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SAFE IS BEAUTIFUL!

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ABSTRACT

In the Netherlands long-term (100y) storage of all waste types in above ground, engineered structures, is a basic element of the waste management system. This is not a 'wait-and-see' solution, because at the same time provisions are taken for the final disposal.
Facilities for treatment and storage of low, medium and high level waste are in operation. The facility for high level waste was commissioned in 2003. This facility is not only a technical building but also a work of art. We show that we are proud on our work. SAFE = BEAUTIFUL!

I. INTRODUCTION

Safe is beautiful! This may seem a strange slogan for radioactive waste management. Normally, safety is the dominant theme in the nuclear industry. Beauty is seldom linked to it. Safety standards, safety principles and safety guides: in no other industry one will find so much documents related to safety. However, the result is a continuous discussion on this item. Safety analysis was more or less born in the nuclear industry [1], but never got the credit for it. Safety was the major topic in discussions with the public on the use of nuclear power for electricity production. But, since the nineties and strangely enough after Chernobyl, the major discussion topic shifted to the waste 'problem'. A majority of the people is willing to accept nuclear power when a solution is found for the waste [2]. But, in the discussions on long-term waste management the 'problem' is then again shifted to safety and safety is translated in numbers that are meaningless to the majority of the people: it creates a large gap between the technical community and the others.

In reality, safety is not at all a problem for radioactive waste management. Radioactive waste can be managed with very high safety standards. Safety levels can easily be reached that are much better than for many other activities accepted in society. It seems that the continuous effort to improve on safety, even when levels of 10^{-6} and much lower are already reached, work contra-productive in the discussions with the public. The result is that people are not convinced of the overall safety because the numbers remain meaningless. When you pay so much attention to this item the activity must be extremely dangerous: low is never low enough, only zero is acceptable!

Discussions on safety numbers will not bridge the gap. Bridging the gap and just starting the communication is perhaps possible when discussions are brought to other and more emotional items such as beauty. When two-way communication starts here, possibilities are created to get acceptance also for the technical items.

COVRA followed this approach in the long-term storage building for high level waste. The technical building was transformed into an object of art.

II. COVRA

All radioactive waste produced in the Netherlands is managed by COVRA, the central organisation for radioactive waste [3, 4, 5]. The policy is that all kinds and categories of radioactive waste are stored for at least 100 years at one site, above ground in engineered structures, which allows retrieval at all times. After the period of long-term storage, final disposal within the Netherlands or within an international framework will take place.

Direct disposal is not feasible because the financial burden is prohibitive for the small quantities concerned. The money needed, estimated to be € 1.3 billion, must be generated with a capital growth fund that is allowed to grow over a substantial time period.

The small quantities of waste can easily be isolated from the environment by storing them for a long time in buildings. Such long-term storage also allows for the application of future disposal solutions (regional or international) or even completely new techniques to remove the hazardous constituents.

The choice to store for a long time was well considered and was not taken as a 'wait and see' option. This is clearly demonstrated by the fact that integral parts of the policy are: the establishment of the capital growth fund and a clear choice for the ownership of the waste that is transferred to COVRA. This policy does not leave the burden of waste generated today to future generations. Only the execution of the disposal is left as a task for the future. All the waste will be kept at one site, well isolated from the environment, well controlled and well monitored.

Many countries with small nuclear power programs face the reality that the quantities of waste to be managed are very small and consequently the amount of money available is also relatively small. In the Netherlands this reality was translated into a policy that works, while in many other countries this reality is neglected and maximal efforts are given to the creation of a final disposal site which economically is not affordable. Countries with small nuclear programs can only afford direct disposal when regional solutions are created [6].

The COVRA facilities at Vlissingen-Oost

COVRA has a site available of about 25 ha at the industrial area Vlissingen-Oost. The site selection process has been described in the literature [7]. At this site a facility is in operation for the treatment and storage of all categories of waste.

The facilities for the treatment and storage of low and medium level waste were erected between 1990 and 1992. In 2000 a storage building for very low level radioactive waste from ore processing industries was commissioned (TENORM waste) and in 2004 a storage building for depleted uranium from the enrichment facility in the Netherlands was commissioned. The construction of the storage facility for high level waste started in 1999 and was opened by H.M Queen Beatrix in September 2003. The first high level waste was stored in the building in November 2003. Both vitrified reprocessing waste as well as spent fuel from research reactors are now stored in this facility.

III. SAFETY

In the design of the facility safety played an important role, both conventional and radiological safety. All aspects normal for nuclear installations were covered: redundancy, defence in depth, physical separation, etc.

The radiological consequences of normal operation conditions were analysed. The result is that outside the facility the risk is lower than 10^{-8} fatalities per year. This is the result when radiological releases are at the level of permitted values. Reality over the past years is that less than 10% of the permitted value is emitted.

For accident conditions a probabilistic safety assessment was performed. Accidents with a frequency of occurrence 10^{-6} were analysed for their consequences. For the high-level waste storage building these accidents had to be taken in account in the design. This meant that accidents up to that frequency level might cause no radiological consequences. Accidents considered are:

- earthquakes with a strength of VI½ on the Mercali scale;
- a plane crash of a F16 fighter;
- flooding resulting in a water level 10 m above normal sea level in the Netherlands;
- LPG gas cloud explosions;
- severe windstorms with wind velocities of 125 m/s.

The result of the safety assessment is that outside the COVRA site the risk is less than 10^{-8} fatalities per year.

After the September 11th events, questions were asked about the safety of the HABOG-facility. The explanation that the building was designed to withstand a plane crash and that a long lasting kerosene fire inside the building following the plane crash can be excluded, immediately took fears away and added positively to the feeling that ‘everything’ was taken in account.

The overall safety level of the COVRA facilities is better than that of other industrial activities in the direct neighbourhood. Therefore safety should not be an issue of discussions.

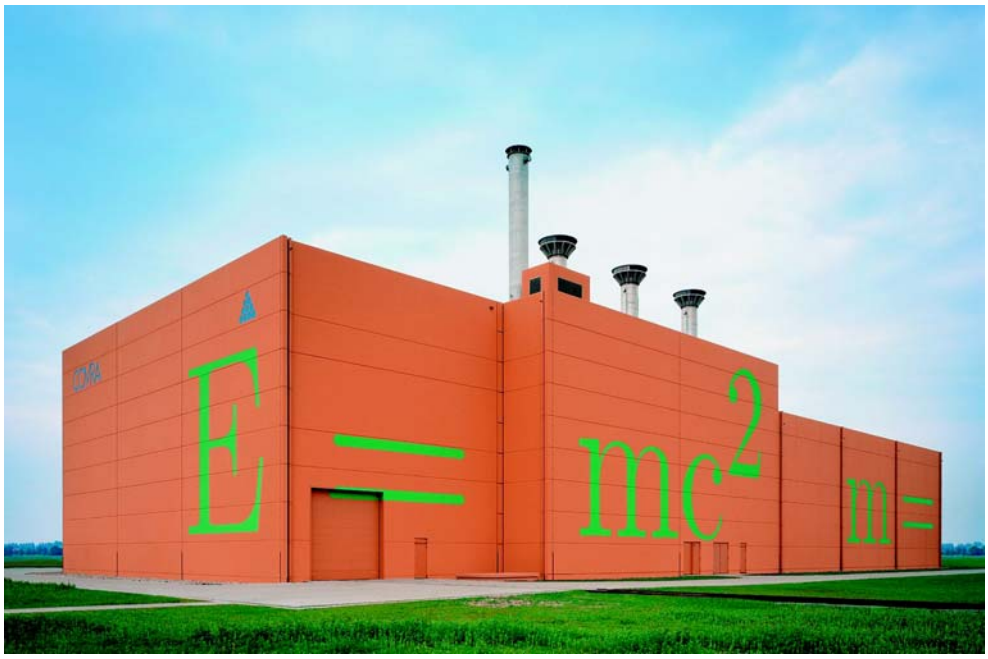
IV. BEAUTY

Already in the nineties, 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 with the public. In the architecture of the buildings the following items had to be recognised: stability, carefulness, good quality, reliability and the buildings must look up to date for a very long time.

The reception of the office building and the exhibition area are directly accessible to visitors. 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. In the layout 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 controlled areas in the waste treatment building is an example.

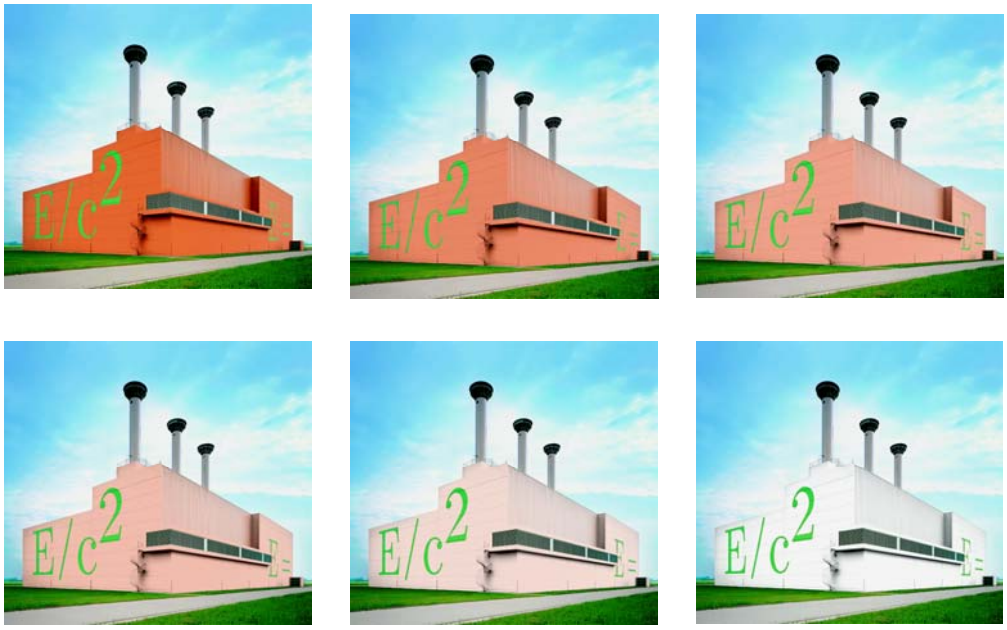
The openness, the attention paid to details such as the exterior of the buildings, the fact that COVRA's activities can really be shown from the inside and an impeccable conduct and behaviour over the past years, resulted in acceptance by the population.

For the appearance of the exterior of the storage building for high-level waste, the HABOG-building, a new approach was followed. Discussions with an artist well known in our region resulted in the idea to make something very special of the new building. This artist, William Verstraeten, creates pieces of art that are not only a joy to look at. Even more important is that his creations invite you to think about things. In his works the effect or possible effect of physical phenomena is often addressed [8, 9]. He became very intrigued by the nuclear processes, the care that has to be given to the waste for long but well known time periods and the interaction with society on these activities. He launched the idea to integrate the building into an artistically concept. He created 'Metamorphosis'. The outside of the building must make people eager to know what is going on inside. Inside the building, that is inside a structure without any window and walls, floors and ceilings of 1.7 m thick concrete, visitors must be made eager to look at the world outside.



HABOG, the treatment and storage building for high-level waste

The building itself became a piece of art, it is a statement by itself. The building has been transformed in a bright orange object. Orange because this explains the transition between dangerous (red) and safe (green). To make a link with the activities 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 vitrified waste in the building produces heat, but in the next 100 years the heat production will change from significant to insignificant. This change in heat production 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 lightly lighter then the existing one. After about 100 years the colour will be white in stead of orange.



Changing from orange in 2003 to white in 2103

Inside the building at four positions a special photograph of a beautiful landscape in the region is shown. It is a landscape formed some 500 years ago and it shows the changes caused by the combination of human and natural activities. The photograph is presented as a colour transparency and forms a window to the outside world.

The beautiful landscape stands of course for the valuable environment that we have to protect. This landscape will still be there after 100 years if we protect it. At a first glance nothing is special on the picture, however if you take a close look at it, it becomes clear that the horizon is present two times. This represents the fact that long-term care is at stake in our work: ‘look over the horizon that you normally take into account’.

Furthermore the picture is shown four times, so as to represent the process of decay. The first colour transparency is the full colour picture. In the second, third and fourth each time a major colour component, yellow, blue and magenta, is extracted. The result is a picture where the colours decay from full colour to bluish, to purple/reddish and finally to just black points. The last picture is not a transparency but the black points are printed on gold leaf and so the last picture becomes the most precious one. A precious thing brought into a building to store worthless waste material. Metamorphosis of a colour picture, metamorphosis of something worthless into something valuable.

The pictures are positioned in the building such as that they correspond in colour to the colour scheme of Feng-shui. Feng-shui was developed 4000 years ago in China and it follows the concept of chi-energy going from one place to another. So here a completely other energy concept than the physical one of Planck and Einstein is introduced.

Metamorphosis

There are many more things that show transformations and 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. SAFE = BEAUTIFUL!

V. CONCLUSION

We are proud on our work and we like to show that. Our work is necessary and useful for society. We will not hide our activities but show them and make it worth looking at them. All radioactive waste produced in our country is brought into the community of Borsele and of course we will take care of it but together with that we open the possibility to look at it differently. We also brought an object of art, a thing of beauty.

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