

1. The problem

Let's imagine a scientific meeting, or a committee of experts, convened to discuss and decide on the design and the construction techniques for a large bridge, planned to link an island with the mainland. The bridge – an important element – must be erected, because there is no alternative way of definitively solving the problem of communicating between the two sides. In other words, what is under discussion isn't whether to build the bridge or not – just how to proceed.

The very heart of the technical debate, for which distinguished specialists from several disciplines are gathered, ranging from construction theory to geology, is about selecting the best and safest solution for the bridge. Two options are being discussed, both dealing with the problems of statics, geotechnics and hydrodynamics – all of which are routinely involved in building bridges of this kind – and in this particular case concerning the bay and the emplacement of the piers.

These, as we can see, are purely technical matters, about which only scientists and engineers are capable of debating and deciding. At this point of the discussion, which, by the way, has been going on for a long time, all the required data are available: calculations and models have been made, the behaviour of the rocks and the maritime currents have been studied, and the seismic risk assessed. As matters stand, everyone is convinced that a sound and totally safe solution is on the table, and that the bridge would also be scenic and rather spectacular. There is nothing left to do but decide.

Surprisingly, when the moment comes to finalize the matter, the majority of the convened experts agree on one further point: in order to select the best technical solution it is essential to consult the local people.

Why? Because for the final decision it's a good thing that there is public consensus. Deep inside, some are convinced that the people have no knowledge about construction theory, but they remain si-

lent, because are afraid of appearing antidemocratic, and because they begin to feel discouraged.

The meeting concludes with a final document in which, to stress the concept, pompous wording on democracy and participation is abundant, and where the engineers and scientists carefully avoid mentioning that the bridge could be constructed, that it would be safe and would resolve many problems. Furthermore, in order to give the people time to understand and digest the decision, they declare that several technical points still require clarification before a safe bridge can be constructed.

What we have imagined above regarding the bridge may appear odd, but it resembles quite closely what is happening nowadays with regard to nuclear waste.

These wastes have the peculiarity, which is now well known, even by the public at large, of remaining radioactive, and consequently potentially harmful, for a very long period of time after production. Consequently, to get rid of them it is not sufficient just to phase out nuclear energy. Even if, from some people's viewpoint they should have never been produced, they do exist, and unfortunately they will not simply disappear. Moreover, they have been generated to provide energy, for scientific research and for medical diagnostics and therapies, which means that they are the by-products of activities carried out to provide widespread benefits. Therefore, nuclear waste has to be disposed of safely. Doing this is not just an option, nor a simple precaution: it is a technical and environmental necessity. In other words it is a moral duty that cannot be overridden, and it is a fact that nobody questions .

If we compare this situation to our bridge debate, what is under discussion is not *if*. Besides, unlike the case of the bridge, even *how* is not under discussion, as technical solutions are available to dispose of the waste, which are under no circumstances disputed.

All the experts in the field, in this case too coming from many varied disciplines, are aware that the systems being applied or planned for nuclear waste disposal are absolutely safe. They are also aware that there is no waste produced by human activity today and probably not in the future, which can be disposed of so safely and reliably as nuclear waste. They are equally conscious that, to attain

this objective, science and technology have made all feasible and reasonable efforts, including some, as we will see, that will possibly prove unnecessary. They are efforts that have never even been attempted for other industrial activities, including some having a far more dangerous impact on human health and on the environment.

Nevertheless, when the moment came to declare not only how to dispose of the waste, but also *where* (which also has to be technically correct and scientifically justified), our experts have been obliged to interact with the political decision makers, and wait for their decision. As this has not occurred, and probably will not in the immediate future, because politicians do not like making this kind of decision, which definitely does not contribute to their popularity, engineers and scientists have stepped backwards, losing their self-confidence and quite often their power of speech.

Without saying it openly, they have practically surrendered to the will of politicians, more or less consciously supporting the needs of politics.

Not unlike the imaginary experts convened to decide how to construct the bridge, these nuclear engineers and scientists have ended up convincing themselves that a decision on waste disposal – a decision which, under the circumstances, should only be one regarding *where* – can only be made when the people's consensus is obtained. Moreover, as if this were not enough, some, as we will see, have gone even further, and claim that the people should also decide *how* to dispose of nuclear waste.

Radioactive waste management experts had always been fully aware that selecting a site for a disposal system would have required careful and patient discussions with the local population, mainly based on scientific information, directed to acquire a certain level of consensus, or at least to minimize dissent. They also knew that any final decision would require a political consensus, achieved and verified by the usual instruments of democracy. But now, with the acquiescence and sometimes the contribution of engineers and managers, a new principle has arisen, apparently noble and truly democratic, which declares that the consensus *of society* is needed to dispose of nuclear waste. This being a concept difficult to define operationally, it has quite frequently ended up meaning the consen-

sus of everyone, which as we know, is a highly difficult goal, especially in a democracy. Whilst waiting to achieve this, politicians can, of course, postpone the uncomfortable decisions that they so dislike making.

What has happened in nuclear waste management, beyond the technical achievements, to justify the present need of a societal consensus for implementing disposal, which is so convenient for those who are reluctant to make a decision?

It is a fact that, for about a decade, the problem of nuclear waste disposal is no longer addressed using rational and scientific criteria, as is the case for other industrial and environmental problems. On the contrary, it has become a matter lying somewhere between social psychology and cosmology, wherein arguments are admitted that elsewhere would undoubtedly be rejected as byzantine.

If this occur today for any type of repository for radioactive waste, it is geological disposal which is specially dominated by this attitude. As we will see later, this kind of disposal is planned principally for the so-called long-lived radioactive wastes, requiring such an extensive period of isolation that it can only be provided by certain deep geological formations.

The question first arose as to whether it is ethically correct to solve the problem of long-lived waste today, or to leave it for future generations. Then, others argued that it is not established whether safe isolation should be provided for one million years, or simply for hundreds or tens of thousands of years – ending up with the present day consideration about the convenience of allowing our descendants to retrieve the disposed waste in a remote and indefinite future.

All of this, it is worth mentioning, has not been devised by politicians but by technical experts, assisted by some sociologists whose attitude towards nuclear energy was not impartial.

What is the origin of this quiet and slow deviation, which could steer nuclear waste disposal into a *cul-de-sac* and even seriously jeopardize the future of nuclear energy, of which engineers and scientists have more or less consciously been the pilots?

In the last fifteen years, right when studies on nuclear waste disposal were approaching maturity, scientists and engineers had to face the new and unexpected situation that arose after the Chernobyl accident, when the antinuclear environmentalists made their greatest effort definitively to demonize nuclear energy.

However, the Chernobyl accident, which occurred in 1986, was the turning point not only of the antinuclear struggle, but also of the way that nuclear experts perceive their role and activities. For them, a kind of penitence has begun, more self-determined than imposed, as if they should publicly expiate the sin of having shown complete confidence in the safety of nuclear energy and having believed that such an accident could never occur.

Nevertheless, even though it was understandable and appropriate that such an event generated uncertainty and doubts in the nuclear community, it soon became evident that what had happened to the Soviet reactor should by no means discredit nuclear technology itself, nor cause a crisis of conscience. Then the question is, what has led nuclear experts to this penitence, a kind of enduring Lent, in which they are no longer allowed to speak openly in favour of nuclear energy, and whereby they feel obliged to demonstrate doubts about their technical achievements? As if they should pay in some way to regain credibility and be politically acceptable.

In the democratic countries, the situation following Chernobyl has not only been dominated by emotional factors, amplified by the boisterous behaviour of the antinuclear environmentalists. Politicians have also played their role, both at national levels, and, as we will see later, in some international organizations. It is a fact that the root causes of the Chernobyl accident, which are far more *political* than technical, and of a typically Soviet political nature, were kept from the public at large.

It is, by the way, rather paradoxical that the need for transparency in anything dealing with nuclear activity, invoked today by technical experts and, equally, by politicians, was not put into practice for this particular case, which was, in nuclear history, the father of all events.

Yet the general public, the same public to which some want to give the authority to say where, or even how, nuclear waste should

be disposed of, is far from being aware of the true causes and consequences of that accident. In the years following the Chernobyl accident, nuclear technology has been put on trial, with, on one side, as prosecutors, loudmouthed and incompetent antinuclear environmentalists, who are permitted to pronounce stupidities, and on the other side, as defence attorneys, technical experts and nuclear managers who were resigned to respond adequately and even to produce concrete evidence to obtain acquittal.

For years, the only circles where it was conceivable to remain unbiased towards nuclear energy were in the schools of nuclear engineering.

The most important consequences of failing to defend nuclear energy (which prevails all over Europe, but has led to a definitive outcome in Italy alone), have been on waste disposal. This may appear rather odd, as, in the nuclear fuel cycle, this is the activity having the lowest associated risk, by no means comparable with large plant operations, like power or reprocessing plants.

As a matter of fact, this has a twofold explanation. First of all, waste disposal requires evaluations extending, as we will see later in some detail, over very long periods of time. These evaluations inevitably involve non-technical issues, relating, for example, to the evolution and destiny of mankind, on which sociologists and philosophers, not being obliged to be scientifically correct nor consistent, may pontificate. This situation allows nuclear energy opponents to spread fear and worry, especially if technical experts remain silent.

Further, failure to provide a disposal system simply means that the storage time of waste must be extended by making additional space available, which does not significantly affect the economy of nuclear energy. This is the case for nuclear countries and, to a greater extent, for those having phased-out nuclear energy generation.

This explains why politicians do not feel any urgency to resolve the problem and to face the opponents of disposal. Instead, they are determined to prolong and defer the process of making the necessary, but disputed, decisions. In so doing they are encouraging, sometimes even claiming, the necessity of societal involvement and general consensus building, which may become an endless process. Deferring a solution is also serving the objectives of certain envi-

ronmental parties, in governmental power in some European countries, whose political programme is mainly based on opposition to nuclear energy. It is essential for these groups to demonstrate that this energy is unable to resolve the fundamental problem of the wastes. Germany is a clear example in this sense, as we shall see later.

The weak defence of nuclear energy after the Chernobyl catastrophe, which we know had a massive impact on the perception of nuclear civilian technology, is not without explanation and justification. Nevertheless, 17 years after the event that left such a profound scar on the history of nuclear technology, we have to recognize that the fact that scientists and engineers are surrendering to the demands of politicians, is making solution of the waste disposal issue increasingly difficult. This is why it is now the moment to give back the priority to science and technology, because these are uniquely involved in safety and environmental protection.

A worldwide problem in nuclear waste management is the siting of the disposal systems. It is commonplace to say that decisions about site selection unquestionably lie with the politicians. It is, however, our belief that although we give them this responsibility, they will never solve the problem. Politicians have to face elections every few years, and if what they have to decide is disliked by the electorate, they will always prefer to postpone such decisions, possibly saying that the people must be allowed further participation and that greater consensus has to be achieved before going ahead.

Nobody disputes the principle that locating a repository for nuclear waste has to be implemented without conflict, and, as far as is feasible, with the public's involvement, or that any final decision requires approval from the usual institutions of representative democracy. Nevertheless, people have to be informed that solving the problem of nuclear waste is not an option dependent on the democratic interplay of political parties, but an unavoidable civil obligation. It is the duty of politicians to honestly explain to people this simple truth, using the mechanisms that they judge to be most appropriate and effective, but avoiding opportunism and demagoguery.

The decision on *how* to provide a solution for waste disposal, the criteria to be applied for and, finally, *where* to locate the repository, should more appropriately be left to technical experts, who are accustomed to use the tools provided by science and technology, and not by politics.

It is not proved that ordinary citizens are more confident in politicians than in scientists and engineers. We are firmly convinced of the contrary, otherwise we should admit that either information has been manipulated by politicians' propaganda, or that technical experts have lost credibility because of their conformism.

It is, after all, in the interest of the politicians that decisions regarding a nuclear waste disposal site, undoubtedly doomed to create opposition and dissatisfaction, have to come from the technical experts. Even when linked to some political or economical circles, they usually maintain sufficient independence of judgment. Decisions made by technical experts, on purely technical grounds, usually have weaker political repercussions and consequently less significant impact on the destiny of politicians.

In order to contribute to restoring technical experts to their role (which in some ways is also a political one, but in a more general sense), it is useful to recall the main events and try to explain why the problem of nuclear waste disposal, which technically speaking is not hard to solve, has become the focus of the difficulties encountered by nuclear energy. We will also try to explain why nuclear waste disposal has become the opportunity for an ecological struggle dominated by irrationality and misinformation, where the needs of politicians appear to have prevailed over those of science, and even of environmental protection, with a consequent huge waste of resources.