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Practical consequences of the current legislation and government policy on natural radioactivity for the mineral sands industry

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PRACTICAL CONSEQUENCES OF THE CURRENT LEGISLATION AND GOVERNMENT POLICY ON NATURAL RADIOACTIVITY FOR THE MINERAL SANDS INDUSTRY

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ABSTRACT

The Dutch Nuclear Power Act (Kern Energie Wet, K.E.W.) has primarily been written for the nuclear industry and the radiological industry. Due to the absence of any other possibly applicable legislation on radiation however, the Dutch government has adopted this Act for the non-nuclear industry as well, such as the mineral sands industry.

The result of this policy has been that debatable and artificial criteria are being applied and used to determine whether a 'non-nuclear' company is subject to a permit under the K.E.W. And once subjected to a permit, those companies are being faced with measures without hardly any relation to the risks they cause for workforce, public and environment, whereas companies that escaped from those criteria are not subjected to such measures, although the risks caused could be much higher.
In addition to that, an unacceptable difference with comparable industries within Europe is created, in an extremely international industry.

This currently applied ridiculous policy, which must have been developed far away from any practical knowledge, should come to an end as soon as possible until the new EC Directive is being enforced in May 2000, and measures should be taken only to protect the workforce, the public and the environment against pre-defined risks (i.e. radiation), based on a Risk Analysis to be carried out as an obligation under the labour law (ARBO-Wet) and the environmental law (Wet Milieubeheer).

INTRODUCTION

The subtitle of this paper could be 'Mr. Sandman', because I am going to tell you a fairy-tale about a sand storage and processing company in the Port of Amsterdam that you will hardly be able to believe. And the reason why I have made the effort to prepare this paper is my quest to publicise this fairy-tale, which sharply reflects the non-sense in the Dutch policy towards radioactivity legislation in the non-nuclear industry, and in particular to the mineral sands industry.

Please note that within this paper some terms and names might be mixed up slightly or are not being used correctly. For instance the applicable Dutch Government bodies are brought down to the Ministry of VROM, although other ministries are also involved, and when referring to the law I will speak about the KEW, although it should be the Besluit stralenbescherming Kernenergiewet (BsK). Since it does not affect the contents, please ignore this.

BRIEF DESCRIPTION OF EGGERDING

Eggerding is a company in the port of Amsterdam that discharges, stores and processes industrial minerals in the widest possible definition.

Since it combines the two main pillars of logistics and processing within one facility, Eggerding is a typical example of Value Added Logistics and is often used as a typical example of this principle in the port of Amsterdam.

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The company is located around a berth in the Coenhaven, and has a quaylength of 1,5 km and a total area of 150,000 m^2, of which 50% is covered storage.

Discharging is being done by means of floating grabcranes, providing maximum flexibility when discharging directly overboard into coasters and rhinebarges or into one of the many warehouses on the quayside where it is stored until further processing is required.

The processing ranges from sieving, washing, drying, grinding to micronising, which is the ultimum technology that Eggerding provides. Micronising of hard industrial minerals and sands means that a particle fineness of 100% < 3μ can be achieved.
Micronising takes place in ceramic lined ball mills with some unique features, that give Eggerding its worldwide competitive edge.

Eggerding is a 100% service company that offers the above mentioned services on a toll-basis for its wide variety of clients. It is therefore never owner of the products being handled, stored or processed at its premises.

The product range is virtually unlimited, since the number of industrial minerals is virtually unlimited. But the main products handled throughout the years are Zircon ($ZrSiO_4$), Rutile, Ilmenite, Garnet, Bauxite, Talc, Aluminium oxide and -hydroxide and feed-phosphates.

There is a wide range of application of these products throughout various industries, but the main focus is on the ceramic-, glass-, refractory-, steel-, paper- and plastics-industry.

HISTORY

Until 1989, no government authority had apparently ever thought about looking into radioactivity levels in the mineral sands industry or, at least, not at Eggerding which by that time was a major player in this industry for over twenty years already !
In that memorable year however, an alarm was received by VROM and by Eggerding from Leningrad that a shipment zircon sand originating from Eggerding in Amsterdam contained excessive levels of radioactivity. The reason this vessel was measured was because of the fact that this vessel had been used for transport of radioactive waste on its previous journey.
Following thorough investigations by various government bodies, however, it was found out that a comma had been placed incorrectly in the data listings, and that the actual level was 10 times as low as was indicated originally, and was therefore within the normal levels. The panic went, the problem seemed solved and the ship was discharged, but as a result of this incident the Dutch Ministry's attention had been drawn to Eggerding and soon the machine began to run.....

THE FIRST DISCUSSIONS WITH VROM

During the initial analyses of Eggerding's business VROM in the first place wanted to establish the actual risk levels of the exposure of the workforce and the public to the radiation from the various minerals. In the second place a decision had to be made whether Eggerding needed to apply for a full KEW-permit.

The first conclusion of the lengthy research period was that there was only one mineral of Eggerding's main business which really needed attention, namely zircon.
Zircon appeared to have typical levels of specific activity in the range of 70 Bq/g, with exceptional lots going up to 150 Bq/g. This radiation originates from the Uranium, Thorium and Radium nuclides within the $ZrSiO_4$ crystals. More about that will follow later.

WHAT IS ZIRCON SAND ?

For a full understanding of the problem it is necessary to elucidate a bit on the background of the natural ore zircon sand.

Zircon is one of the many erosion products of rock formations that wear and deteriorate naturally as a result of the influence of the wheather. With streams and rivers the material eventually flows into the sea and ends on the seabed.

Due to the wave motions applied to the seabed soil over thousands of years, the zircon is moved towards the coasts along with all other sands and materials on the seabed. As zircon is a heavy mineral however with a specific gravity of around 4,000 kg/m^3, the hydraulic forces have a different effect on zircon and the other heavy minerals compared to the ordinary silica-sand. And due to this effect a natural separation is created, splitting the heavy minerals from the normal sand and depositing it in concentrated areas with concentrations ranging from 3%-40%.
And this is why we find concentrations of zircon sand and other heavy minerals on various beaches around the world, mainly in Australia and South Africa. It is therefore a naturally deposited erosion product, and has therefore not always been there as part of the earth's crust.

Zircon is mined in open pits along with other heavy minerals, which are separated from each other by means of hydraulic separation processes.

PROCESSING OF ZIRCON SAND

One of the most important applications is the use of finely ground zircon as an opacifier in ceramic glazes. And ultrafine grinding is one of the services that Eggerding offers, including it's unsurpassed technology of dry micronising with a fineness of 100% < 3μ.

This fineness is achieved in a dry ball-milling process, whereby the material is transported through the mill by means of an airflow through the mill, which ends in a filter. This filter retains 10 mg/m^3 micronised particles, in accordance with the environmental permit applicable for the facilities in Amsterdam.

THE RISK ANALYSIS

Many calculations were run to establish the risk factor of the exposure of the workforce and the public to this radiation, and the conclusion was that no risk existed over the famous $1*10^{-6}$ criterium, except for one debatable element which heavily depended on the correction factor.

The risk factors were calculated to be as follows:

Risk from the chanelled air emissions	due to inhalation:	$1.9*10^{-7}$
	due to deposition:	$5.4*10^{-8}$
Risk from diffuse air emissions:		$5.4*10^{-7}$
Risk from water emissions	due to discharging	negligible
	due to drain outlets	negligible
Risk from ingestion of contaminated nutrients		negligible

Risk from external radiation	at the West pier	$1.9*10^{-7}$
	at the East pier	$7.4*10^{-6}$ (1)
	at the quayside	$9.2*10^{-8}$

(1): based on an extremely debatable correction factor 5 instead of 100.

Conclusion: in neither of these risk cases the factor $1*10^{-6}$ is exceeded and hence there should not be a problem.

THE PERMIT OBLIGATION

But now we arrive at the core of the case. The KEW states that a permit is compulsory when the chanelled emission into the air of *radioactive material* exceeds 50 mBq/m^3. With a specific activity of 100 Bq/g and a dust emission of 10 mg/m^3 an easy calculation learns that this results in a radioactive emission of 100 mBq/m^3, twice the limit.

And despite the fact that the risk factor never exceeds $1*10^{-6}$ (except for the one debatable one), VROM decided that a permit was compulsory and there we went.

Not having the necessary inhouse experience on this subject, Eggerding initially accepted VROM's wisdom, applied for a permit and after lengthy negotiations eventually got one in 1994, at that time not realising the injustice it was being subjected to. But since then experience and knowlegde was gained gradually on this subject throughout the past years and we realised what had happened.

THE INJUSTICE

What is the injustice in VROM's decision. The crucial factor is that the emission criterium of 50 mBq/m^3 would not apply if the emitted material would have been *solid, naturally radioactive material* instead of *radioactive material*. And that is where the trick lies: VROM is of the opinion that by micronising the sand, it it transferred from solid, naturally radioactive into radioactive. Criteria for this policy can not be found anywhere in the KEW, but are a pure interpretation of VROM.

Obviously we have been questioning why our physical treatment of the material caused this transfer. The reason is believed to be that it is not to be considered 'solid' any more after the grinding. We have been strongly opposing to this statement, based on a number of considerations:

- Ground material is still 'solid' in the physical sense of the word. When one would have to choose from the three physical aggregation phases solid, liquid or gaseous there can be no discussion. Yes, VROM said, but it can be blown away into the air and it does not stay on a spade (it is not 'steekvast' in Dutch). Actually it does, even better than unground sand, but such discussions one can hardly win.

- Prior to arriving in The Netherlands (or anywhere else), zircon sand is not at all natural any more when this criterium is applied. Firstly, zircon is found in concentrations ranging between 3% and 40%, amongst many other heavy minerals. Since the various minerals need obviously to be separated for the various applications, and in order to avoid shipping silica-sand over the oceans, it is separated at the mines already. What arrives in Amsterdam and Rotterdam is therefore highly concentrated material which has had various physical treatments, and with much higher radioactivity than the original ore on the beach ever had.

- In some other industries, KEW permits have been made compulsory since the ore was heated or calcinated, causing emission of Pb-210 and Po-210. The fact that such treatment causes a chemical alteration (changing of the matrix) of the original ore is considered to be a ground for transfer of such ores into radioactive material as well.
  Zircon sand is also calcined at the mine prior to shipment in order to burn out the organic contaminations, which affect the application.

The above means that based on VROM's policy on which materials are considered to be radioactive materials, all companies in The Netherlands that store, handle, process or transport zircon sand should be subjected to a KEW permit:

- Discharging and storage companies could illegaly have in its possesion, without knowing it when they are not measuring, radioactive material when the radioactivity exceeds 100 Bq/g, which happens incidently with zircon. Just because VROM considers the calcination in the originating country to be a change in the chemical matrix.

- All companies receiving ground zircon sand, in bulk silo, blown into their silo's, either from Eggerding or from any other supplier are probably exceeding the channeled emission criterium of 50 mBq/m^3 through the filter on top of the silo.

It is quite obvious that VROM has a massive problem in applying the KEW for the non-nuclear industry. Some companies are unnecessarily constrained, whereas others remain outside the reach of VROM's control.

WHY OBJECT TO A PERMIT ?

One could question: why object to a permit and make such a problem about the injustice being faced with compared to other companies ?

The reason is simple: due to the air emissions a permit is compulsory. Although unreasonable in itself already, the worst part is that due to this permit the entire operation in the port of Amsterdam is subject to this permit.

This means that one can store 100,000 tonnes of zircon sand in the middle of Amsterdam (provided that the risk level of $1*10^{-6}$ is not exceeded) without a KEW-permit, but when storing 10,000 tonnes in the port of Amsterdam and grinding 1 tonne, a permit is applicable for the entire facility, including the storage !

And a permit as a piece of paper only would be acceptable, but please note the top-of-the-iceberg list of regulations that are applicable in Amsterdam:

- radioactivity bookkeeping of all minerals stored in Amsterdam, including those that have the activity of a cobblestone. We need to know at any time how many Bq we have in stock;

- radiation protection by means of lead-slabs or concrete walls around the warehouses at the end of a pier in the port of Amsterdam, a place quiet as the desert;

- a level 3 radiological expert continuously on the payroll;

- yearly excessive reporting on the regular measurements around the premises, which figures vary hardly when we do not change the lay-out and the function of the facility;

- costly measurement and special transport and dumping regulations of all waste that leaves the premises.

And please remember: these measures are not mandatory when running a massive zircon storage terminal anywhere in The Netherlands, as long as no grinding takes place.

HOW WE PROCEED

It goes without saying that when we realised what was going on here, we approached the Ministry of VROM last year and confronted them with our facts and findings. And we must admit that its perception has been enlightening.

VROM realises the massive problem they are facing: when admitting now that subjecting Eggerding to a permit is not realistic, a massive claim will be the result. Since at the time of the permit application, VROM were the experts, and Eggerding can not be blamed for not providing this valuable background information that VROM claims was unknown to them. It should have been their homework.
On the other hand, when persisting that a permit is applicable and compulsory, an almost endless list of many more companies handling or processing zircon sand will have to follow. And that would mean that subjecting Eggerding was administrative (willekeur), which could also have consequences.

In the meantime, Eggerding has decided to follow the wisest path. We fundamentally disagree with VROM that we are creating radioactive material with our micronising process, and various expert opinions support our view. This would mean that we would have to fight this fundamentally, which will bring us eventually to the Highest Court of The Netherlands, since VROM is unlikely to give up immediately, realising what this would result in.

As a company, however, we don't feel it our public obligation to spend the funds to win this case, thereby creating interesting jurisdiction. We take the most economic path, which so far has been approaching VROM and requesting in all reasonableness to have our permit reduced to only those elements that in the eyes of VROM cause the permit: the chanelled air emissions.

And we are certainly willing to take all those measures that are considered wise to protect our workforce and the public against the risk of radiation, because that is not the issue of the case.
And fortunately VROM is willing to treat our dossier reasonably, probably also realising the weakness of its own position.

We are therefore a bit like Galileo Galileï, who admitted to the Roman Church that the earth was flat, but when leaving the church quietly whispered 'and still she is round'.

My message therefore to all future companies that will be facing the same non-sense: don't let VROM ever say: look at Eggerding, they also accepted it !

And my message to VROM is: drop all KEW permit cases, only look at the actual risk factors and have the necessary measures taken obligatory under the labour law (ARBO-Wet) and the environmental law (Wet Milieubeheer), and wait until the new Euratom guidelines will become applicable. They might be more stringent, but they are apparently a lot more realistic.