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Myths and representations in French nuclear history: The impact on decommissioning safety

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ABSTRACT: The mythology surrounding atomic power, which makes reference to its omnipotent energy or devastating catastrophic fire, has, since the 1950s fed the collective imagination and public debate in nuclearised societies. Although it can be assumed these debates have little in common with the operational realities of managers, the recent accident at the Fukushima nuclear power plant has shown that in many countries the debate on the withdrawal of nuclear power may lead to political decisions that have an impact on the entire population. The decommissioning of many operational plants (whether because nuclear power is being withdrawn, or because plants have become obsolete) has had an impact on the representations shared by actors in these organizations.

Decommissioning operations have the effect of creating a tension between ideas of “deconstruction” and those of production. In this special phase of the plant’s life cycle, interactions between actors play a key role in the construction of a shared system of representations, which is based on both a new organizational culture and a shared safety culture. These shared representations are at the origin of a cognitive consensus that must facilitate action and decision-making within organizations.

This article is a historical study of representations of nuclear energy in France from the post-war period to the modern day. It first highlights the strength of myths and representations found in the design and construction phases of nuclear technology. The second part of this article shows how myths and representations affect decisions that are taken during the decommissioning of facilities. Finally, the third part of this analysis describes the consequences of these systems of representation on the morale of actors involved in decommissioning and the construction of a shared decommissioning culture.

1. INTRODUCTION

The concept of the *imaginaire* (the imaginary) can be defined as, “a set of productions, mental or physically materialized, based on language and visual images, forming coherent and dynamic wholes, which have a symbolic function in the sense of a nesting of strict and figurative senses” (Wunenburger, 2003). The public debate on nuclear energy is fed by a collective *imaginaire* consisting of a very heterogeneous set of representations. This set of mental constructions corresponds to the creation of an image of civilian and military nuclear energy that is based on a layering of symbols, narratives and metaphors, which build up over long periods of time.

The creation of these systems of representation depends on a series of factors that influence the cognitive schemas of contemporary societies. First, the transition to modernity is characterized by a loss of confidence in technology and expertise. This crisis is reinforced by a lack of transparency in decision-making observed by the general population. Second, the intensification of the means of production, the urban concentration of populations, the increasing prevalence of consumerist models of society and the acceleration of trade have reduced risks; in particular industrial risks, which do not seem to respect geographic, temporal or social boundaries (Beck, 2011). The third factor is related to the others: the loss of confidence and the globalization of risk amplify feelings of vulnerability. This sentiment increases the need of individuals to feel safe. The effect is all the more evident as individual's become increasingly insecure due to the hyper-mediatization of technological accidents, which have become key vectors in the creation of the social *imaginaire* (Le Breton, 2012). This has a major impact on the perception of nuclear risk and the design of energy and industrial policies. The ensuing debates are therefore not far from the operational realities of managers, as demonstrated by the strategic impact of the accident which occurred at Fukushima, both in terms of electronuclear power generation and the decommissioning of facilities.

The article therefore looks at myths and representations in French nuclear history, from the post-war period to the present day. Ultimately, the aim is to measure the impact of these images on the safety of contemporary decommissioning operations. The first part of the analysis thus determines the influence of representations during the construction phases of nuclear technology. The second part demonstrates the role they play in decisions to decommission sites, while the third shows their degree of influence on the morale of actors involved in decommissioning and the construction of a shared organizational and safety culture.

2. REPRESENTATIONS OF NUCLEAR TECHNOLOGY IN FRANCE

First of all we will show the influence of representations on the process of nuclear technology construction in France. Many historical studies have already been made of how civilian nuclear energy has been developed in France, the interpretation of which could drive public debate. Two studies seem particularly relevant: *Le rayonnement de la France* [The influence of France] (Hecht, 2004), which examines the intertwined history of the nuclear programme, technology and France from the 1950s to the late 1960s; and *L'agir contestataire à l'épreuve de l'atome* [Dissenting action put to the

test by nuclear energy] (Topçu, 2010), which explores the evolution of opposition to nuclear energy and “government of the criticism” from 1968 to 2008.

2.1 Technology as a symbol of power

In 1944, France had been deeply wounded: the memory of defeat and the Occupation had permanently marked the national consciousness; human losses were very high, any industry that had escaped destruction during the war was likely to be obsolete; the economy was paralyzed and rationing was still in force.

To overcome the technological lag of the country, the provisional government decided to establish the Atomic Energy Commission (CEA) in October 1945 in order to develop applications for nuclear energy. The initiative clearly highlighted the key challenge of nuclear energy. Consequently, superior technical performance, embodied in the nuclear development programme was presented by experts as the solution to the country's decline (Hecht, 2004).

The first nuclear reaction, carried out by CEA physicists in December 1948, confirmed the gradual recovery of France. Another important step forward was taken in July 1952, when the government voted in favour of the Gaillard Plan, which provided the CEA with the necessary funding for the construction of the French-designed *Uranium Naturel Graphite Gaz* (UNGG or gas-cooled) reactors.

The G1 (1956–1968), G2 (1958–1980) and G3 (1959–1984) reactors were developed at Marcoule in southern France. These UNGG prototypes illustrated the technological and industrial success of the country. “With these three nuclear power plants, France begins electricity generation from nuclear power and takes her place among the major nuclear nations alongside the United States, the USSR and England. Marcoule is the name of atomic energy in France”, (French news, 1955). The press and local authorities compared the site to a cathedral, able to compete with the most prestigious monuments in Paris and the region was expected contribute to the enrichment, even the renewal, of the nation's heritage. Meanwhile, the electricity company *Électricité de France* (EDF), which was formed following the nationalization of electricity and gas companies in April 1946, built the EDF1 reactor at Chinon (1963–1973), followed by EDF2 (1965–1985) and EDF3 (1966–1990). This time it was not religious imagery that was invoked, rather that of the modern castle.

Following the founding of the French Fifth Republic in 1958, Charles de Gaulle placed great emphasis on the nuclear programme. Although the number of facilities increased during his two presidential terms, the period is mostly remembered for images of the explosion of the first French atomic bomb in February 1960. The country now had a deterrent strike force, whose technological power boosted the nation's image.

The development of nuclear energy did not generate much public debate in France in the 1950s and 1960s. Opponents focused more on the dangers of nuclear weapons, although protests never reached the intensity of the international movement for nuclear disarmament. Only a few, isolated voices spoke out against nuclear power plants, the production of radioactive waste or the risk of accident.

From 1967–1968 the Consultative Committee for the Production of Nuclear Electricity studied various alternative nuclear programmes and recommended the adoption of the American system of pressurised water reactors (PWR), which were more profitable than the UNGG-type reactors. EDF supported the recommendation, while the CEA wanted to maintain the French system. In 1969, social unrest (which had had an impact on the CEA) intensified following the announcement by President Pompidou on 14 November 1969 of the end of the UNGG programme. On 17 November, 4,000–6,000 demonstrators marched in Paris in support of the French system. But the government's decision was final. The “war of the systems” ended at the same time as the civil unrest. From this point on, national independence would no longer be guaranteed by a particular technology, but by the ability of the French programme to prove itself and promote the virtues of atomic energy at the international level.

2.2 The image of atomic energy: from the Messmer Plan to the Fukushima accident

In March 1974, French Prime Minister Messmer announced an increase in electronuclear power programmes and plans to build 13 nuclear power plants in two years. The political class supported the nuclearisation of the country and it attracted little attention during the 1974 presidential campaign. The programme was given new impetus by President Giscard d'Estaing and his government.

It was at this time that opposition in civil society started to crystallize. The anti-nuclear movement developed in France in the early 1970s from the environmental movement – which in turn found its origins in the events of May 1968 that saw unprecedented civil unrest in France. Activists equated nuclear power to “a big tool for the radical transformation of society, to turn it into a technological, centralized and authoritarian model, towards a society based on consumption and waste” (Topçu, 2010). Militant actions took various forms: sites were occupied, petitions were signed, documents were drawn up, alerts were launched, etc.

The antinuclear movement intensified its activities following the presentation of the Messmer Plan. The sites chosen for the construction of nuclear power plants received the most criticism. Superphénix (a reactor located near Lyon, in south-east France), in particular, became a powerful symbol of the struggle. The confrontation in July 1977 between around 20,000 protesters and police escalated and ended in one death and hundreds of injuries. The rejection of the “nucleocracy”, authoritarianism and capitalism, embodied by the Messmer Plan remained major issues for the movement, which also concerned itself with environmental protection and health risks. However, this diversity in their targets prevented activists from presenting a united front and hampered their efforts. Opponents included a wide variety of actors, such as the physicists making up the Association of Scientists for Information on Nuclear Energy, economists at the Institute of Legal and Economic Studies at Grenoble, and the French Democratic Confederation of Labour (a major trade union confederation) which provided the group with more resources and enhanced its ability to present counter-arguments and provide information about the movement. Nevertheless, in the mid-1970s the majority of the French population still remained in favour of civilian nuclear energy.

The increase in opposition led EDF to organize an extensive information campaign to reassure the public. The lack of impact on French public opinion of the accident at Three Mile Island (March 1979) showed the effectiveness of the pro-nuclear campaign, and the gradual erosion of the protest movement.

The Chernobyl disaster (April 1986) brought a very different perspective and deeply transformed the image of nuclear energy. In France, a “policy of secrecy” – deeply embedded in the culture of decision-making in the nuclear sector – concerning the impact of the radioactive cloud, was followed by the Central Service for Protection against Ionising Radiation, the government, the administration and local authorities, accompanied by silence from the scientific community and the press. The few dissenting voices were marginal and largely unheard. Following the disaster, although anti-nuclear protests remained rare and the majority of the population continued to support civilian nuclear energy, there was a change in strategy. Two independent laboratories for countermeasure-expertise – the Independent Commission for Research and Information on Radioactivity; and the Association for the Control of Radioactivity in the West – were established and the number of alerts increased. Rather than reject nuclear technology, from now on it would be monitored.

Actors in the nuclear domain changed their communication strategy with the aim of changing the harmful image of nuclear energy. In the second half of the 1980s they began a debate on the “desacrilisation” and “popularisation” of the nuclear industry. Efforts were also made to make the nuclear industry more transparent and democratic. In response to their critics, they developed the image of the “green atom”. For example in the 1990s EDF advertising created a link between nuclear power and environmental conservation. This debate dominated the public sphere, as a result of resources that far exceeded those of anti-nuclear activists. Even the emergence of new communities, such as the Nuclear Exit Network that was fundamentally opposed to the representation of atomic energy as “democratic” or “green” failed to revive the intense opposition of the 1970s.

Nevertheless, the public debate was revived by the accident at Fukushima Daiichi (March 2011). The press gave the event urgent and symbolic importance, hailing it as the beginning of a new era of nuclear catastrophes in the new millennium. Articles announced the end of the myth of “Soviet carelessness” and the “failure of technoscience” (Foucart, 2011; Géral, 2011). Other authors denounced “techogenic pride” (Goanec, 2011), and the “hubris” of the Japanese archipelago (McCormack, 2011). The accident was frequently associated with Hiroshima and Nagasaki.

Reactions were different in other European countries: Germany programmed the closure of its nuclear reactors by 2022, and Switzerland in 2034. In France, two weeks after the accident, 56% of the French population expressed concern with regard to nuclear power; by March 2013, the level had dropped to 42% (Agence France-Presse, 2013). The Fillon government refused to close down the nuclear industry, which it claimed was the guarantor of national energy independence. EDF announced the creation of a rapid reaction force in case of an accident. Stress tests were conducted on European nuclear power plants at the request of the European Council.

In May 2012, François Hollande’s general election victory against Nicolas Sarkozy resulted in significant changes in French energy policy. In accordance with the new

government's socialist programme, the president wanted to phase out the country's dependence on nuclear energy through the creation of huge energy savings and the development of renewable energy. A statement from the President's Office in September 2012 confirmed the imminent closure of the Fessenheim nuclear power plant in north-eastern France. This not only pleased environmentalists, but also restated the major decommissioning challenges faced by the French nuclear industry.

The design of nuclear technology in France has generated representations which have in turn influenced the strategies of actors in the nuclear sector. Debates have been driven by the decisions of policy-makers, the impact of crises and changes in risk perception. On this latter point differing images of the industry, which are arbitrated by both proponents and opponents of nuclear power have influenced not only how production is organised, but also how sites are deconstructed; these two phases are historically inseparable.

3. THE INFLUENCE OF REPRESENTATIONS ON DECOMMISSIONING POLICY

The second part of this article shows how decommissioning policies form part of the history of representations of the nuclear industry. The Institute of Radiological Protection and Nuclear Safety defines this process as, "the set of operations to remove the constituent components of a decommissioned nuclear facility" (<http://www.irsn.fr/>). The first such operations were undertaken in France in the early 1960s. Research laboratories, experimental reactors and fuel cycle facilities were dismantled in the 1960s and 1970s. The dismantling of several powerful reactors began in the 1980s. But it was not until the late 1990s that decommissioning operations entered an industrial phase. In France, over thirty nuclear facilities (such as first-generation EDF reactors, Superphénix, the CEA reactor at Fontenay-aux-Roses, the Strasbourg University reactor, reprocessing plants at The Hague, etc.) are currently in the final phases of shutdown and decommissioning.

3.1 The mirror effect of decommissioning

"Like all industrial facilities, nuclear facilities, at the end of their period of operation, will be dismantled", (see <http://www.asn.fr/>). This statement from the Nuclear Safety Authority (*L'Autorité de Sûreté Nucléaire*, ASN) clearly places this type of operation in a context that corresponds to the "popularised" image that actors in the nuclear industry sought to give to nuclear energy following the Chernobyl accident. Consequently, decommissioning is implicitly defined as the "normal" end point of a "normal" system.

The International Atomic Energy Agency identifies three strategies for the decommissioning of nuclear facilities: deferred dismantling, safe containment and immediate dismantling. The latter strategy, which is recommended by the ASN, involves decommissioning the site when operations end, without waiting for the reduction of radiation levels.

The ASN argues that the immediate dismantling strategy is preferable because it reduces problems related to radioactive waste management for future generations. Moreover, the ASN argues, operators benefit from systems that can manage the

majority of waste resulting from decommissioning. Operators too, have gained considerable experience as a result of actions that have been carried out since the 1980s. This know-how enables them to better manage not only the technical aspects of decommissioning, but also the environmental and health risks associated with it. Moreover, this strategy advocated by the ASN overcomes certain problems created by deferred dismantling, such as loss of expertise gained during the operational phase of the facility. Consequently, the ASN argues that in France, all of the conditions for immediate dismantling are met and its technical feasibility is guaranteed.

The regulatory framework places many demands on operators, who must carry out an assessment of the cost of operations and hold sufficient funds to meet their financial needs (Act no. 2006-739, 28 June 2006). They must also communicate regularly with public agencies and keep the general public informed. This legal and technical requirement appears to be consistent with the rhetoric that describes nuclear energy as “green”, “reliable” and “transparent”, advanced by actors in the nuclear industry.

This “mirror effect” characterizes not only factors related to immediate decommissioning, but also the various issues implied by this strategy. Decommissioning is seen as a growing market since the Fukushima accident. The economic component is all the more important as many ageing European reactors will soon be taken out of service (Garrić, 2012). It was in this spirit that French President François Hollande announced the closure of the Fessenheim nuclear power station, in order to provide, “an example of successful decommissioning, so that nuclear power stations that are about to reach the end of their lives in many countries of the world and which require technological expertise, may once more provide an opportunity for the French nuclear industry” (Barjonet, 2012). France must therefore quickly make a name for itself against foreign competition, “Whoever dismantles the first units will be best placed to take care of all the others” (*L’Usine Nouvelle*, 2012).

Moreover, it is not only the ability of the nuclear industry to generate profits that is at stake, but also the image of France. The success of site decommissioning and the export of French expertise strengthen the soft power of the country, through a demonstration of technical expertise in the system as a whole. The technical argument is, however, irrelevant if we do not pay attention to the environmental impact of the final goal of immediate decommissioning. Phrases such as “back to grass”, “return to the meadow”, or “the green stadium” are a good illustration of the desire of policy-makers to prove the “green” and “sustainable” dimension of civilian nuclear energy; the gauge of legitimacy from the point of view of current environmental imperatives.

3.2 Decommissioning: the last myth of nuclear power?

Decisions and activities related to decommissioning have led to a certain amount of criticism, which feeds the poor public image of the nuclear industry. Economic and financial uncertainties related to decommissioning of sites are regularly reported by the press: the validity of EDF, Areva and CEA estimates compared to the true cost of decommissioning, concerns expressed by the Court of Auditors about the level of provisions for operators; the relativisation of announced profits; uncertainties regarding jobs following the shutdown of a facility, etc. The issue of cost estimates demonstrates the deep mistrust of the antinuclear movement towards decommissioning. For example, Greenpeace France believes that the Court of

Auditors has clearly underestimated figures in its report of January 2012 (Garric, 2012).

The lack of transparency is another leitmotif that runs through the public debate. This deficiency, an integral component of French nuclear history, discriminates against decommissioning activities because in addition to promoting democracy, transparency encourages the development of “credible and readily understandable solutions” (Lecomte, 2011). Opaque decommissioning procedures became a prime target for the *Réseau Sortir du nucléaire* (the Nuclear Exit Network). In February 2010, the group launched a petition, signed by more than 20,000 people, calling for genuine public debate on the decommissioning of nuclear facilities and the future of radioactive waste. They demanded that these consultations should mark a break with previous debates that were deemed to be “bogus”, in order that decommissioning was carried out with respect for the needs of workers, residents, the environment and democracy (Réseau Sortir du nucléaire, 2010).

Dismantling a nuclear power plant creates a significant amount of radioactive products: residual fissile materials, fission products, gas filters, activated metal structures, cleaning fluids, etc. (Bonnaure, 2011). In a magazine interview, Christine Bergé argued that the management of these products highlights the myth of nuclear decommissioning and a return to nature: “It might be dismantled but it doesn’t actually resolve the problem of radioactivity. A nuclear power plant is really a giant rubbish bin whose contents are scattered about” (Laurent, 2011). The denunciation of this myth challenges prevailing ideas of managed decommissioning and the sustainable “green” atom.

Representations of decommissioning bring to light both the powerful relations at work in the public debate and the strategic challenges for the nuclear industry. These representations shed light on the relationship that existing companies may have with technology and its uses, and make it possible to situate, in ongoing decommissioning operations, the debates and myths that make up the history of civilian nuclear energy. It is on the basis of this dual temporality and the various discursive registers that representations become organized into systems that can improve the morale of actors and create a shared decommissioning culture.

4. THE IMPACT OF REPRESENTATION SYSTEMS ON THE MORALE OF ACTORS AND THE CONSTRUCTION OF A SHARED DECOMMISSIONING CULTURE

This last part of the article describes the impact of the public debate on the actors involved in decommissioning. It considers on the one hand the effects of decommissioning on the organization of the facility in question, and on the other hand, the positive and negative effects of societal representations on the employees responsible for this final period of the life cycle of nuclear power plants.

4.1 Decommissioning: reorganization of working groups and social networks

Decommissioning is often the result of a sudden political decision and this final phase of the life of the nuclear power plant is marked by a profound reorganization of working groups. First, the plant’s organogram is modified to meet the objectives of

decommissioning (Pelleterat de Borde et al., 2013). This modification must provide the skills needed for decommissioning, but it must also establish the various end-points of the departments in charge of the decommissioning. The maintenance department must provide services to the decommissioning project team while at the same time responding to requests from the operations department for the maintenance of the reactor. As for the operations department, it must ensure the safety and operation of the reactor for the purpose of decommissioning. However, asking employees – who had previously been expected to produce and give a positive image of their profession – to deconstruct the tool of their trade requires them to take ownership of words and thoughts that are able to maintain collective morale in a virtuous circle for the safety of the operation (Martin & Guarnieri, 2013).

However, representations found in the public debate weigh on the professional culture of employees. The decision to decommission, when it is politically and historically motivated by a disaster, creates upheaval for actors. In France, Superphénix and Fessenheim are symbolic examples of the trauma caused by these policy decisions. The decision to decommission a nuclear facility has various impacts, not only on the plant's employees and their families, but also on the economic and political environment of the site. Located in rural areas, nuclear power plants bring both jobs and boost revenue for local authorities who are able to finance the necessary infrastructure (schools, housing, sports facilities, etc.) and boost commercial facilities (Claes, 2001). The closure of the site also therefore has an impact on the environment surrounding the plant, which lowers the morale of its employees. While they may not necessarily lose their jobs (if they are employed by EDF or the CEA) they may be transferred geographically. Their mobility has a bearing on the economy of the region and also on well-established social networks.

This unsettling period for both employees of the facility and its subcontractors is closely related to the societal debate on nuclear power.

When the plant is operating, social networks and production pressures enable employees to create a strong professional identity for themselves and their families. This professional identity allows them to make sense of their actions and maintain morale.

4.2 The effects of representations of the nuclear industry on the professional culture of decommissioning

The professional culture of employees of nuclear power stations can only be understood with reference to the pioneering days of the operation of French nuclear power plants. It finds its origin in industrial reconstruction and a belief in the liberating power of atomic energy.

In this sense, the construction and operation of the Phénix nuclear power plant in the 1970s was seen as a human adventure. “They were working with passion, with bosses who knew how to run a team that brought together people from different backgrounds. It’s also the idea of working for the energetic future of humanity and this coherence between ethics and day-to-day work is a precious thing” (Sauvage, 2009).

The professional identity of the employees of nuclear facilities is therefore first and foremost based on a scientific culture and the belief that one is participating in a pioneering and innovative movement. The employees who are at the head of this movement have a particular status. They are guarantors of both production and the safety of the population. It is this strong professional identity that maintains their motivation for their work despite the efforts of the antinuclear movement to denounce the dangers and limitations of this method of production. This motivation increases their vigilance and attention to safety.

It is quite different during decommissioning.

Professional identity during decommissioning has yet to be created. In fact, decommissioning takes place over a long period of time and employees who are involved in the project are likely to be transferred or to retire. For the most part, they do not see the end of the project. The main problem lies in giving the work meaning. The feeling of transience and belonging to a profession that does not exist can lead to a loss of vigilance and a sense of collective action during operations where the consequences of making poor decisions are serious. Interviews that were carried out in a nuclear power plant that was being decommissioned demonstrated this asymmetry in professional identity between maintenance teams that had entered the decommissioning phase and who managed subcontractors, and team leaders who struggled to give “a sense of meaning” to the project.

“So at the time, when it worked, the teams were given more to do than now and I would say that making a plant work to produce something is much more motivating than doing something, when we know that there’s nothing behind it (...) before we were producers, now we’re scrapyards operators. Operator in the true sense of the term means an operator that produces electricity. Today we’re pipe cutters” (a team leader).

In this context, the public debate about the costs and risks of decommissioning can lower the morale of actors who seek meaning and a professional culture.

Cultural change therefore requires a definition of the profession of decommissioning in order to create a new professional identity, which ensures that the same attention is paid to decommissioning activities as in operational phases. This identity must be consistent with the prevailing public debate. The myth of green decommissioning, a genuine profession that can guarantee the end of life for nuclear power plants in France and abroad, may help to create a new professional identity for both the facilities’ employees and subcontractors.

5. CONCLUSION

The public debate on nuclear power, whether global or limited to the situation in France, is framed in terms of risk and technological expertise. It is based on a symbolic dimension rooted in a belief system; the liberating power of technology on the one hand and impending disaster on the other. Decisions to withdraw from nuclear power find their origins in the history of the industry. These decisions are not neutral in terms of social impact. The destruction of the tool of their trade for personnel working in the nuclear industry has an impact on their experience of their work and how they maintain the collective morale that is necessary to ensure the safety of the

plant. Under these conditions, it seems to be necessary to study, from a sociological and historical perspective, what it is that motivates employees and how they create their professional identity, before any reorganization for decommissioning. In this context, the Fessenheim power plant could provide a ground-breaking field of investigation for a new professional culture.

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