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# NO TIME WASTED!
# 25 years COVRA: Radioactive Waste Management in the Netherlands

Hans D.K. Codée, Ewoud V. Verhoef
COVRA N.V.
P.O. Box 202, 4380 AE Vlissingen, The Netherlands

## ABSTRACT

Time will render radioactive waste harmless. How can we manage the time radioactive substances remain harmful? Just ‘wait and see’ or ‘marking time’ is not an option.
We need to isolate the waste from our living environment and control it as long as necessary.

December 2007 was a time to commemorate, as the national waste management organisation of the Netherlands, COVRA, celebrated its 12th anniversary. During this period of 25 years a stable policy has been formulated and implemented.
For the situation in the Netherlands, it was obvious that a period of long term storage was needed. Both the small volume of waste and the limited financial possibilities are determining factors. Time is needed to let the volume of waste grow and to let the money, needed for disposal, grow in a capital growth fund.
A historical overview of the activities of COVRA is presented and lessons learned over a period of 25 years are given.

## INTRODUCTION

Time is about the only thing that will destroy radioactivity and render radioactive waste harmless. Radioactive waste management is therefore a kind of time management. How can we manage the time radioactive substances remain harmful? Just ‘wait and see’ or ‘marking time’ is not an option.
We need to isolate the waste from our living environment and control it as long as necessary. Up to a million years of control cannot be offered by any societal structure. Only the geology of mother Nature has this capacity. Practical factors influence societal choices strongly and therefore worldwide only a small amount of long-lived waste has been brought in a deep geologic repository. It seems however only a matter of time before all waste will be contained in the deep underground.

December 2007 was a historical time for COVRA, the national waste management organisation of the Netherlands. COVRA celebrated its 25th anniversary. During this period of 25 years a stable policy has been formulated and implemented.

In the Netherlands one nuclear power plant, two nuclear research centres, a uranium enrichment plant and a medical isotope production facility are in operation. In addition, there is a widespread

use of radioactive materials in other areas. The nuclear power plant Borsele (PWR, 450 MWe) is in operation since 1973 and is scheduled to remain operational until 2033.
The annually produced quantity of radioactive waste in the Netherlands is small and very heterogeneous. All radioactive waste is managed by COVRA, the Central Organisation for Radioactive Waste. Its task is to execute the policy of the government. The policy lays down that all radioactive waste will be stored above ground in engineered structures allowing retrieval at all times for a period of at least 100 years. After this period of long-term storage final disposal is foreseen. The policy is based on a step-wise decision process in which all decisions are taken to ensure safe disposal in a repository, but without excluding unforeseen alternative solutions in the future.
Buildings for the treatment and storage of all categories of waste have been constructed, commissioned and are now in full operation. COVRA has a site available of about 25 ha at the industrial area Vlissingen-Oost. There is a facility for the treatment of low and medium level waste as well as a modular storage building for the cemented waste packages. A separate storage building is available for the very low level radioactive waste from ore processing industries. This calcined waste product is stored in 20 ft standard size containers. Depleted uranium is stored in another building; this material is stored as the uranium oxide in DV70 containers. The storage facility for high level waste, mainly spent research reactor fuel and reprocessing waste was commissioned in 2003 and operates to full satisfaction. Information on the siting process, licensing, construction and practical experience in the Netherlands can be found in the literature and in the NEWMDB of the IAEA. [1, 2, 3, 4, 5]

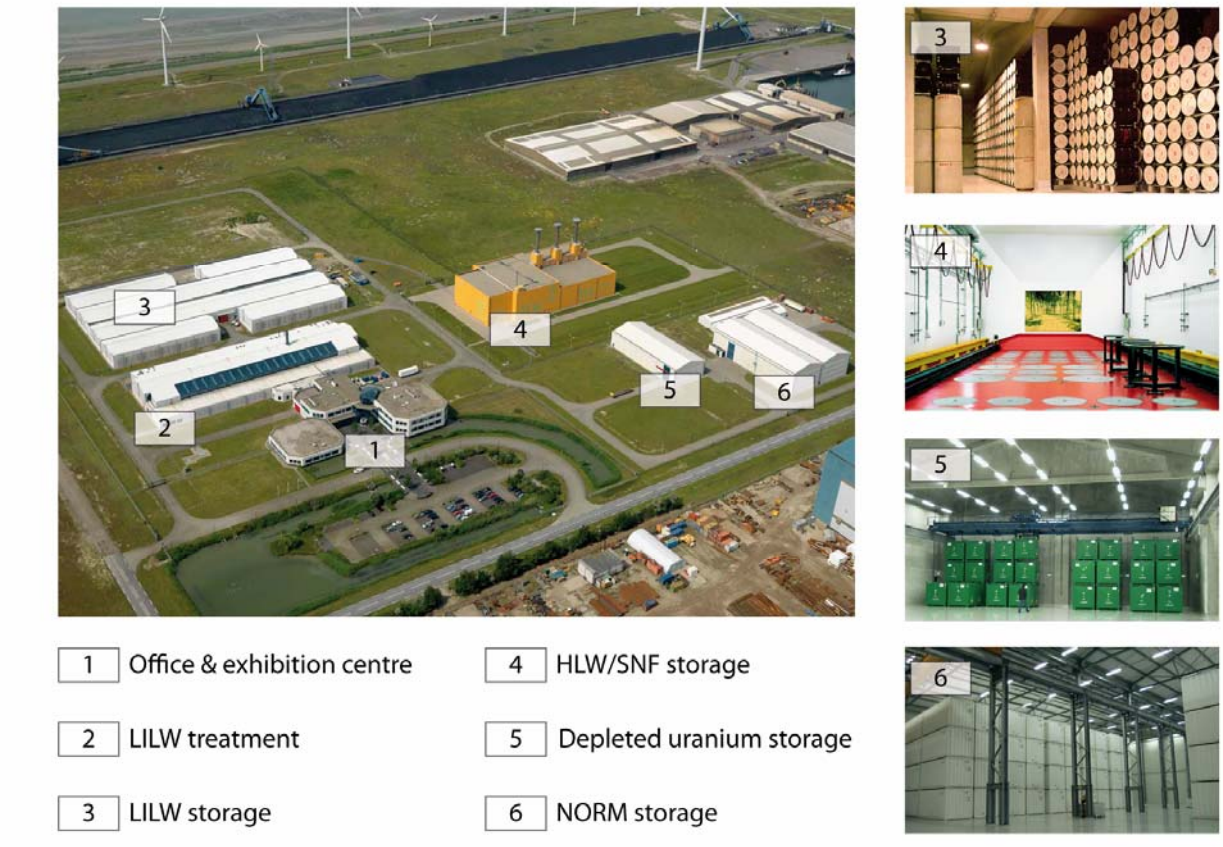


**Figure 1. The COVRA facilities.**

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**1895-1982**

We know about radioactivity since its discovery in 1896 by Henri Becquerel. Röntgen discovered X-rays the year before and Pierre and Marie Curie spoke for the first time about radioactivity in 1897. The first uses were mainly in the medical and research field and the wide spread use of radium in watches and other equipment. The first nuclear reactor became critical in 1942 and the boost of nuclear applications in research, medicine and energy production started in the mid fifties of the last century. In almost all countries the first steps into the nuclear area were with the construction of a research reactor. Research centres were created in Europe such as in Petten in the Netherlands, SCK-CEN in Belgium, the centres in Karlsruhe and Jülich in Germany, Ispra in Italy, or Ciemat (formerly JEN) in Spain.

During all these years the Environment was not at stake because it had not yet been invented! Radiation protection however started early after the discovery of ionizing radiation. The International Commission on Radiological Protection was established in 1928. During many years man was protected but the environment was ignored and waste was not a problem.
The general philosophy in waste management was to dilute and disperse. Discharges into the air, rivers or seas were standard practice because it was not realised that the dilution properties are not endless. Realise that it is only recent that we generally acknowledge that carbon dioxide should not be diluted infinitively.

In the past, solid waste was dumped in landfills without segregation on hazardous properties. The hazards and both the complexity as well as the importance of the environment were underestimated. Still today we are far from really understanding the complex processes in nature. In Japan in the Minamata Bay pollution with mercury caused many victims. Bhopal and Seveso can be mentioned as well. Scandals and careless behaviour, but also growth of prosperity and increasing living standards opened the eyes of world for the importance of the environment in the second part of the last century.

Radioactive waste is very small in quantity and was originally often kept on site of research establishments. Sometimes it was buried shallowly together with other waste or dumped into the ocean. The last practice started as an uncontrolled mechanism. Drums with radioactive waste were simply set overboard in the middle of the ocean. In the sixties and seventies of the last century an international surveillance mechanism was developed, controlling the practice. It was common practice in European countries such as Belgium, France, Germany, Italy, Netherlands, United Kingdom, Sweden and Switzerland. Violent opposition by environmental groups as well as the development of a new philosophy for waste management brought an end to this practice in 1982. In stead of ‘dilute and disperse’, the philosophy for the management of hazardous substances including radioactive waste became ‘contain and isolate’. In today’s century this philosophy has been changed into ‘integral chain control and sustainability’.

With the new philosophy, the Netherlands also had to develop a new policy for the management of the nation’s radioactive waste. Essential element in the new policy was the establishment of a dedicated radioactive waste management organisation. COVRA was born in 1982!

**1982-1992**

In the new policy all radioactive waste produced in the Netherlands has to be managed by COVRA. Its only statutory task is to execute the policy of the government with respect to radioactive waste. The main elements of the management system are:

- all kinds and categories of radioactive waste are stored for at least 100 years above ground, in engineered structures, which allow retrieval at all times;
- the long-term storage, together with a central treatment facility is considered as a normal industrial activity and is located on one single site;
- research will be performed on final disposal possibilities within the Netherlands or within an international framework.

Direct disposal is not yet feasible in the Netherlands. A disposal site for this type of hazardous waste is not available and the small volumes of waste do not require an immediate final solution. Furthermore the public acceptability for deep geologic disposal is low and the financial burden of a direct disposal facility is prohibitive for the small quantities concerned. The money can however be generated when a capital growth fund is allowed to grow over a substantial time period. Long-term storage also allows for the application of future international or regional disposal solutions or even completely new techniques to remove the hazardous constituents.

COVRA started its activities at the site of the Energy Research Foundation (ECN) at Petten. This was just for historical reasons. Since the beginning of nuclear activities in the fifties waste treatment and the organisation of the sea-dumping operations was done by the research institute. In the eighties such an activity was felt as inappropriate for a research establishment.

The first years at Petten COVRA had to set up an organisational structure and a practical infrastructure to collect the waste. A storage building for low and medium level waste was constructed with a capacity of ten years waste production. An office building was constructed and employees were hired. Due to political agreements, COVRA was only allowed to stay at the Petten site for a period of ten years at the most. Setting up the organisation was the first job, but preparing for the future came directly afterwards.

A site had to be found for COVRA's long-term activities. This was considered to be a task of the government. Volunteers were not really expected and therefore a site selection procedure was set up. On the basis of the recommendations of the site selection committee, the information given in the "site independent-EIS" and additional consultations with local authorities the Minister of the Environment left the choice for the final site to COVRA. Approval of this choice by the government would be given by granting the necessary licences. In June 1986 COVRA selected a site in the municipality of Borsele, close to the site of the nuclear power plant.

Ultimately licences were granted and the construction activities started at the new site in 1990. The available site is about 25 ha. An office building, a waste treatment facility and storage facility for low and medium level waste were erected and commissioned between 1990 and 1992. All waste at the Petten site was brought over to the new facility and all waste management activities in Petten were ended.

**1992-2007**

After the completion of the necessary buildings for the low and medium level waste, in 1999-2000 a facility for low level waste from the ore processing industry was built and commissioned. In 1994 the licensing procedure started for the high level waste storage facility. The construction phase started in 1999 and the building was inaugurated by HM Queen Beatrix in 2003. In 2004 a building was constructed for the storage of depleted uranium, resulting from the enrichment facility in the Netherlands.

At the new site COVRA took it as a challenge to built a good relationship with the local population. As soon as we could show real activities, COVRA could work on the process to obtain acceptance by the community. In the design of the facilities attention was paid to psychological and emotional factors. It was felt that a good looking exterior could help to establish a good relation.

Visitors are always welcomed. Normally they will get an explanation of what radioactivity is, of the uses and dangers of radioactive materials and they get a guided tour in the facilities. In total these visits take at least two, but most of the time up to three hours. Seldom visitors come to our facility without notification.
In the lay-out of all the installations the possibilities for visitors to have a look at the work as it is done, has been considered. Creating a good working atmosphere open to visitors was aimed at. For instance the entrance of daylight in the radiological areas is an example.

Nowadays there is hardly any opposition against COVRA. From the region quite some people have visited our facilities and generally they take a positive attitude towards COVRA. This does not automatically mean that they are also in favour of nuclear power production, but it takes some of the emotions away from that discussion.

During construction of the high level waste storage building, the so called HABOG facility, the idea was born to do something special. Discussions with an artist, William Verstraeten, resulted in a provocative, but brilliant idea. He launched the idea to integrate the building into an artistical concept. He created ‘Metamorphosis’.

Metamorphosis. The building itself is now a piece of art, it is a statement by itself. The building is an orange object. Orange because this explains the transition between dangerous (red) and safe (green). To make a link with the activities on the inside, on the outside wall three formulas are painted in green. The ‘Einstein formula’, written in the well known form as $E = mc^2$ as well as $m = E/c^2$ and ‘Planck’s formula’, $E = h\nu$. Metamorphosis from mass to energy.
The decrease in heat production of the high level waste will be shown on the outside of the building. Every time that the building needs to be repainted this will be done in a colour that is slightly lighter then the existing one. After about 100 years the colour will be white in stead of orange. There are many more relations between the art concept and the waste management concept. Both are mixed and related and cannot be separated anymore. The strictly rational scientific world and the emotional artistic world have become one. COVRA offered to the community of Borsele the largest art work of the Netherlands together with the storage facility for radioactive waste.

In stead of the modest non-provocative and somewhat silent attitude we showed during the first years of our existence, now we are actively present. We are proud on our work and we like to show that. Our work is necessary and useful for society. We will certainly not hide our activities but show them and make it worth looking at them. With this attitude we will do our work for the next 25 years and further.

## NO TIME WASTED! WHAT DID WE LEARN?

During the existence of COVRA, we learned from our experience to treat a large variety of radioactive waste and to implement long-term storage. Many others learned the same thing, some things are so obvious that you hardly recognise them as lessons learned. Hereafter the experience will be shared in the form of relatively short statements. The list certainly is not complete and contains communication, policy and technical points.

1. *Tell about the decay of radioactivity*
   That time makes radioactivity, and hence the danger, disappear, is like magic to most people. But, keep telling it, keep explaining it. Do not use only logarithmic plots with extremely long time scales, most people cannot read them. Everybody knows that radioactive materials 'produce' radiation; almost nobody knows that they decay.
2. *Show that radiation and radioactivity are part of nature*
   At COVRA's exhibition centre we have a cloud chamber. For most people this is an eye opener. Such machines should be present at many places, schools, universities, science exhibitions etc. Tell about the presence of radioactivity in the human body. Generally, there exists black and white thinking: no radiation is good, any small amount of radiation will cause cancer and death.
3. *Tell that nuclear power stations are not the only sources of radioactive waste*
   Radioactive materials used outside the world of nuclear power stations are not harvested from trees. You need a reactor to produce them.
4. *Create direct contacts*
   Sending out a lot of information does not mean that it will be read nor understood. COVRA started with free newsletters. The impact is very limited. It is better to invite people to your facility. Make sure that you can visit and see 'everything'. Implement this in the design of your facilities. The closer you can look at things the better.
   Look for opportunities to start communication. The artwork 'Metamorphosis' is very often the start of a contact with people; much more than radioactive waste is. With art you will reach the non-technical part of the population, which is by far the majority. Be creative, there are certainly other ways too! Our own enthusiasm for technology and exact science is not enough to bridge the knowledge gap with society.
5. *Public acceptance increases when you are not situated in remote area's*
   For the siting process, COVRA has been treated as a 'normal' industry and is now located on a 'normal' industrial area.
6. *Long-term storage or direct disposal are not opposing policies*
   Long-term storage is a phase in the process to disposal; the length of which depends on the waste volume production rate.
7. *Creating a dedicated waste management organisation has been proven to be valuable*
   Dedicated waste management organisations were first set up in the eighties in Western-

Europe; this has been followed in the nineties by the creation of dedicated waste management organisations in almost all European countries.

8. *A stable, national policy for radioactive waste management is extremely valuable*
   A waste management organisation gains trust from the population when they show stability in their policy, this requires stability on national policy level.
9. *Getting started with a solution is the difficult part*
   A facility in operation and impeccable conduct will loose public interest. Public interest will generally be focussed on activities that are new; a newcomer will have problems because he cannot yet show real facilities. The public has difficulties in reading and understanding drawings and plans. Starting a new nuclear activity in an area where a nuclear activity is already present is easier than starting in a virgin area.
10. *For long-term storage of LILW a cemented waste form, small packages, inspection possibilities, humidity control and simplicity have proven their value*
    All LILW is treated such that the final product is embedded in concrete. Although the variety of waste products is large, the experience is positive. A solid product and an alkaline environment is created, this prevents internal chemical activity or damage.
    The standardized waste form is a 200 litre drum or a 1000 litre container. The 200 litre drum is a galvanized steel drum filled with concrete and waste. The 1000 litre container contains a 200 litre steel drum with cemented waste. Standardized and relatively small packages have been chosen in order to ease handling and repair when needed.
    Horizontal stacking on pallets in blocks creates inspection possibilities.
    Because of our coastal location air humidity control with simple mobile equipment has proven to be valuable: it prevents condensation and diminishes corrosion.
11. *Waste tariffs should be linked to parameters that can easily be measured*
    The COVRA tariffs for LILW are linked to physical state, liquid or solid, to volume and to surface radiation dose. Deliberately there is no link to radionuclide or activity, because these are not so easy to control. Because of the absence of a price relation, the information on radionuclide and activity can be trusted.
12. *For the long-term storage of HLW corrosion prevention, intervention possibilities and simplicity of design are important*
    Spent nuclear fuel from research reactors is stored in canisters filled with helium; these canisters as well as vitrified waste cylinders are stored in an argon atmosphere. An empty storage compartment is available; when inspection or repair is needed a filled storage compartment can always be emptied.
    A cooling system based on natural convection minimises control and maintenance.
13. *Both for LILW as for HLW, only contamination free packages are stored*
    In the storage buildings contamination is absent. In the case of handling, resulting in contamination, the contamination will always be removed. Radiation protection regime can be limited to radiation fields only.
14. *Small is beautiful?*
    Of course it is wise to create as little waste as possible. However, when the waste volume becomes very small the economy of scale may work against good solutions. Regional, or multilateral, co-operation both with respect to treatment of waste as well as with respect to long-term storage and definitively with respect to final disposal will result in better solutions. State boundaries are temporary lines drawn by man. Sustainability and security should not be controlled by temporary situations, they should be controlled by

supranational structures. Although time will result in the total decay of radioactive waste, the solutions we create should be as independent of time as possible.

## CONCLUSION

The size of the nuclear programme in a country strongly influences the choice of a radioactive waste management system. In the Netherlands a tailor made system has been developed that now is in operation for 25 years. Lessons are learned on both the technical aspects as well as on public relation aspects. The Netherlands can be proud on the infrastructure that has been put in place and that operates to the full satisfaction of its users.

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