame – 'the big picture': how one perceives a problem makes all the difference in how the public will see the solution. By defining the problem of the radioactive waste in a larger context we can help the public understand and interpret the results of the safety case. This includes illustrations on how the public benefits from the nuclear applications, what is at stake when these nuclear technologies are dismissed and how the process of finding a solution works. When the public can see the results of the safety case within the larger context it is easier to discuss or explain the results. Elements to be addressed in the Context Frame are the backgrounds of the radioactive waste disposal and were the waste comes from, the necessity and the benefits of the OPERA Safety Case and its role in the stepwise implementation process of geological disposal of radioactive waste as a safe solution for the long-term.
- The Moral Frame – 'caring and sharing': the safe and efficient long term management of radioactive waste is something that involves the entire Dutch community. Not only does the waste come from products that we, and future generations, benefit from, we also share a responsibility to our future generations and the environment when it comes to a safe waste disposal. Sharing this responsibility with the society on a personal level will encourage people to think about or debate the results of the OPERA Safety Case. This frame appeals to high moral frames such as responsibility, community and justice. Elements to be addressed in the Moral Frame are the necessity and benefits of the applications that produce radioactive waste, societal responsibility of managing existing and future radioactive waste, the consequences of dismissing the radioactive waste problem (what happens when we don't take our responsibility?) or subsequently dilemma-sharing (involve the audience by sharing the dilemma you are facing and

subsequently share the responsibility of finding a solution) of the radioactive waste problem.

- The Competence Frame – 'in science we trust': The results of the OPERA Safety Case can only be accepted when the research that led to those results is trusted and understood. Since numbers, especially large numbers, are hard to interpret for the general public and the models used for the safety assessments of the OPERA Safety Case and their outcome will consist of a lot of data and equations, it is important that the public confidence in the scientific arguments provided and the research performed. By providing a spoken or written explanation or interpretation with the numbers or results it is possible to avoid public misunderstanding or even manipulation of the numbers. Embedding the numerical outcome in a storytelling message will help the public understand the data and outcome of the safety case. Explaining the scientific approach and acknowledging clearly any limitations or uncertainties can enhance the public confidence in the science and methods. Elements to be addressed in the Competence Frame are the starting point or basic issue of the OPERA Safety Case, the assumptions made, the methodologies used and the meaning of the numbers.

When forming the communication frame it is the key to steer away from the words and phrases used by the opponents. Examples of words and phrases used by opponents can be found in Chapter 3.1 and 3.4, but also Chapter 2.2 on general perceptions should be considered. Furthermore, media monitoring (see Section 5.9), either as performed as part of the CIP project, or as part of the future communication process, may provide insight in the tone of voice and sentiments used in the public debate on radioactive waste.

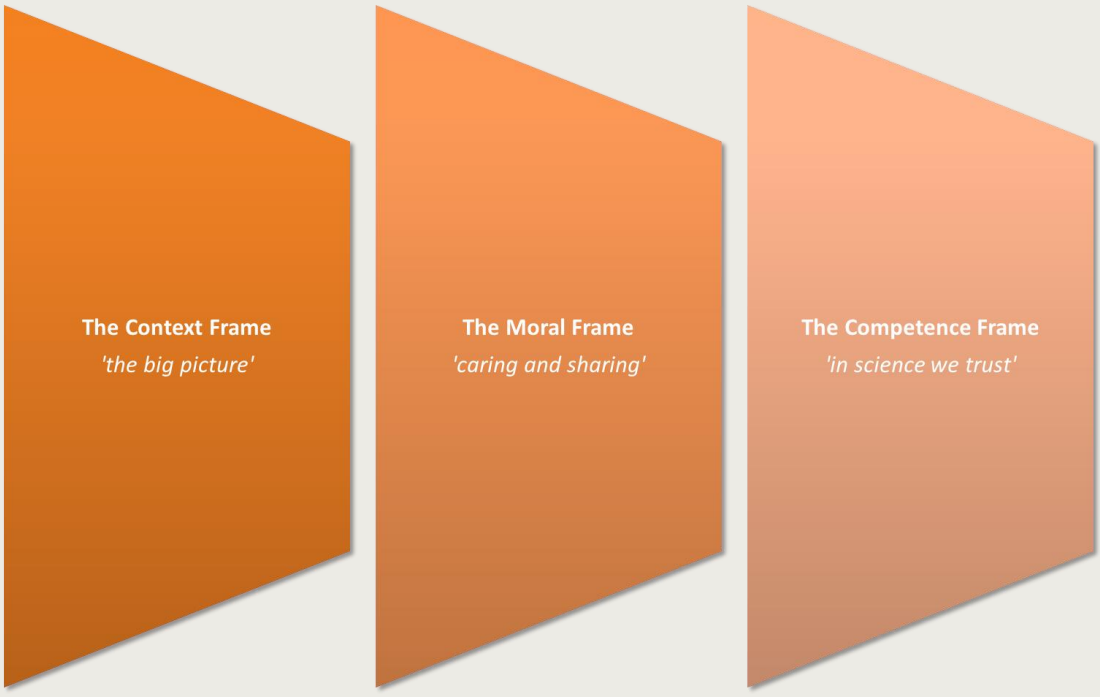

Figure 5-4: Key frames for the OPERA Safety Case

5.7. Tools and activities

Each target audience defined in Section 5.5 has its own characteristics; they will gather or receive their information in different ways and are exposed to different media. An overview of the importance and efficiency of several communication tools for different target group is given in [81, Table 28 and 29 on p.163], however it must be noted that nowadays online communication tools are of much more importance than in the beginning of the century and the online trends and available tools are changing all the time. There is a wide range of basic communication tools available that can be used to deliver a message to the target audiences identified in Section 5.5. In order to make the list manageable, a differentiation between face-to-face communication, hardcopy offline communication and online communication is made, although it should be noted that some tools are crossovers.

Communication tools

In the field of communication there are numerous communication tools that can be used to convey a message to the public. Table 5-3 gives an overview of the most relevant communication tools that can be used, considering the target audiences and communication goal.

A short description and examples for the different communication tools is provided in a separate document (M1.3.1.B, '*Communication Toolbox*'). The Toolbox serves as a guideline for all communication-related activities and can be used for the implementation of the communication strategy of the OPERA Safety Case Results.

Table 5-3: Overview of communication tools

Face to Face	Off-line	On-line
Exhibition	Newsletters	Newsletter
Public meeting	Factsheet	Factsheet
Presentation	Leaflets & Brochures	Website
Guided tour	Poster presentation	Educational material
Press conference	Educational material	Video's
	Press release	Social Media
	Advertising	Press release
	Infographic	Advertising
	Interviews and articles	Blogposts

Figure 5-5 gives an overview on the three main elements for communicating the OPERA Safety Case:

- An OPERA Safety Case report that integrates the scientific-technical outcomes of OPERA, following international recommendation as discussed in Chapter 2;
- A more condensed report, aiming at communicating the very extensive information of the OPERA Safety Case to broader public interested in the outcomes;
- Supporting background information covering a broad range of contextual aspects as discussed in Chapter 2 to 4 and summarized in Section 5.4, making use of different communication tools.

All three elements are necessary for a successful communication.

Figure 5-5: Main elements for communicating the OPERA Safety Case

With respect to the supporting background information that needs to be provided, the content of the message, available budgets and manpower, timing and outreach are all aspects that play a role in choosing the right communication tool for the objective. When eventually the available budget for the implementation of the communication strategy is clear, the executive structure is established and the exact content of the safety case outcomes are known, the Toolbox can help in selecting a combination of tools based on these assessments. The communication tools in the Toolbox are individually assessed on their suitability for the target groups, planning and message-frames to provide a guideline for choosing the right communication tools. In addition to the communication tools, the Toolbox contains three templates that will help in constructing a clear message, prepare for public meetings and setting-up a social media guideline.

Target-tool-matrix

Choosing the right mix of several communications tools will increase the chances of the message being noticed, retained, and thereby lead to the desired outcomes of the communication' objective. For each of the three communication objectives defined in Section 5.4, appropriate tools from Table 5-3 were selected for each target group. The resulting set of '*target-tool-matrices*' is provided in Appendix 6. These target-tool-matrices provide a ranking for timing, outreach and suitability in terms of message frames and target groups per communication tool.

When choosing the communication tools and activities it is good to keep in mind that the more the target audience members see the message, the more they absorb it. Repetition of the key frame or the key message will increase the potential of the message and frame

retention. Target audience members may also be more inclined to believe the message when it is repeated by different sources.

Communication timeline

A main conclusion from the case studies and literature study was the observation that it is important to involve the public in the project by communicating early on about the process, context and backgrounds. This will give the audience the chance to familiarize with the topic and to build up knowledge and understanding before they are presented with the outcomes of the research.

Table 5-4: Timeline-matrix of communication tools (dark green: high activity, light green: medium activity, white: no or low activity)

	Tool	website	social media	leaflet	video	public meeting	infographic	(expert) presentation	educational material	newsletter	weblog	factsheet	exhibition	advertising	guided tour	press release	poster presentation
2014	July																
	August																
	September																
	October																
	November																
	December																
2015	January																
	February																
	March																
	April																
	May																
	June																
	July																
	August																
	September																
	October																
	November																
	December																
2016	January																
	February																
	March																
	April																
	May																
	June																
	July																
	August																
	September																
	October																
	November																
	December																
2017	January	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----
	February																
	March																
	April																
	May																
	June																

* proposed publication date of the OPERA Safety Case report

In Table 5-4 on the previous page, an example indication for the application of communication tools over a period of three years is given ('timeline-matrix). The publication date for the final report on the safety case outcomes is set on January 2017[18], which date is used as a central focus point for the planning of the communication. To allow some flexibility in the implementation the planning is indicated in periods of months or weeks around this date. Consequently a shift in the publication date also results in a shift in the schedule. This timeline-matrix is indicative, but the general pattern is that communication activities should be initiated as soon as possible.

5.8. Risks and chances in communication

As discussed before, the communication strategy proposed in this report is not a communication strategy in the traditional sense but meant to provide a guideline for effectively obtaining the objectives formulated in Chapter 5.4. Consequently it is important to contemplate the possible risks and chances that come with this strategy:

- **Change in situations:** This communication strategy provides a guideline to attain the objectives formulated in Chapter 5.4. Should these objectives change over the course of time, e.g. due to political, environmental or social developments, it is advised to review the communication strategy as a whole. These developments may include changes in regulation and legislation or other governmental decisions, natural disasters like earthquakes or floods, incidents in nuclear facilities, or general changes in the public attitude.
- **Execution:** The effectiveness of this communication strategy depends on the executor. The company or organisation that will coordinate or carry out the communication efforts will influence the credibility and the outreach of the message and therefore the results. This communication strategy does not take into account which company or organisation can or will implement the strategy but merely gives a guideline for obtaining the objectives. The literature study (Section 2.2) shows that the Dutch audience values the information coming from scientific organisations the most and information provided by the industry the least. Most trust is given to '*composite bodies*' that represent several different societal groups like government, industry, environmentalists, scientists, doctors and academics. The reputation, credibility and societal status of the communicator(s) can influence the communication both positively or negatively.

  An important element of successful public communications is deploying self-confident staff members that are not afraid to take vulnerable positions in a debate. At the same time in public meetings, the organizers or speakers should be confident enough to properly address the public in case its behaviour or language is inappropriate for a fruitful debate.
- **Budget**: Since there was no information on the amount or availability of a budget for the implementation of the communication strategy, this factor has not been taken into account.
- **Chances:** Assess what internal or external factors can positively affect the communication objectives and how these can be best utilised.

[18] This date is an optimistic estimate. Dependent on the progressing works, the publication date of the OPERA Safety Case report should be adapted.

5.9.Evaluation

As discussed previously, the communication of the results of the OPERA Safety Case is not confined to a single event but will need continuous efforts. It should starts early with informing the target audience on the process, background, contexts and frameworks in which the OPERA research programme takes place. Following the outlined strategy will eventually lead to inform the public on the results of the OPERA Safety Case.

Knowledge about the effects of the communication efforts enables the necessary fine-tuning of the communication tools. Evaluations can help to collect valuable information in order to make tactical or strategic adjustments to the chosen frame, communication tool or key message or to allocate resources. Therefore, evaluation of the communication strategy is recommended not only at the end of the process but also mid-course.

Evaluation questions to be addressed are:

- Is the key frame and/or key message widely accepted by the public?
- Is the key frame and/or key message more accepted than frames or messages from opponents?
- Is the key frame and/or key message part of the public discourse?
- Is the public's level of knowledge regarding OPERA, radioactive waste or the safety case process higher than before?

The following aspects need to be considered in order to properly check the accountability of the communication strategy [80]:

- ***Use of sample audience:*** When implementing new communication tools or efforts it can be helpful to test the tool or the message on a sample group that is representative to the target audience. Necessary adjustments can be made following their feedback and reactions.
- ***Measuring communication results:*** A measure can be quantitative or qualitative. Numerical measurements of the communication results above reveal little about the effects. It is therefore recommended to combine a numerical measure with data interpretation measurements. Surveys, online and in-person, feedback forms and quantitative data analysis can be used.
- ***Monitoring of a baseline:*** In order to obtain real and measurable results it is important to create a baseline to compare data and evaluation results. Since the main objective is to raise the knowledge of the public on the process, outcomes and backgrounds of the OPERA Safety Case, it is recommended to collect baseline information on the knowledge of the Dutch public on the topic. Analysing media coverage, traffic on the OPERA website, or public opinion surveys (e.g. Eurobarometer [17, 18, 44]) can be of use.

Media monitoring

Online media monitoring services are useful evaluation tools that provide specialized software called robots, bots or spiders that compile all the text of online news sources and social media based on the search terms. A carefully plotted media monitor can provide information about the amount of attention the media has for a specific topic. Analysis of the data also provides insights in the prevailing sentiment of the public and reactions and counter reactions to news coverage. A good overview of the present-day public opinion and media coverage on the subject of radioactive waste disposal in specific and nuclear technologies in general can be a relevant part of a successful communication strategy.

By starting the media monitor early, the result of this media monitor can also be used as a baseline for measuring the impact of a communication strategy in the future. As part of this project, a limited media monitoring campaign was performed (a short overview of the set-up and results can be found in Appendix 7). Since the performed media monitor was very basic it cannot give reliable insights in the positive or negative sentiments of the public, but its main purpose was to keep a close eye on the media attention with limited efforts. The outcomes of such a monitoring may be used to consider communication actions, e.g. taking part in discussions or providing additional information where misunderstandings may direct a public discourse. That would require more in-depth analysis of the outcomes by reading the news, determining the sentiment of the reports and tracing the relevant events that led to the media attention on moments with increased media attention. Therefore, it is advised to perform additionally periodical qualitative media monitors, starting early in the communication process. In addition, the results of the Eurobarometer surveys can be analysed for evaluating public opinion and knowledge.

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Appendix 1: Information leaflet provided for interviews

Radioactief afval en eindberging
Overal waar met ioniserende straling of radioactieve stoffen wordt gewerkt, wordt radioactief afval gegenereerd, van onderzoek en elektriciteitsproductie tot diagnostische behandelingen in ziekenhuizen. Onderzoek naar de berging van radioactief afval dient dan ook een wezenlijk maatschappelijk belang. In Nederland wordt het radioactief afval centraal ingezameld en voor tenminste 100 jaar bovengronds opgeslagen bij de COVRA in Zeeland. Gedurende deze periode wordt onderzoek uitgevoerd naar mogelijkheden voor eindberging van het radioactief afval.

Het radioactief afvalbeleid is onder meer in de nota Radioactief Afval uit 1984 vastgesteld. In die nota staan onder andere de uitgangspunten van het beleid (Isoleren, Beheersen en Controleren) en de keuze voor een diepe ondergrondse berging op lange termijn. Op dit moment worden twee potentieel geschikte, in Nederland voorkomende gesteenteformaties voor de diepe berging in beschouwing genomen: steenzout en Boomse Klei. Voor het gastgesteente steenzout is in de afgelopen 35 jaar in Nederland al veel onderzoek gedaan. Voor het gastgesteente Boomse Klei is in Nederland veel minder kennis beschikbaar.

OPERA en de Safety Case
In 2011 is het Onderzoeksprogramma Eindberging Radioactief Afval (OPERA) gestart. OPERA is een vijfjarig programma dat bekijkt onder welke voorwaardes veilige, lange termijn geologische opberging van radioactief afval in Nederland mogelijk is. Hiervoor worden de verschillende aspecten met betrekking tot lange termijn veiligheid van een dergelijke berging onderzocht, om op het eind een zogenaamde Safety Case te vormen. Deze bestaat uit een verzameling van argumenten en bevindingen die een heldere uitspraak over de veiligheid van een eindbergingsfaciliteit op lange termijn moeten geven, en eventuele kanttekeningen met betrekking tot resterende onzekerheden. Een Safety Case laat niet alleen zien onder welke voorwaardes een eindbergingsfaciliteit mogelijk is maar maakt ook duidelijk welke onopgeloste problemen er nog zijn en geeft hierdoor een leidraad voor onderzoek in de toekomst. OPERA zal zoveel mogelijk aansluiten onderzoeksprojecten in het zevende EURATOM kaderprogramma en het onderzoeksprogramma in België, dat al 30 jaar bestaat en onderzoek doet naar de mogelijkheden voor eindberging in Boomse Klei.

Communicatie
Binnen het onderzoeksprogramma wordt ook een basis voor een communicatiestrategie gelegd. De doelstelling hierbij is om na te gaan, op welke manier de uitkomsten van de Safety Case het beste aan een breder publiek gecommuniceerd kunnen worden. Bestaande informatie en ervaringen over publiekscommunicatie van Safety Case studies en daaraan verwante thema's worden geanalyseerd. Naast een studie van bestaande literatuur en casestudies wordt door middel van drie interviews met toonaangevende deskundigen op het gebied van (wetenschaps-)communicatie, framing en/of nucleaire communicatie aanvullende inzichten en meningen over communicatie van de uitkomsten van de OPERA Safety Case worden verzameld. Al deze gegevens vormen de input voor een onderbouwde communicatiestrategie over de publiekscommunicatie van de onderzoeksresultaten van de Safety Case van OPERA.

Appendix 2: Interview Patricia Osseweijer

Patricia Osseweijer: "Zoek het in het delen van een probleem."

> *Patricia Osseweijer is hoogleraar wetenschapscommunicatie. Ze promoveerde aan de Vrije Universiteit Amsterdam en heeft een master in moleculaire biologie (Universiteit Utrecht). In 1999 werd zij afdelingssecretaris van de afdeling biotechnologie en van de Onderzoeksschool Biotechnologische wetenschappen aan de Technische Universiteit (TU) Delft. Osseweijer zette een nieuwe onderzoeksgroep op die zich richtte op maatschappelijke vraagstukken gerelateerd aan biotechnologie. Dit leidde tot een sectie Biotechnologie en Maatschappij aan de TU Delft. In 2002 was Osseweijer betrokken bij het opzetten van het Kluyver Centre for Genomics of Industrial Fermentation, waarvan zij managing director werd. Ze ontwikkelde het programma Genomics en Maatschappij en werd als programmaleider verantwoordelijk voor de coördinatie van sociaalwetenschappelijke onderzoeks-projecten. Haar onderzoek richt zich momenteel onder meer op integrale en maatschappelijke duurzaamheid voor een biobased economy, meningsvorming en de rol van wetenschappers in publieksinteractie. Ze is voorzitter en medeoprichter van de stichting Imagine Life Sciences.*

Over vroegtijdig betrekken van publiek
"*De wetenschappelijke en wettelijke randvoorwaarden voor een onderzoek naar een eindberging van radioactief afval zijn allemaal duidelijk afgebakend. Maar daarnaast spelen ook morele zaken een grote rol. We zullen met elkaar moeten besluiten wat we wel en niet toestaan. Welke onzekerheden kunnen en willen we accepteren? Het is hierbij van belang om het publiek te betrekken bij deze afwegingen.*"

Niet alleen is Osseweijer een groot voorstander van het vroegtijdig betrekken van het brede publiek bij wetenschaps- en risicocommunicatie, ze waarschuwt ook voor de mogelijke gevaren die het niet tijdig informeren met zich meebrengt: "*Zo'n 80 procent van het algemene publiek is in eerste instantie helemaal niet geïnteresseerd in de materie. Maar dit gebrek aan kennis en betrokkenheid zorgt juist in een later stadium voor protesten wanneer een nieuwe of onbekende technologie wordt geïntroduceerd, al dan niet gevoed door tegenstanders. Het is dus belangrijk om mensen zo vroeg mogelijk te betrekken bij je onderwerp.*"

Over de kracht van entertainment en emotie
Maar hoe krijg je die 80 procent ongeïnteresseerde mensen nu betrokken? "*Richt je op de emotionele kant en breng het onderwerp naar ze toe*", stelt Osseweijer. "*Het grote publiek heeft vaak geen flauw benul waarover het gaat. Gebruik entertainment om de aandacht van mensen te trekken en zorg dat je in hun belevingswereld komt.*" Ze ontwikkelde hiervoor het Three E-model: Entertainment, Emotion and Education. Hierbij wordt met behulp van Entertainment de aandacht van de mensen getrokken; mensen identificeren zich met het onderwerp door emotie waarna pas aan het eind kennis wordt vergroot wat je kunt zien als onderwijs. Als voorbeeld noemt ze succesvolle campagnes rondom biotechnologie. "*We hebben evenementen gecreëerd die mensen aanspreken en nieuwsgierig maken. Zo was er een avond Bio-Based-Bikken waar inwoners van Delft onder het genot van een duurzame maaltijd konden discussiëren en luisteren naar wetenschappers over de bio-based economie.*" Wanneer je iemand een genetisch gemanipuleerde tomaat laat proeven wordt het onderwerp veel tastbaarder en dwing je mensen er over na te denken. "*Richt je op de vraag: hoe maak je een onderwerp tastbaar?*

Maak het aaibaar, open en bespreekbaar. Hoe krijg je mensen zo ver dat ze een genetisch gemanipuleerd plantje vasthouden of eten? Daar heb je creativiteit voor nodig. Het zou een idee zijn om in het kader van radioactief afval of eindberging een brainstorm te creëren om ludieke acties te bedenken rondom het thema." Osseweijer benadrukt dat het belangrijk is om het publiek het probleem eigen te laten maken voordat je antwoorden of oplossingen gaat presenteren. "*Zoek het in het delen van het probleem.*"

Over het veranderen van de discussie
Fanatieke tegenstanders en critici zullen er altijd zijn, maar toch is het belangrijk om ook met deze mensen rond de tafel te gaan zitten. Uiteraard moeten NGO's wel benaderbaar zijn. Osseweijer geeft een voorbeeld van een samenwerking met NGO's die uiteindelijk wel is gelukt bij bio-based innovaties door ze direct aan te spreken op hun verantwoordelijkheid of te informeren naar hun zorgen over het onderwerp en ze op die manier deel uit te laten maken van het project. "*Er is ook een project waar NGO's een deel van de financiën krijgen om mee te doen. Natuurlijk loop je een risico dat ze dat niet willen maar je verliest er niets mee. Als het probleem maar goed wordt gedeeld want dat is de ingang om vervolgens samen naar oplossingen te zoeken*", aldus Osseweijer. "*De uitdaging is om een andere ingang in de discussie te vinden. De insteek moeten niet de risico's zijn die een eindberging of nucleaire technologie met zich meebrengen maar bijvoorbeeld wel de scenario's wat er gebeurt als we niets doen. Zo is de discussie over genetisch gemodificeerd voedsel gedraaid naar de vraag: 'Hoe voeden we de wereldbevolking?' In dit geval zou het bijvoorbeeld kunnen gaan over energy security. Hoe gaan we om met de groeiende vraag naar energie van een uitdijende wereldbevolking? Hoe gaan we dat redden? De medische kant van het verhaal is zo mogelijk nog meer aansprekend. Het betreft immers de gezondheid van mensen en dat betrekt ze direct bij het onderwerp, iedereen is voor medisch onderzoek en diagnostiek, maar wat gaan we doen met het radioactief (medisch) afval?*"

Over wetenschappers en communicatie
Osseweijer ziet wetenschapscommunicatie als een verantwoordelijkheid van de wetenschapper. "*De wetenschapper moet het publiek informeren over zijn of haar werk omdat het publiek uiteindelijk ook betaalt voor dit werk.*" Om die informatie met het grote publiek te delen is het volgens Osseweijer het beste om enthousiaste wetenschappers zelf het woord te laten voeren, al brengt dit ook uitdagingen met zich mee. "*Wetenschappers zitten vaak diep in de materie en hebben een rationele benadering die haaks staat op het publiek dat alles veelal benadert vanuit de emotiekant.*" Omdat wetenschappers weliswaar de taak hebben, maar lang niet altijd de competentie, moeten universiteiten de wetenschappers ondersteunen. "*Afdelingen communicatie kunnen ook communiceren namens en met de wetenschapper; hem of haar peilen of duiden, aanvullen en ondersteunen. Wetenschappers worden helaas nog vaak tegengehouden door de structuur van universiteiten waar de focus vaak ligt op onderzoek en wetenschappelijke publicaties en niet op publiekscommunicatie. Commerciële bedrijven zien dit wel en besteden grote budgetten aan marketing en communicatie. Universiteiten moeten dit nog beter leren*", licht Osseweijer toe.

Over jongeren
Osseweijer is medeoprichter van de stichting *Imagine Life Sciences* die wetenschappelijk onderzoek, onderwijs en ontwikkelingssamenwerking met elkaar verbindt en zo biotechnologie in een positiever daglicht zetten. "*Ieder jaar organiseren wij de Imagine scholierenwedstrijd voor HAVO- en VWO-leerlingen. Wetenschappers geven hierbij ideeën voor projectvoorstellen aan die door scholieren in een profielwerkstuk worden uitgewerkt tot een business case. Het winnende voorstel wordt, als het haalbaar is, door Imagine in het ontwikkelingsland uitgevoerd en de winnaars mogen er naar toe om het te zien.*" De wedstrijd laat zien dat biotechnologie een positieve oplossing biedt voor de problemen in

ontwikkelingslanden en geeft jongeren de gelegenheid om actief mee te helpen. "*De volwassenen bereiken we indirect via de ouders, familie en leerkrachten. Ieder jaar tijdens de prijsuitreiking zit de zaal bomvol met volwassenen en jongeren*", aldus Osseweijer. Ze raadt dan ook absoluut aan om jongeren als specifieke doelgroep te betrekken in de communicatie. "*De focus op de jongere generatie is dan ook zeker een advies. Ook omdat zij uiteindelijk geconfronteerd zullen worden met de gevolgen van keuzes die nu worden gemaakt.*"

Aanbevelingen en conclusies:

1. Begin vroeg met de communicatie; de meerderheid van de mensen zal aanvankelijk geen interesse hebben in het onderwerp maar gebrek aan kennis en betrokkenheid kan in een later stadium leiden tot protest en tegenstand.

2. Gebruik entertainment en ludieke acties om de aandacht te trekken van het publiek en benader ze in hun eigen belevingswereld. Maak een onderwerp bespreekbaar door het tastbaar te maken.

3. Werk samen met NGO's en spreek ze aan op hun verantwoordelijkheid. Deel het probleem en laat ze onderdeel zijn van de oplossing.

4. Zoek een andere ingang in de discussie, waarbij niet de risico's leidend zijn maar de scenario's wat er gebeurt als we niets doen. Hoe gaan we om met de groeiende vraag naar energie van een uitdijende wereldbevolking en wat doen we doen met radioactief medisch afval?

5. De boodschap over wetenschappelijk onderzoek komt het beste over wanneer het door de wetenschappers zelf wordt verteld. Laat enthousiaste wetenschappers zelf aan het woord en ondersteun of faciliteer ze waar nodig.

6. Betrek jongeren als specifieke doelgroep in het communicatieproces. De focus op jongeren is ook van belang omdat zij uiteindelijk geconfronteerd zullen worden met de gevolgen van keuzes die nu worden gemaakt.

Appendix 3: Interview Sarah Gagestein

Sarah Gagestein: "Kennistekort is een onderdeel van het probleem maar absoluut niet de oplossing."

> *Sarah Gagestein is eigenaar van taalbureau Taalstrategie. Ze adviseert politieke partijen, maatschappelijke organisaties en bedrijven over hoe zij framing kunnen inzetten om hun communicatie duidelijk, overtuigend en aantrekkelijk te maken. Zo werkte ze voor diverse politieke en maatschappelijke organisaties en bedrijven als: GroenLinks, Rijkswaterstaat, Reclassering Nederland en Politie Rijnland. Ze behaalde aan de Universiteit Leiden cum laude een MA in de retorica, daarnaast heeft ze en Bachelorsdiploma Talen en Culturen van Japan en een Bachelorsdiploma Communicatie- en Informatiewetenschappen.*

Over het radioactief afval frame
"*Radioactief afval is een ingewikkeld frame waarbij mensen zonder veel van het onderwerp af te weten toch een hele sterke mening en emotie hebben.*" Kenmerkend voor deze frames is dat ze heel snel worden gelinkt aan grote thema's zoals veiligheid en toekomst. Bovendien blijven emotionele frames sneller hangen omdat mensen gevoeliger zijn voor negatieve prikkels. "*Wanneer we tien positieve dingen horen en één negatief ding dan zullen we het negatieve onthouden*", legt Gagestein uit. De negatieve associaties zijn diep geworteld in de samenleving. Niet alleen roepen de onderwerpen nucleair en radioactief afval direct associaties op met grote kernrampen zoals Tsjernobyl en Fukushima maar ze maken ook deel uit van een diep verankerd cultureel gedachtengoed. In het dagelijkse leven worden mensen in films, boeken en op televisie doorlopend geconfronteerd met nucleair in negatieve of zelfs apocalyptische scenario's. Als concreet voorbeeld noemt Gagestein de film *The Avengers* die ze onlangs heeft gezien ."*Het is een film over superhelden waarbij aan het eind van de film een grote strijd wordt geleverd in New York. Als ultiem wapen wordt uiteindelijke een kernraket afgevuurd. De atoombom wordt hier dus neergezet als het laatste redmiddel*", vertelt ze. "*Dat is dus een onderdeel van het frame waarin nucleair zich bevindt, het allerergste wapen denkbaar met catastrofale gevolgen.*"

Over het nucleaire debat
Bij de vraag of het mogelijk is om een dialoog over radioactief afval te voeren zonder het algemene debat over nucleair en kernenergie te voeren is ze duidelijk: nee. Volgens haar is het frame rond radioactief afval onlosmakelijk verbonden met het frame rondom nucleair. "*Wanneer je over radioactief afval gaat praten, dan zal je het moeten hebben over nucleair, over kernenergie en over straling want dat is wat de mensen bezighoudt. Natuurlijk krijg je de negatieve frames er dan gratis bij, die worden automatisch getriggerd. Op dit moment zullen de eerste associaties met nucleair vooral te maken hebben met militaire of energietoepassingen en veel minder gaan over geneeskunde of innovatie. Toch zal je het hele nucleaire debat moeten voeren, anders heb je geen kans van slagen. Dit is wat mensen bezighoudt, wanneer je onderwerpen buiten de discussie houdt, verlies je je geloofwaardigheid.*"

Over framen en reframen
Hoewel een kenmerk van het nucleaire frame is dat mensen weinig technische kennis van het onderwerp hebben, is informeren alleen niet de oplossing wat Gagestein betreft. "*Kennistekort is een onderdeel van het probleem, maar het is absoluut niet de oplossing. Goed uitleggen staat niet gelijk aan overtuigen; met argumenten alleen kan je een bestaand frame niet ontmantelen. Het gaat erom een beeld te schetsen waar een ander*

zich in kan herkennen. Je moet iemand door jouw bril kunnen laten kijken. Daarvoor moet je je verdiepen in de vraag wat mensen drijft en kijken naar je eigen invloed op het publiek." Niet zelden komt hierbij de last van de 'kennisvloek' om de hoek kijken; als afzender van de boodschap ben je zo bekend met de materie en de achtergrond dat je alles vanuit je eigen perspectief ziet en je jezelf niet meer kan voorstellen wat een ander niet weet. Dit is op te lossen door een inductief onderzoek toe doen naar de bestaande frames rondom nucleair en radioactief afval. "*Door met focusgroepen rond de tafel te gaan zitten, kan er gekeken worden welke 'haakjes' er zijn, waar de kansen liggen. Wat hoort het publiek bij jouw uitleg? Op die manier kan je er achter komen welke frames er zijn die nu nog niet dominant zijn maar dat wel kunnen worden. Dit kan waardevolle input opleveren en aanknopingspunten geven voor een ander debat over nucleair en radioactief afval.*"

Over succesvolle reframes
Is er een voorbeeld van een bijzonder sterk negatief frame wat is uiteindelijk is gereframed? "*Misschien niet helemaal hetzelfde maar wel vergelijkbaar is het frame wat in de Verenigde Staten is ontstaan na 9-11. Er is toen een heel sterk frame opgebouwd rondom de 'war on terrorism' met veel aandacht voor het gevaar voor terroristische aanslagen en de veiligheid van de Amerikaanse burger. Dat frame bestaat nog steeds maar de laatste tijd is een verandering merkbaar en begint het frame te wankelen. Andere waarden zoals privacy krijgen nu meer aandacht. De media bekritiseren nu de Patriot Act of verwijten de overheid dat ze een andere agenda hebben waarbij het ze gaat om de olie en niet om het bestrijden van terrorisme.*"

Over taalgebruik en de afzender
Hoewel woordgebruik belangrijk is bij het opbouwen van een frame is het in het geval van radioactief afval weinig zinvol om het woord afval te reframen. "*Je ziet het wel in de afvalindustrie dat het woord wordt vervangen door 'recycling' en er is een afvalverwerkingsbedrijf dat inmiddels de slogan voert: afval bestaat niet. Maar het radioactieve frame is te zwaar om het met alleen ander woordgebruik te reframen*", licht Gagestein toe. "*De kunst is om een concreet perspectief te schetsen dat aansprekend is en een alternatief biedt voor het bestaande frame. Hierbij zit de kracht in het verhalende element, mensen moeten zich letterlijk een beeld kunnen vormen.*" Wie de boodschap brengt en hoe deze zich presenteert is belangrijk voor een sterk frame. "*COVRA is als afvalverwerker van de nucleaire wereld voor het grote publiek minder geloofwaardig; nucleair afval is immers hun business*", aldus Gagestein. De complexiteit van de boodschap kan hierbij volgens haar wel een voordeel opleveren. "*Het biedt een mogelijkheid om de wetenschap te gebruiken als afzender van de boodschap. In Nederland worden wetenschappers als bijzonder betrouwbaar gezien, ze hebben daarmee een stapje voor op politici en woordvoerders van de industrie.*"

Aanbevelingen en conclusies:

1. Een negatief frame plakt sneller dan een positief frame. Wanneer we tien positieve dingen horen en één negatief ding dan zullen we het negatieve onthouden.

2. Nucleair wordt eerder geassocieerd met militaire toepassingen en kernenergie dan met innovatie en gezondheid. Dit is een onderdeel van het frame waarin nucleair zich bevindt.

3. Er is geen dialoog mogelijk over radioactief afval zonder algemeen debat over nucleair en kernenergie. Het frame rond radioactief afval is onlosmakelijk verbonden met het frame rond nucleair.

4. Kennistekort is een onderdeel van het probleem, maar het [kennis bijspijkeren] is absoluut niet de oplossing. Goed uitleggen staat niet gelijk aan overtuigen.

5. Framen betekent iemand anders door jouw bril laten kijken en een ander perspectief bieden. Verdiep je in de vraag wat mensen drijft en kijk naar eigen invloed op het publiek.

6. Als afzender van de boodschap kan je vaak niet meer zien wat de ander (niet) weet; de 'kennisvloek'. Inductief onderzoek naar bestaande frames kan hier uitkomst bieden.

7. Alleen het woord radioactief afval reframen zal niet werken omdat het frame rond radioactief afval te sterk is. Er moet een concreet en beeldend perspectief worden geschetst dat aanspreekt en een alternatief biedt voor het bestaande frame.

8. De complexiteit van de boodschap kan een voordeel opleveren. Gebruik wetenschap als afzender. Wetenschap wordt in Nederland als bijzonder betrouwbaar gezien en dat is een voordeel t.o.v. afzenders als: politici en woordvoerders.

Appendix 4: Interview Remco de Boer

Remco de Boer: "Publiekscommunicatie is zwoegen in de loopgraven"

> *Ir. Remco de Boer studeerde Bouwkunde aan de TU Delft. Al tijdens zijn studie verdiepte hij zich in de marketingcommunicatie van advies- en ingenieursbureaus, met name in de VS en Groot-Brittannië. Na zijn afstuderen werkte hij voor verscheidene bouwadviesbureaus voordat hij in 1996* 'de boer communicatie' *begon. Klanten zijn vooral techniek- en wetenschapsorganisaties, overheden en kennisinstituten. De Boer schrijft regelmatig over de rol van communicatie in techniek en wetenschap. Zo becommentarieert hij in ieder nummer van technologietijdschrift* De Ingenieur *de manier waarop technologie in het nieuws komt. In de periode 2009-2013 had hij een tweewekelijkse column in* Cobouw*, het dagblad voor de bouw. De Boer is als columnist verbonden aan* Delft Integraal*, het wetenschappelijke magazine van de TU Delft. In 2012 verschenen van zijn hand twee boeken,* 'Over communicatie en ander ongemak' *en* 'Verloren vertrouwen – Lessen uit de Utrechtse asbestzaak'.

Over publiek draagvlak

Wat is eigenlijk de definitie van publiek draagvlak? Volgens De Boer is het woord actueel geworden in 2010 toen het als harde voorwaarde voor de opslag van CO_2 werd opgenomen in concept regeerakkoord tussen CDA en VVD met gedoogsteun van de PVV. In het akkoord stond letterlijk "*opslag van CO_2 kan ondergronds plaatsvinden met inachtneming van strenge veiligheidsnormen en lokaal draagvlak.*" De Boer: "*Doordat minister Verhagen het publieke draagvlak als expliciete voorwaarde benoemde, werd het een argument om iets tegen te kunnen houden. Door burgers wordt publiek draagvlak dan ook vaak geïnterpreteerd als:* 'wanneer wij het niet willen, dan gebeurt het niet'. *Vanuit de politiek hoorde ik laatste een tweede kamerlid zeggen dat zij publiek draagvlak zien als hun verplichting om de burgers actief te informeren. Dat zijn twee totaal verschillende interpretaties. En nergens staat duidelijk hoe groot een publiek draagvlak zou moeten zijn of hoe het moet worden gemeten, terwijl het wel als argument wordt gebruikt bij beslissingen.*" De Boer benadrukt dat het goed is dat er kritische geluiden zijn maar hij ziet ook gevaar. "*Er zullen altijd tegenstanders zijn, dat hoort ook zo. Maar tegenwoordig zie je vaak dat de democratische meerderheid, toch de grondslag van Nederlandse maatschappij, wordt overschaduwd door de term* 'publiek draagvlak'. *Op die manier wordt de discussie overgenomen door tegenstanders en niet gevoerd op inhoud of democratische grondslag.*"

Over tegenstand en actiegroepen

Mensen worden mondiger en komen sneller in het geweer. Actiegroepen of bewonerscomités zijn snel gevormd en hebben een groot bereik. Volgens De Boer komt dit doordat mensen meer informatie tot hun beschikking hebben, al wil dat niet zeggen dat ze ook meer kennis hebben van een onderwerp. "*Het internet is geduldig, voor elke mening of denkrichting zijn er wel argumenten en medestanders te vinden. Als burger kan je alles vinden en alles is te onderbouwen. Het is heel gemakkelijk om dan al snel te denken:* 'zie je wel, ik dacht het al'. *Wanneer drie fanatieke tegenstanders een avondje met de laptop rond de keukentafel gaan zitten, hebben ze aan het eind van de avond een website in de lucht. Op het internet hebben ze rapporten om hun argumenten te onderbouwen en vervolgens kunnen ze actie gaan voeren. Omdat de media geneigd is meer aandacht te geven aan tegengeluid en ludieke acties, ontstaat er een mediaperceptie dat er veel*

publieke weerstand is. Vervolgens is de overheid verplicht om hier aandacht aan te besteden. En dat allemaal omdat drie mensen rond een keukentafel gingen zitten."

Over emotionele bewonersbijeenkomsten
De Boer ziet in zijn werk als communicatieadviseur regelmatig hoe wederzijds onbegrip en onhandige communicatie van overheid of opdrachtgevers leidt tot conflictsituaties en een tekort aan publiek draagvlak. Basale omgangsvormen gaan tijdens emotionele bewonersbijeenkomsten overboord en er wordt geroepen en gescholden. "*Ik merk vaak dat de beleidsmakers die de bijeenkomst hebben georganiseerd bang zijn voor de boze burger en niet goed weten hoe ze moeten reageren. Wanneer ze worden geschoffeerd of uitgescholden door mensen staan ze met hun mond vol tanden of trekken ze zich terug achter formele antwoorden.*" Hij pleit er voor dat de beleidsmaker of vertegenwoordiger aan de andere kant van de tafel de burger aanspreekt op zijn gedrag in plaats van het te tolereren. "*Burgers zijn zo fel omdat ze die ruimte hebben. Wanneer ze die niet krijgen verandert direct de toon van het debat. Sommige burgemeesters zijn daar heel goed in. De Amsterdamse burgemeester Van der Laan zei ooit tijdens een heftige bijeenkomst op rustige toon tegen een geagiteerde bewoner: '*Zo ga ik geen gesprek voeren, op die manier gaan we niet met elkaar om'*.' En dat werkt. Ik geloof stellig dat wanneer beleidsmakers of ambtenaren zelfverzekerder en bewuster het debat in gaan er een basis is voor een succesvolle communicatie.*"

Over publieksparticipatie
De Boer is kritisch over publieksparticipatietrajecten: "*Vaak wordt publieksparticipatie en inspraak behandeld als een verplicht nummertje: dat moeten we ook nog doen want dat hoort er bij. Natuurlijk is het belangrijk maar dan moet je wel eerlijk en helder communiceren welke invloed de mensen krijgen.*" Hij stelt dat een van de belangrijkste redenen waarom publieksparticipatieprojecten mislukken, is omdat mensen zich niet serieus genomen voelen. "*En heel vaak hebben ze daar ook gelijk in!*", voegt hij toe. "*Burgers betrekken is iets anders dan ze beslissingsrecht geven en wanneer mensen denken dat ze mee mogen beslissen terwijl dit eigenlijk niet zo is, dan worden ze natuurlijk kriegel. Je moet van te voren duidelijk en eerlijk tegen het publiek zeggen welke bijdrage ze kunnen leveren, ook als dat betekent dat je ze moet vertellen dat er helemaal geen ruimte is voor inspraak omdat alles al is besloten en ze alleen nog iets mogen zeggen over de kleur van de verf.*"

Over geloofwaardigheid en menselijke communicatie
"*Publieksbijeenkomsten hebben zelden een menselijke aspect; er staat nooit een 'mens' voor de zaal. Ik zie het ook in de geschreven communicatie vaak gebeuren. Er wordt besloten dat de burgers geïnformeerd of betrokken moeten worden over een plan en vervolgens wordt er een formele brief opgesteld die de mensen niet aanspreekt en alleen maar afstand creëert. Dan is de toon al gezet voordat je de zaal in gaat.*" Hij is dan ook een overtuigd voorstander van menselijke communicatie waarbij de burger eerlijk wordt geïnformeerd, ook als de boodschap lastig is. "*Goodwill of sympathie van het publiek moet je kweken door te vertellen wat het nadeel is van een techniek of een oplossing, door ook de schaduwkanten te belichten en niet alleen maar een juichend verhaal te vertellen.*" Hij noemt de communicatie rondom de Noord-Zuidlijn als een goed voorbeeld van hoe een intensieve en menselijke communicatie met de burger draagvlak kan verkrijgen waar dat eerst niet was. "*Het project had een dieptepunt bereikt en het publiek was het zat. Door open te vertellen welke problemen er waren en hoe moeilijk het was een oplossing te vinden werden burgers betrokken bij het project en kon het weer op de rails komen.*"
De Boer is bijna wekelijks te vinden in een buurthuis of zalencentrum ergens in Nederland om een inspraakavond, bewonersbijeenkomst of informatiedag bij te wonen. Hij concludeert dat het grootste werk niet moet worden gedaan in die zalen maar bij de

organisaties thuis. "*Publiekscommunicatie is zwoegen in de loopgraven. Vaak is het struikelblok niet eens de uitvoering van de publiekscommunicatie maar gaat het veel meer om een verandering in de grondhouding binnen de organisatie. Daar ligt de echte uitdaging. Het vergt moed om je als organisatie kwetsbaar op te stellen naar je publiek en open en eerlijk te communiceren. Daarvoor moet je eerst intern werken aan het zelfvertrouwen van de mensen binnen de organisatie. Ze moeten trots zijn op hun werk en sterk in hun schoenen staan om het debat te kunnen aangaan.*"

Aanbevelingen en conclusies:

1. De democratische meerderheid dreigt te worden overschaduwd door de term '*publiek draagvlak*' wanneer deze niet concreet wordt ingevuld. Op die manier wordt de discussie overgenomen door tegenstanders en niet gevoerd op inhoud of democratische grondslag.

2. Mensen worden mondiger en komen sneller in het geweer. Actiegroepen of bewonerscomités zijn snel gevormd en hebben een groot bereik.

3. Mensen hebben meer informatie tot hun beschikking maar dit leidt niet automatisch tot meer kennis over een onderwerp.

4. Het internet biedt documentatie en onderbouwing voor alle argumenten en elke denkrichting. Er is altijd wel een rapport te vinden dat een mening of vermoeden bevestigt.

5. Tijdens een bewonersbijeenkomst moeten organisatoren of sprekers de burger aanspreken op hun gedrag wanneer dit onbehoorlijk is.

6. Publieksparticipatie werkt alleen wanneer de burger eerlijk en helder wordt verteld wat hun ruimte is, ook wanneer die nihil is.

7. Goodwill en sympathie kweek je door ook de negatieve of nadelige kanten van een verhaal te belichten.

8. Succesvolle publiekscommunicatie begint met zelfverzekerde medewerkers die niet bang zijn om zich kwetsbaar op te stellen en het debat aan te gaan.

Appendix 5: Observation from OPERA Expert Meetings

The OPERA research program included several Expert Meetings where consortium leaders from the various work packages did exchange information and present their work. The meetings allowed an effective communication between the experts. At the request of the COVRA, consortium member Ellen Jelgersma attended most of the expert meetings in order to get an idea of the background and contents of the program.

Layman experience

All the presentations of the Expert Meetings were of a very high scientific standard. Although I have a thorough knowledge of nuclear and radiation related issues, I am still a relative layman on most of the topics addressed during the expert meeting. It is safe to say that I was out of my depth during most of the presentations. But even so, attending the meetings allowed me to have a unique look inside the process of performing a scientific program and the tremendous efforts that have been made by a wide variety of scientists and experts.

Listening or talking

It can be quite intimidating to be unable to understand the content of a presentation. Especially if you are, or feel you are, the only layman in the room. But I soon learned that talking with the scientists about their work and asking questions was a much better way to get a basic understanding of the different topics than just listening to their presentations. In a conversation we could very quickly gap the bridge between their high scientific level of work and my layman curiosity questions. The enthusiasm and willingness of the experts to talk about their field of work can break down barriers. It strengthened the believe and trust that the OPERA program was thorough and the results trustworthy, even though I am still in the dark about the details of most of the work.

Supporting the scientists

At two Expert Meetings I have been given the opportunity to give a presentation about the media monitor of the OPERA project CIP. The interactions during and after these presentations made it clear that public communication or dealing with the media is considered a challenge for most scientists. At times it can even be 'scary', sometimes resulting in a tendency to avoid public communication when possible. Given that scientists with their enthusiasm and knowledge are well equipped to tell the public about the importance of the research, this would be a waste. Communication experts can provide useful support to scientist in such case and may enable them to perform public communication with more confidence.

Engaging

I have seen and heard a great variety of presentations but the ones that particularly stayed with me are the ones that used engaging analogies or practical examples. I vividly remember one meeting were the presenter brought with him a lump of Boom Clay to demonstrate the favourable characteristics of the clay. Up till then I had heard and read a lot about Boom Clay, but it was the first time I actually saw and felt the material and it made the topic much more interesting. Now I really knew what we were talking about!

Communication hooks

Attending Expert Meetings sparked an enthusiasm for the topic of long-term safe disposal of radioactive waste that might be surprising considering the fact that I was out of my depth most of the time. But for me, the topic touches some interesting perspectives:

geological history and science fiction. Or, as I explained to my sons of 9 and 11, we look back to the time of dinosaurs and try to craft a safe future for humankind ten thousands of years ahead. To me, that is an exciting program to be part of. I believe these perspectives will also provide potential engaging 'hooks' for public communication that can explain to the public the purpose and necessity of the research program.

Recommendation and conclusions:

1. Giving a good presentation to an audience is appreciated but conversations and dialogue are far more compelling for laymen. By allowing people to query experts or scientists directly, you break down the barrier and start building trust.

2. With their enthusiasm and knowledge scientists provide a great communication potential. But in order for the scientist to be able to confidently face the public, the communication expert has to empower them by building confidence, providing tools and working on their communication skills.

3. Making the subject palpable in the most literary sense of the word will help to engage the public. Letting them see or feel the clay, the canister or the cement that is being researched will engage them in an exciting and memorable way.

4. The historic and futuristic aspects of the research program provide a good communication perspective to engage the public in the purpose and necessity of the program.

Appendix 6: Target-tool-matrices

Objective:	**Creating Awareness on the topic of Radioactive waste disposal and safety cases**				
Tools	Target Audience, Level 1			Examples	Frame
	Children 6-12	**Students 13-18**	**Adults >19**		
Educational material	x	x		Toolbox for classroom presentations, topical factsheets for teachers	Moral, Context
Website	x	x	x	Children's page, online game, online competition, background information, photo stream	Context
Leaflet or brochure	x		x	Cartoon inspired brochure, leaflet with fun facts	Moral, Context
Guided tours	x	x	x	Online interactive tour of waste management facility, actual guided tour for classes, tour for children/youth groups of environmental organisations	Context
Social media		x	x	*Twitter*, *Facebook*	Moral, Context, Competence
Video	x	x	x	Short information clips, personal story telling clips	Context, Competence
Public meetings		x	x	Local meetings, expert lectures, personal presentations	Moral, Context

Objective: **Informing on Context and Process of the OPERA Safety Case**					
Tool	Target Audience, Level 2			Examples	Frame
	Children 6-12	Students 13-18	Adults >19		
Guided tours		x		Technical themed tours	Competence
Website	x	x	x	Regular updates, FAQ's, midterm reports	Context, Competence, Moral
Exhibition		x	x	Themed exhibitions (photography, science, future etc.), interactive exhibitions, interactive traveling exhibition, local exhibitions, guest exhibitions in relevant museums	Moral, Context
Infographic		x	x	Visualisation of the disposal implementation process	Competence
Presentations			x	Expert presentations, Symposia, Speakers on relevant events	Competence, Context
Social media		x	x	*Twitter*, *Facebook*, reference to website and other activities, community building	Moral, Context, Competence
Blogposts			x	Storytelling, *meet-the-scientist*	Competence
Video		x	x	Short information clips, personal story telling clips	
Newsletter				Updates, backgrounds, stories	Competence, Context
Press-releases/press-conference	x	x	x	Personal interviews, opinion articles, columns, interview for school television or children's news	Competence, Context

Objective: **Informing on context, proces and results of the OPERA Safety Case**					
Tool	Target Audience, Level 3			Examples	Frame
	Children 6-12	Students 13-18	Adults >19		
Guided tours		x		Tours dedicated to waste disposal	Competence
Social media		x	x	*Twitter*, *Facebook*	Moral, Context, Competence
Public meetings			x	Expert presentations, movie presentations, discussion meetings	Moral, Competence
Poster presentation			x	Visual representation of the results	Context
Leaflet brochure	x		x	Short brochure referring to website	Context
Educational material	x	x		Toolbox update for classroom presentations, topical factsheets for teachers	Moral, Context
Advertisements			x	Online or offline media campaign to draw attention to website, public meetings or presentations	Context
Press-releases/press-conference		x	x	Personal interviews, opinion articles, columns, interview for school television or children's news, television interviews, columns, newspaper articles, opinion pieces	Competence, Context
Factsheet		x	x	Cartoon inspired factsheet for children, creative form factsheet	Context, Competence

Appendix 7: Media monitoring

As part of the CIP project, a limited media monitoring campaign is performed.

Objectives of media monitoring

- To gain insight into the news coverage of the radioactive waste issue
- To gain insight into the public perception and sentiment on the subject
- To gain insight into the public understanding of the subject
- To detect and monitor changes of the above, whether or not as a result of a (future) communication strategy

Criteria and limitations for the media monitor

- Lengthy monitors (longer than a year) are likely to provide an excess of data. Limited or recurring monitors for a shorter period (e.g.) will provide a more general but manageable representation of media attention and sentiments.
- Media monitors require time and efforts; establishing, maintaining and analysing

Set-up of the media monitor

With these conditions and limitations in mind a basic, quantitative media monitor was performed, making use of Google Alerts. The monitor ran over a period of 35 months, starting 1 June 2014 and ending on 30 April 2016. Search profiles were used with key words and Boolean queries to limit the results to news and topics that deals with radioactive waste, and more specific with radioactive waste management and disposal. During that time alerts were given on eight keywords or keyword combinations. The initial searches were refined after the first test run, in order to include the words 'OPERA' and 'safety case'. The resulting list of used keyword is:

- '*radioactief EN eindberging*' (= '*radioactive* AND *waste disposal*')
- '*kernenergie EN afval*' (= '*nuclear energy* AND *waste*')
- '*nucleair afval*' (= '*nuclear waste*')
- '*eindberging* EN *nucleair* EN *kernafval* EN *radioactief*' (='*waste disposal* AND *nuclear* AND *nuclear waste* AND *radioactive*')
- '*kernafval*' (= '*nuclear waste*')
- '*OPERA* EN *nucleair*' (='*OPERA* AND *nuclear*')
- '*Safety Case*' EN '*OPERA*' (='*Safety Case*' AND '*OPERA*')
- '*nucleair EN eindberging*' (= '*nuclear* AND *waste disposal*')

Analysis of the outcome

In the first four months of the media monitor only the amount of the Google Alerts and media type was noted. It quickly became apparent that this would only give a quantitative result that would be difficult to analyse. Therefore, during the rest of the media monitor all Google Alerts were noted with a date, media source and subject line thus providing more meaningful information.

Example of broader notation:

1 oktober 2014:	*westerwolde actueel: GroenLinks Stadskanaal organiseert bijeenkomst over opslag kernafval in zoutkoepels*
1 oktober 2014:	*drimble.nl: GroenLinks Stadskanaal organiseert bijeenkomst over opslag kernafval in zoutkoepels*
2 oktober 2014:	*friesenieuwsflitsen.nl: Geen kernafval onder sneek of elders in de gemeente*
8 oktober 2014:	*Elsevier: Booreiland ontruimd om radioactief schip*
19 oktober 2014:	*Reporter: Kernafval Petten: 'Niemand weet wat voor kernafval er ligt'*

Results

In total 632 Google Alerts were included in the Media Monitor. The Media Monitor was set up to cover the Dutch media. Because of the common language, Belgian media alerts were also part of the monitor. Starting the fifth month of the monitor all alerts were noted with a short description, date and media source and, as far as possible, Belgian media sources were excluded from the monitor.

The keyword 'k*ernafval*' got the largest number of hits with 269 results, followed by '*nucleair afval*' (160) and the Boolean queries '*kernenergie & afval*' (153), '*radioactief & eindberging*' (41). The searches on the combination 'e*indberging & nucleair & kernafval & radioactief*' and '*nucleair & eindberging*' were least successful with only two and seven Google alert hits, respectively. For the combinations '*Safety Case & OPERA*' and '*OPERA & nucleair*', not a single Google alerts notification was recorded during the media monitor period.

Table 1: Overview number of hits of media monitoring per year

Keywords	Number of hits				
	2013	**2014**	**2015**	**2016**	**Total**
radioactief EN eindberging		7	34		**41**
kernenergie EN afval	10	29	109	5	**153**
nucleair afval	38	41	53	28	**160**
eindberging EN nucleair EN kernafval EN radioactief	0	0	2	0	**2**
kernafval	35	130	81	23	**269**
OPERA EN nucleair	0	0	0	0	**0**
Safety Case EN OPERA	0	0	0	0	**0**
nucleair EN eindberging	0	3	4	0	**7**
Total numbers:	**83**	**210**	**283**	**56**	**632**

Table 2: Overview number of hits of media monitoring per media type

Keywords	Media type						
	Blogpost	**National newspaper**	**Regional newspaper**	**Forum**	**TV**	**Radio**	**Total**
radioactief EN eindberging	*29*	*6*	*5*	*1*	*0*	*0*	*41*
kernenergie EN afval	120	22	9	1	0	1	153
nucleair afval	75	54	20	0	8	3	160
eindberging EN nucleair EN kernafval EN radioactief	1	0	1	0	0	0	2
kernafval	163	27	71	0	6	2	269
OPERA EN nucleair	0	0	0	0	0	0	0
Safety Case EN OPERA	0	0	0	0	0	0	0
nucleair EN eindberging	5	2	0	0	0	0	7
Total numbers:	**393**	**111**	**106**	**2**	**14**	**6**	**632**

Discussion & conclusion

Although this Media Monitor has been up for a considerable amount of time, it was limited to Google Alerts. The results give an overview of the media attention on the subject over a long period of time but the fact that a key word or combination of key word did not yield any results does not necessarily mean it has not received any media attention: it just didn't come up in the Google Alerts.

A long-term Google Alerts media monitor with minimal efforts can offer a statistical baseline that will show the amount of media attention on a specific subject. It shows whether or not media attention is growing or diminishing. Regarding the very long run-time of the OPERA project a basic media monitor like this would fit the purpose. Google alerts preferences can be set to daily updates and provides exact publication dates thus making it possible to keep a close eye on the media attention. The outcomes of such a monitoring may be used to consider communication actions, e.g. taking part in discussions or providing additional information where misunderstandings may direct a public discourse. This would require more in-depth analysis of the outcomes by reading the news, determining the sentiment of the reports and tracing the relevant events that led to the media attention on moments with increased media attention.

Such an in-depth analysis was done for a presentation at the OPERA Expert Meeting in November 2014[19]. The media monitor showed a peak in the alerts in July and October 2014 when the amount of alerts almost doubled in comparison to the previous months. Upon further analysis, the reason for the increased media attention could be traced back to an article in a regional newspaper that was referring to a TNO report. After closely reading the sources of the Google Alerts, the development of the media attention could be traced back, starting with an article on the TNO report in the regional newspaper followed by local media attention and finally parliamentary questions on the subject. All through this process the sentiment was mostly negative.

Finally, media monitoring can be used to analyse the effects of a communication strategy or to adjust the implementation of communication tools. It is advisable to focus communication efforts on a specific timeframe and then analyse the outcome. The release of a report or a public announcement of a meeting or decision that is expected to spark media interest could be a good reason to start a media monitor or to intensify a long-term one.

[19] Jelgersma, E, TJ Schröder, *OPERA-CIP - communication in perspective. Online media monitor*, Presentation at the 4th OPERA Expert meeting, Utrecht, November 2014.

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