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An Emotional Approach to Future Sustainable Nuclear Energy Development

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One of the obstacles, possibly the most important one, to rapid future re-development of nuclear energy is people's anxiety, mistrust and total lack of enthusiasm for the uses of this form of energy. This is essentially an emotional problem.

The results of public polls should give us confidence in a much more positive future for nuclear energy. In Sweden, a majority of those interviewed favour the existence of the Swedish nuclear power plants. In May 1999 in the USA, the Nuclear Energy Institute (NEI) published results which showed that "Americans who favour nuclear energy clearly outnumber those opposed", but their "common perception ... is that a majority of Americans oppose nuclear energy".¹

If a majority supports nuclear energy use, why do so many governments, especially in Europe, close nuclear plants or promise to do so at a defined point in the future? Are they misinformed, like the American citizens, of what others think? Probably not. My explanation is that although when interviewed many people accept the survival of existing plants, they do not *like* them. "Politicians are looking for ideas that can be taken by everyone".² Politicians have to favour what the majority would like to see. When as a specialist of nuclear energy you get some acquiescence on the need for it, this is most often followed by the comment: "Is there no other solution?", or: "Could you do it in a better way?".

The purpose of this paper is to open the discussion on what is behind this last sentence; is there a "better" way to develop nuclear energy? Better meaning in this case something that more people would appreciate to see producing electricity.

An Historical Anxiety

Probably the most extensive study of this subject, *Nuclear Fear* by Stuart Weart³ was published in 1988. He wrote: "Fifteen years ago when I began studying the history of nuclear energy I did not think that images were important in themselves. I was wrong. Radioactive monsters, utopian atom-powered cities, exploding planets, weird ray devices, and many other images have crept into the way everyone thinks about nuclear energy, whether that energy is used in weapons or in civilian reactors. The images, by connecting up major social and psychological forces, have exerted a strange and powerful pressure within history."

Nuclear energy seems to be related in people's mind to a number of scary images:

- The atomic bomb.

- The scientist or engineer, technology obsessed (if not mad), and thus dangerous.
- Proliferation of dangerous materials, collected by super-skilled terrorists.
- Radioactive wastes, that will put future generations at risk.
- Exploding power plants (see Chernobyl) and the ensuing radioactive contamination.

There may be a few other items but these are probably the most frequently cited. These fears are not always evident from data collected on the feelings of the lay person. But literature and other artistic expressions such as films probably reflect correctly a wide range of expressed or hidden opinions.

The author and others made a survey of existing books and films which either have nuclear as their central subject or make strong allusions to it in the course of an otherwise different intrigue.⁴ These latter stories may have the widest influence, because usually they are part of a fiction that is highly popular; a recent example is the James Bond movie *The World is Not Enough*. The intrigue is more about oil than nuclear, but the tool to create a world panic is to explode in the Bosphorus a submarine by introducing excess plutonium into its reactor.

The first obsession, the **atomic bomb**, is present in everyone's memory. The mushroom cloud, the irradiated population of Hiroshima or Nagasaki, the subsequent tests in the atmosphere, are still present in every mind. Any media dealing with nuclear activities tends to illustrate its comments with these now historical images. Repeating again and again that a nuclear reactor is nothing like an atomic bomb has never completely reassured. And the Chernobyl accident with its wandering radioactive cloud did not help in any sense.

This impression is so strong that some people are convinced that someday, a nuclear explosion, possibly during some sort of nuclear war, would lead to the final destruction of our world. A huge number of what are called survivalist novels, on life "after the bomb", have been published. Typical of this genre are Nevil Shute's *On the Beach* and Robert Merle's *Malevil*. Like these two, many such scenarios have gained a much wider audience as films.

The atomic bomb and its consequences were a major anxiety during the Cold War years. It was due to the horror of potential total destruction, but also the association with secrecy, power held by a military and industrial complex that did not tell its name, and finally the fear of the unknown devilish plutonium. The political part of this has essentially disappeared from the media and fiction scene, although it is not completely out of people's minds. The fearsome image of the bomb and plutonium clearly remains, although often unspoken.

Chiva observed that: "Everything has the impact of history — the fact that atomic energy first took the form of a bomb and a massacre to become part of our everyday life — gave globally and everywhere a quality of danger and anguish to what belongs to this new conquest of the technical world."⁵

The **nuclear specialist** has a very ambiguous status in the public imagery. In Western Europe and North America, it is usually admitted that the plant operators are doing a proper job. But quite often, the aims are questioned: "Do we really need to use nuclear energy?", "Can electricity not be provided by a

less dangerous method?” And too often the reasoning goes one step further: “What if some of you are not as sane as you think, or are careless, or wrongly instructed?”

The recent incidents in Britain and Japan were catastrophic from that point of view. Carelessness in controlling plutonium had psychological and political consequences far beyond the factual impacts. The technical incident at Tokai-Mura opened the door to new doubts about the perfect mastering of the technology that we in the nuclear industry so often like to refer to.

This image is abundantly developed in fiction and films. From Dr Strangelove films to Simpson comics, we have a large team of mad or stupid “experts”. Such a description is certainly not new and we did not have to wait for the development of nuclear energy to see bizarre scientists in literature: Mary Shelley published *Frankenstein* in 1818. As Ted Mole⁶ mentions in a recent analysis, “As industrialisation progressed, it too became a major theme of novelists, among the most famous Dickens, Kingsley, Gaskell, Eliot and Gissing. In parallel with the demonisation of science these writers tend to demonise the perpetrators and process of industrialisation... They created a huge cast of industrial villains who pursued profit at all costs, human, environmental and spiritual.” Thus the situation is not new.

What is perhaps new is that at the beginning of the twentieth century, we also had enthusiastic writers who proposed a positive view of science and scientists. Jules Verne, although his heroes sometimes blew up their island at the end of the story, was probably the most influential in making young boys — and girls — dream of becoming engineers. But in the last twenty years there have been very few such authors, and even fewer who ever wrote positively about nuclear energy. Very seldom do you find in a thriller a declaration like: “From now on the world economy depends on plutonium, like it was the case before with oil.”⁷

As Claire Maden writes in her study⁸ of the portrayal of science and scientists in popular fiction: “Does the portrayal of scientists and science in fiction really matter?... Can the image of scientists we absorb from fiction influence our attitude towards scientists in general?” She concludes: “Science and scientists have long been treated poorly in literature... Perhaps when the divide between Snow’s Two Cultures has been bridged, and we have learned to look forward rather than to dwell on an idealised vision of the past for a cure to our problems, fiction will be able to deal with scientists more even-handedly.” We will come back to that.

Terrorist action has taken a prominent place in recent years as an objection to the development of nuclear energy, and especially when plutonium recycling is proposed. The idea that these materials can be safely transported is simply beyond many people’s acceptance. Actually, there has not been a single example of terrorist blackmail with plutonium. A real theft of this material that could lead to even a crude weapon fabrication has never been experienced. Nevertheless, opponents always present this as an undisputable fact, and most people accept it as a strong possibility.

Literature and films are full of such stories: from the UK TV film *Edge of Darkness* in the 1960s to the very recent *Plutonium Murders*, there are dozens of terrorist stories. In such stories, fissile material might be diverted for

purposes of greed, like in Patricia Cornwell's *Cause of Death*, or for more political objectives (*The Fifth Horseman* is probably one of the best known). The impact on the public mind is such that most do not reason when it comes to the problem of proliferation. The final remark of the most reasonable ones is always: "Even though you do a really good job, it might happen some day..."

This attitude is also typical for the evaluation of transportation. It is present when fissile materials transport is considered, with the risk of theft added to the contamination risk. It is still present in considering the transport of radioactive wastes. Eric Lindeman reported previously on that subject to the Uranium Institute Symposium.⁹ He quoted a number of newspapers articles on two transports: one by the *Pacific Swan* through the Panama Canal, another organised by the Department of Energy in the USA. Interestingly, he notes: "Almost all the media members present confessed to experiencing a sense of fear mixed with anxiety to secure first-hand knowledge about the controversial containers."

Lindeman summarises this attitude as: "There may or may not be good reasons for this shipment, and it may be very safe. But we do not want to think about it, and we will not have to once it has gone. This may be the best the industry can hope for realistically — acquiescence to the need for or perhaps the inevitability of the transports and willingness to put up with them."

The handling, conditioning and disposal of **radioactive wastes** are probably the most common objections in present discussions on nuclear energy. The reaction of the public is very difficult to understand for the technologists who have been doing their best on this issue for decades. What makes nuclear wastes so peculiar in people's mind? After all, radioactivity disappears while chemical toxicity remains forever. Even if some nuclear wastes were accumulated in the past in rather unsatisfactory storage facilities, most nuclear wastes are now safely stored, then packed with maximum care, like no waste has ever been treated before.

Nevertheless in literature we have a different picture. Recently a reviewer of *Where Nobody Sees* by James Watson wrote that in this book, "Those concerned with the nuclear project are a bunch of violent, unpleasant criminal types with no redeeming features. The whole book is constructed so as to leave no scope for the reader to make up his or her mind regarding the issue at the centre of the book. The subject of nuclear waste is not even treated as an issue to debate, it is simply assumed to be an undesirable activity with undesirable people and therefore to be opposed by all sensible people concerned about the environment."

Waste is the central subject of the above example, but more often it comes as a side effect. In *Sahara*, Clive Cussler insists on how money can pervert everything: the solar plant in the desert is in fact a cover for nuclear waste storage. This doubt about the honesty of the investors and the duration of the waste disposal management is central to the discussion. Thus grows a desire to have some solution independent of man's technology and management in the future.

Behind it all is a real anxiety about the effects of radiation, whatever its level. Comparison with natural background does not seem very convincing: is it of

the same nature? The fear is not reasoned. In Patricia Cornwell's *Cause of Death*, one of the otherwise very strong and positive police officers reacts: "Look, a little radioactivity is like a little pregnant or a little dead, in my opinion... Some people are phobic of all kind of things. Me, its radiation. You know how much I hate being in the x-ray room with you, and when I turn on the microwave, I leave the kitchen."

The last theme I want to briefly describe is the **safety of nuclear power plants**, including the possibility of an explosion. Since Chernobyl, it is a demonstrated fact that such an accident can happen. The observation that it has been less devastating than some other technological disasters like dam ruptures or chemical explosions makes no difference. Again, radioactivity was dispersed and images that reminded of Hiroshima were widely distributed. Huge areas of land were contaminated and have had to be isolated. A major scare now is, what if such contamination ever happened in a large town? After Chernobyl, nuclear development (at least in Europe and the USA) was essentially halted.

Previously, the Three Mile Island accident had already influenced the development of nuclear energy. But it did so mostly by imposing more safety rules, continuous training and new technological measures. I was amazed at the time that the industry did so little to advertise the fact that even though the reactor was completely destroyed, nothing serious happened outside (except unrealistic governmental decision to evacuate). After the Chernobyl accident, the industry said it could not happen in other countries because the plants were so different. But again, the TMI experience was not advertised, as it could have been, to demonstrate the effectiveness of the containment and other safety precautions.

Most people are positively impressed when they have visited a nuclear power plant. But this does not prevent some kind of anxiety. The badge that monitors the received radiation shows that the dose received is negligible, even when you have the chance to go into the reactor hall during unloading and see the "beast" for yourself. It is impressive, but all the precautions taken also create anxiety.

In *Burning the Apostle* (Bill Granger), a group of eco-warriors intends to have the reactor (the Apostle) burn: it should look like an accident and contaminate or possibly kill people around, so that nuclear plants will be stopped forever. The man in charge of introducing the ignitors, although skilled, trained and fearless, is nevertheless impressed by the sight of his enemy, the plant: "Perhaps it was the sight of the Apostle itself that made him tingle, unlike anything in the nature around it, billowing steam into the grey sky and sitting in splendid isolation surrounded by miles of chain-like fencing."

In this part of my analysis, I have often mentioned fiction because I consider that it both reflects the deep feelings of people and influences them: a two-sided situation. It has a much stronger impact on opinions than we, managers and technologists, expect. We must also remember that writers and actors are often, although not all of them, celebrities. Ordinary people thus are more likely to believe what they say.

Just one example: Michael Douglas was appointed by Kofi Annan as UN Messenger for Peace in 1998. "He became fully alert to the nuclear dangers

following the making of the *China Syndrome* in 1979. This film was about the melt-down of a nuclear power station and was released just three weeks before the disaster at Three Mile Island.”¹⁰ He was invited to come to London by the Oxford Research Group to address British Parliamentarians and to influence the government in “taking a leading role in multilateral nuclear disarmament”. This I certainly support, but how did he talk about civilian nuclear power plants?

The Power of Dreams

The power of fiction is due, writes Patrick Mannix,¹¹ to: “The ability of literature to create characters, then, a unique and powerful rhetorical tool. At the very least, it can enable an author with a weak ethical appeal to speak through a created personality with a stronger one. At best it can place the personality of the character and, therefore, his ethical appeal, at the very heart of the artistic experience. If that personality changes as the result of the conflicts that the novel presents him with and if these change somewhat enlighten us, we have an artistic work with a high thematic content. If we feel compelled to change an opinion or take some action on the basis of our experience of the character’s transformation, we have a literacy and rhetorical artefact.”

The same author, who worked mostly on the military aspects of anti-nuclear fiction, writes: “I would not maintain that significant changes result from the public’s experience of any one single work of anti-nuclear fiction, but rather from a general pattern of such experiences. Little by little such a pattern, by repeating and reinforcing the arguments against nuclear weapons, infiltrates the consciousness of a nation. Little by little people begin to accept attitudes that are inimical to the presence of such weapons.”

I am sure that the same phenomenon has occurred with the production of electricity by nuclear plants. Little by little, this activity shifted in people’s minds from a rather positive attitude in the 1950s to the present negative or passive one. If, as we saw initially, many people tolerate these plants, very few would demonstrate enthusiastically in the streets to build new ones. Real accidents like Chernobyl have certainly influenced this attitude, but works of fiction like the *China Syndrome* did their part.

Surprisingly, the industry has never tried to counteract this effect by presenting another story. Even though a few good scenarios existed, none of us ever did what Jane Fonda did: invest in fiction that would support our ideas. We are “authors with a weak ethical appeal”, as Mannix says. But we could have used a created personality that has one. For example, *Overload* by the well-known Arthur Hailey could have been the scenario of a popular film. The hero, a coal power plant manager, says things the industry would like to hear more often, such as: “Some of those who call themselves environmentalists have ceased to be reasonable believers in a reasonable cause and have become fanatics. They are a minority. But by noisy, rigid, uncompromising, often uninformed fanaticism, they are managing to impose their will on the majority.”

Using the power of dreams is much more than just “lobbying” people’s minds through fictitious stories. It has a fundamental influence on the activities of

human beings. A very interesting study by Thierry Gaudin, *Les Pouvoirs du Rêve*,¹² analysed the importance of dreams on technology.

A typical example is Alberto Santos-Dumont. Of Brazilian origin, he lived all his youth (until 1893) in coffee plantations, which at the time were already highly mechanised. It made him dream of ever better machines and specially flying ones that would be heavier than air. He tried again and again, until he flew his machine around the Eiffel Tower. He wrote: “In those times, my favourite writer was Jules Verne. The sound imagination of this author, acting like magic on the immutable laws of matter, fascinated me since childhood. In his audacious concepts, I saw, with no embarrassing doubts, the mechanics and science of the coming ages when man, by his sole genius, would equal a demigod.”

When nuclear energy’s peaceful applications became public after the end of World War II, the hope that it would be the panacea to all our energy problems was vivid. Alain Le Guernec¹³ remembers: “I loved this year 2000 seen from the 1950s, with its atomic rockets we could find in multicoloured toys made in painted tinsplate, cheap and kitsch at the same time, with its utopia at ‘trois francs six sous’ from *Science et Vie* magazine.”

The popular science books of the 1950s — especially those coming from Eastern Europe — were full of hopes for the potential uses of new technologies. In *L’Energie de l’Atome*,¹⁴ we find descriptions of future nuclear energy applications: power plants for electricity production, metallurgy, propulsion of large boats, and also railway engines and aeroplanes, as well as space rockets and small power reactors used as space power sources.

Some predictions became real applications, some never came true for technical or economic reasons, but some also because they scared people. The dream of the US Air Force and its political supporters to have a machine that could fly with the sole time limitation of the “quantity of sandwiches and coffee required by the crew” had to be stopped by President Kennedy after a billion dollars had already been spent.¹⁵ Other uses of nuclear energy were halted by fierce opposition, such as in the space programme, although they had been demonstrated to a large extent.

On the other hand, huge nuclear-powered aircraft carriers that can navigate for months without refuelling, provoked no objections in the public. Anxiety about the activities of nuclear submarines came mostly about abandoned Russian submarines in the Kara Sea. Probably few people even know that the big ice-breakers are nuclear powered. But crowds have been motivated to stand in front of the doors of nuclear power plants, shouting to have them stopped and dismantled.

Where did the nuclear industry go wrong? What has it done to transform the dreams of nuclear electricity “too cheap to be measured” into nightmares of devilish toxic plants? To help us understand, the most typical example is probably the development of the fast breeder, especially in France. For the engineers who devoted most of their professional life to it since the late 1950s, the breeder was probably the most wonderful machine ever developed. It could operate for years with very little material extracted from the ground, recycling again and again, transforming inert material into fissile fuel, generating minimal wastes. Small prototypes had been operated successfully: the dream of abundant energy with little environmental impact and security of

supply for years was materialising. The demonstration plants were started without new major obstacles. Then, France decided to build Superphenix. Why did crowds assemble at that time to oppose the construction work? Thousands of young people marched to Creys-Malville and fought against as many policemen: tear gas and other devices made the battlefield look like a reconstruction of earlier wars. For decades, Superphenix became a symbol of the powerful opposing the people's will, of little David the ecologist fighting against big Goliath, the environmentally-blind industrialist. Thus, a technically and environmentally sound solution has gone down the tubes.

I will not try in a few lines to analyse all the reasons why. Certainly, one is that Superphenix gave the wrong dreams: nightmares of sodium fires, contamination and plutonium proliferation. The technicians in the 1970s were so proud of their solutions that they never thought they had to explain why they were so. Information was none of their business. The builders and operators considered that explaining would come later. The plant site was protected by electrified barbed wire fence. The guardhouse was not manned by hospitable information officers. If you attempted to visit in 1976, you were chased by armed men and barking dogs. Nothing to make you dream of a brave new world with free electricity.

Even more important, most people made no relation between the power plants and the electricity supplied to their house. Jokingly, the German nuclear association promoted the slogan in those days: "Why nuclear power plants? In my house, electricity comes from the plug." Probably few people understood what the joke was. Twenty years later, utilities did their best to connect the plants with electricity applications in users' minds, sometimes using striking images, like Electricité de France (EDF) did in a memorable campaign in the late 1990s. Polls that followed seem to show that it was effective.

Clearly it is important in the present days of emotional democracy — a Belgian Minister recently said that we no longer live in a democracy but in an emocracy — that people have some emotional attachment to technologies to see them develop. Examples are numerous: you cannot attack the use of cars in any way without a huge outcry. Raising the price of petrol makes no difference to car use. "My car is my freedom" was the slogan of a campaign some years ago in Belgium; you could see those stickers on the bumpers of cars blocked in traffic jams (where is the freedom?). Tobacco is a demonstrated killer, much more efficient than the present uses of radioactive material, but it provides some sort of personal and social pleasure. This individual risk is preferred to the fairly remote risk of radioactivity which is present in the mind.

Can a Popular Nuclear Energy be Reinvented?

The nuclear industry could have done better in its relations with authors, script writers, films producers, etc. Many would not refuse to have a look at our activities and describe them in more realistic, if not better, words than the usual dramatic production. A recent example is Jacques Braibant's *Syndrôme M*. The main story is about sects and how one of them tries to reconstruct the ten plagues of Egypt to unbalance the Western nations, planning the final apocalyptic plague, the explosion of Tihange nuclear power plant, for the eve of the year 2000.

In the last forty pages of the book, all the action takes place on the nuclear site. The author had asked to visit the plant and was taken around. At his request, an independent safety specialist checked the final version. The reader's reaction is usually: "Very realistic. Not exactly reassuring, but those people in the plant or the authorities dealing with the situation, seem to be realistically described. Nice characters too... Efficient and reliable even though they are stressed by the circumstances..."

Utilities and other companies involved in nuclear activities are not used to improving their image using fiction. But making people dream is almost as important as informing them rationally. Being efficient and productive are not sufficient. Lindbergh wrote: "The pure happiness of flying as an art has given place to the pure efficiency of flying as a science... Science isolates man from real life, it marks a rupture between mind and senses." The acceptance of a technology is not only based on rational evaluation, it must also fulfil some positive expectations, some dreams of a better, if not more extraordinary, future.

The Belgian Air Force understood this situation and supported a Flemish TV serial called *Windkracht 10* (Windforce 10) which was shown every Sunday evening for four months. It was a story about how handsome young helicopter pilots saved lives day after day on the Belgian coast. It was based on fact, and used real air force Sea King helicopters. The result was a new wave of candidates to join the air force: an increase of 20%, as never seen before!

The US Postal Service — which by the way also supports a team in the Tour de France and had Lance Armstrong winning — in early 2000 supported a comedy on cable TV called *Showtime*. Two inspectors from the postal service play a major role in the film and give a positive image of this service. Although the hidden sponsorship gave rise to some criticism, no-one really objected to the service's participation in what was good entertainment.

Such involvement in popular entertainment has been common practice in some areas, with the military establishment proposing the use of its equipment and sites. In France, the popular TV serial *Une Femme d'Honneur* uses the Gendarmerie d'Auxerre premises and probably other support, as mentioned in the film's closing credits. The nuclear industry should give some thought to this sort of participation. Why have we been so shy with such possibilities?

But the nuclear industry should also re-evaluate its technical solutions/proposals, looking at them through the eyes of the public, with its dreams for ideal solutions using a minimum level of technology, with its ethical requirements: "We need electricity but the end does not justify the means."¹⁶ This is not the industry's usual attitude: we consider that if we have a good and reasonable technical solution, we should be able to inform and convince the public that it is the best we can do now. But can we be sure of that? "It is vital that people in the nuclear industry are able to engage competently in the ethical discourse. We are kidding ourselves if we think we can counter moral stances simply with practical arguments, perhaps it is even counterproductive..."¹⁶

Public acceptance is presently essential. During the Scientific Forum "Sustainable Development: a Role for Nuclear Power?" held in Vienna during the IAEA General Assembly in September 1999, it was said that, "Investors

will not tolerate long delays and the ensuing high costs. So a key issue is to have social acceptance.”

We saw above how authors react to the aggressive aspects of nuclear sites: barbed wire fences, huge buildings, cooling towers with their huge plume of steam. The need for cooling water means that the sites are often coastal sites of great natural beauty. Efforts were made to preserve this aspect but not always successfully. It is certain that P D James does not think that the nuclear plant she situates on the coast of Norfolk in *Devices and Desires* contributes to nature conservation.

Did we really have to come out of our original caverns? I am not talking of prehistoric man, but of the fact that the first nuclear power plants in Europe were built deep in the ground. It was the case for Lucens and Chooz to take just two. When Lucens broke down, no-one was troubled and the plant was closed. The Chooz A plant started in 1966 with very little opposition and was always supported by the locals. It was not the same when EDF decided to build the huge Chooz B power plants in the open, in the close neighbourhood.

Could nuclear facilities be built that convey a more acceptable image? If one decided to build a fuel manufacturing plant underground, it would not require all the aggressive fencing presently used. Access would be easily controllable at ground level in the administrative or laboratory buildings. Technicians often object that doing so would add some 10% to the cost and possibly create problems with potential water penetrations. So what?

Why do we have to build plants on nice new sites, sometimes of agricultural or natural value? Can we not restore used industrial sites? Belgium was typical of this kind of attitude when it looked for a new site near Andenne in the late 1970s. None of the officials involved ever proposed the use of one of the huge abandoned quarries that are along the Meuse. It was instead proposed to use agricultural land a few kilometres away on the hill, with pipes bringing the river water. Had we gone mad at the time? The project was later abandoned.

Another objection often raised by the public is the huge size of nuclear plants. The industry was convinced that bigger was cheaper: this has been shown not to be true anymore. Smaller nuclear plants are economic today. Although there is some fascination among the public for huge bridges or boats, when it comes to safety or even reliability there is a tendency to think that small is beautiful. We all know that there are now — fortunately — new projects being developed in universities and by some companies that are much more moderate in size than the nuclear plants in operation presently in OECD countries.

Basically, these new concepts want to fulfil the conditions that would make them “politically correct reactors”, as described during a special session of the American Nuclear Society 1999 Annual Meeting in Boston. These conditions are:

- Proliferation-proof.
- Demonstrated deterministic inherent safety.
- No reprocessing and a feasible scheme for disposal of spent fuel.
- Competitive with natural gas electricity production.

Personally, I do not think the last condition is essential, although it seems so important in the eyes of economists and investors. What does competitiveness mean against a product, natural gas, whose price is so unstable, whose security

of supply is so dependent on political conditions, and (because it cannot be stored) whose supply is so dependent on special contractual conditions with major low price large users?

There is now concerted action within the European Union on smaller gas-cooled reactor types. It gives a lot of hope that a solution which is much more “public friendly” will come out of this research. ECN in the Netherlands is working on the ACACIA project,¹⁷ an industrial heat and power cogeneration system that will generate 14 MWe of electricity and 17 tonnes/hour of steam, using a reactor developed by a US/Russian programme, or a Japanese programme, or a South African programme. When this project was presented to the public, there was no association in people’s mind with Chernobyl.

I have a special appreciation for the Eskom project in South Africa. It is an international collaboration involving South Africa, Germany, the Netherlands, the UK, Russia, etc. on a rather small modular plant (100 to 115 MWe output). It must meet the conditions mentioned above. I hope it will be mostly built in a factory instead of on-site, thus leading to shorter construction time, and that it will be manufactured in a series instead of one at a time.

These reactor projects will at some time in the future be submitted to public scrutiny; their size, safety, modularity, the possibility of factory production that makes them somewhat similar in production to the familiar large aircraft, are positive factors. But again, this is what we would have called in the past a top-down decision process. Should we not start an inquiry or, better described, a vast study and concentrate on the conditions that would make a reactor acceptable to a large proportion of the public? A sort of bottom-up decision process. Are we certain that the “politically correct” criteria mentioned above are those that would make a nuclear plant easily accepted, or even favoured?

Can the nuclear industry also do something of this nature with nuclear wastes and the associated radioactivity? This is certainly the core of the problem, the most difficult question. It will most probably take at least a generation of efforts to familiarise the public with this natural phenomenon. Some in the industry believe that medical and food applications, which are gaining more and more acceptance, will help in this direction. Radioactive sources have been accepted on satellites to produce electricity, in the past they were also in pacemakers and smoke detectors. How small does a source have to be to become accepted as a common tool?

It is strange to think that all of us have accepted carrying potentially dangerous explosives in our cars (a full petrol or liquid gas tank), and the introduction of the same in our homes (gas bottles of all sizes), although they have a demonstrated capacity to explode. We see cars exploding in most thrillers. And we do not care. We could heat our homes for free, if we accepted carefully conditioned nuclear wastes in our cellars, but this looks at the present time like a mad proposal. For ever?

Final Remarks

If the nuclear industry really wants to have a re-deployment of nuclear plants — and I think society will need it — it must gain more popularity among the public, because in the end this matters more than anything else.

I suggest that we in the industry should be more emotional in our approach, and possibly more dramatic. Shall we dramatise the contradiction of halting nuclear plants while we have to reduce our CO₂ generation? Shall we advertise how scandalous it is to burn clean natural gas, a source of so many future manufactured products? “Is this ethical behaviour?”, questioned recently Fred Decamps, the head of ONDRAF, responsible for nuclear waste management in Belgium.

In our scientific communication, we must take into account the emotional sensitivity of the layman. Why do we use unfriendly units such as Becquerels, leading to impressive high numbers? We must change our morbid vocabulary which speaks of skeletons and coffins, sarcophagus and burial. We must remember that even on such scientific questions, there is a place for emotions in our communication. Guedeny observed even in 1973 that even among the power plant professionals, “Emotional factors always took over the intellectual ones in the evaluation of the radiation risk, whatever the function or the hierarchic rank.”⁵

I suggested above that we should adopt a more bottom-up approach. Fred Decamps summarised the required evolution as going from a DAD (decide, act and defend) approach to a DDD approach:

- Dialogue, for a sufficiently long time to get out all the opposition and uncertainties.
- Decide, but give sufficient explanation of the reasons for the decision.
- Deliver, what has been promised in due time.

Governments and their advisors have widely integrated in their decision processes the need for dialogue and consensus research. Be it the House of Lords Committee in the UK, the Ampere Commission in Belgium, or the nuclear consensus talks in Germany, discussion and transparency seems to be the leitmotiv. But the resultant publicity will almost certainly increase the need to integrate in the preparation of responses the emotional reactions of the public.

G Friedman observed that, “These subjective reactions of the population must be taken, in their determination and their implications, as objectives, possibly leading to important effects and thus needing to be closely studied. The people in charge of the development of atomic energy in various countries have until now, neglected them too much.”⁵ And this was written in 1962!

Let us remember that to convey on TV his positive message on nuclear activities, the charm of Georges Charpak, his abundant white hair and seducing blue eyes, did more than his reasoning. People had the feeling that such a nice personality must tell the truth. We have to be a little less factual and technical, and a little more enthusiastic and emotional, and maybe nuclear activities will be slightly more acceptable.

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