Decision to reorganise or reorganising decisions? A First-Hand Account of the Decommissioning of the Phénix Nuclear Power Plant

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MINES ParisTech, Centre for research on Risks and Crises (CRC), BP 207, 1 rue Claude Daunesse, 06904 Sophia-Antipolis Cedex, France. melchior.pelleterat@mines-paristech.fr

INTRODUCTION

There are already many studies that seek to link the reliability of systems to their host organisation [1, 2, 3, 4]. Although the issues have traditionally been addressed in terms of an *a posteriori* analysis of crises or disasters [1, 5, 6, 7] a significant body of research has focused on the observation of systems under normal operating conditions, notably the Berkeley researchers who worked on the High Reliability Organization (HRO) project. Other researchers have chosen to observe organisations and their actors in specific phases of operation. This was the strategy selected by Mathilde Bourrier [3] and Pierre Fournier [8, 9], for example, in the context of scheduled nuclear reactor shutdowns. It was also the approach adopted for the study presented here, which looks at the effect of ongoing organisational changes taking place in a nuclear power plant being prepared for decommissioning. This study, conducted between 2010 and 2012, is focused on the Phénix nuclear power plant located at Marcoule in southern France.

Apart from a few periods of scientific test campaigns, the Phénix nuclear power plant was taken out of service at the end of 2009. The plant has two striking features. The first is that its organisation has radically changed with respect to its services architecture and its employees' scope of work. These elements constitute a major organisational transformation. However, and this is the second feature, the plant has not yet entered the decommissioning phase in the regulatory sense of the term. Specifically, its General Operating Rules have not changed. Consequently, the plant finds itself in a strange position, suspended between normal operations and decommissioning. That situation is having an unknown impact on the overall reliability of the system. Phénix is waiting for the decree to be issued which will actually enter it into the decommissioning phase. This decree is expected to appear sometime in 2013; meanwhile, the plant is in transition. It was in this very specific situation that the plant management decided to ask the Centre for research on Risks and Crises (CRC) of Mines ParisTech to conduct a study on the contribution of human and organisational factors to safety management in the context of nuclear decommissioning.

This article does not aim to present the results of the study, i.e. the themes and conclusions that emerged from the research process itself. Instead, it aims to outline its theoretical and methodological foundations, present the modalities of the study and describe its expected outcomes *with respect to the organisation*. It also examines the relevance of this type of approach with respect to the issues raised by nuclear decommissioning.

The article is divided into two sections. The first places the study carried out at Phénix in a broader theoretical and methodological context. The second is a detailed description of how the study was carried out and its contribution to risk management in the decommissioning of nuclear facilities.

ORGANISATIONAL THEORY AND RESEARCH TOOL VALIDATION

The study is characterised by the implementation of a dedicated research system (described in the second part of this paper) to meet the research aims that are described in the following sections.

Understanding the Organisational Implications of Managerial Choices

It has become common in the professional environment to talk about Human and Organisational Factors. However, it has also become common to see efforts to manage these factors take precedence over careful thinking about the impact of proposed measures on the social structures in place [11]. Understanding the full implications of an organisational choice such as the decision to modify the service architecture of a nuclear power station is not easy, even to the organisation's own actors. Bourrier reminds us that "organisational reform is like disrupting an ecosystem" [11] and that "what managers mostly lack is knowledge of the implications of their organisational choices" [13]. Although it is necessary to support this awareness and understanding, support can only logically be provided when it is the operator itself that takes the initiative, i.e. when it realises the importance of this understanding for the management of the at-risk system that it is responsible for.

This was precisely the approach taken by the Phénix management, from the end of 2010 and continuing throughout the study. Their primary objective was to understand the organisational changes that had taken place in 2009-2010 and their effects. The study looked specifically at the impact of the change on the decision-making process (trade-offs, negotiations), the constraints experienced by actors and the visibility they had on the decision-making environment.

The starting point for the study was that there exists in all organisations, to a greater or lesser extent, a gap between the organisation as desired – the formal organisation – and the organisation as it is experienced – the informal organisation. Crozier and Friedberg, writing in the 1970s, reminded us that an organisation, whatever its size, is a contingent construction. It results from a constant adaptation to challenges and from strategies of the actors that compose it, strategies that are constructed in relation to other actors, the formal organisation, the environment and areas of uncertainty in the flow of information [14, 12].

Understanding the implications of a major organisational change, such as that experienced by the actors at Phénix therefore requires the researcher to be aware that the balance of an organisation is the result of an economic, social and regulatory environment and a collective construction by the organisation's own actors, with respect to these constraints. Changes in these specific elements can only lead to a change in social relations within the organisation, relations that should be observed, analysed and put into context. Each organisational environment corresponds to a mode of social regulation whose implications must be understood [15]. In the case in question, the implications of this organisational transformation and the resulting change in the social balance at the Phénix plant may be linked to the safety and security of facilities. It was for this reason that the plant management voluntarily requested the study.

The study was designed to be firmly anchored in the field. As Reynaud pointed out, "to develop a well-founded theory of social systems, it is necessary to give up the idea of a homogeneous social space where the same indicators would have the same meaning in all areas, of an established *a priori* stable division or of actions whose meaning could be identified independently of those given to them by actors" [15]. This idea of a grounded, well-anchored theory was close to the hearts of Glaser and Strauss [16]. It alludes to the inversion of the classical scientific timeline that leads from the question to the results via the hypothesis and field work. It was at the crossroads between the ideas explained above and the first direct field data that we were able to establish two main

hypotheses, constantly reformulated throughout the study that formed their foundation.

The first hypothesis stated that the transition from normal operations to Final Power Off involved a restructuring of social and professional relationships at the plant. This reorganisation was predicted to have an effect on safety management at the facility by making decision-making processes more opaque and creating areas of deep uncertainty in information flows [12]. Understanding and regaining control of these areas of uncertainty would therefore constitute a challenge to organisational reliability at Phénix.

The second hypothesis stated that it is not appropriate to focus all efforts to supervise operations on sub-contractors. It is of course clear that deviations by subcontractors can lead to situations that are harmful to operational safety, regardless of the state of the system [10]. However, it seemed to us that the interface between the operator and its subcontractors and beyond that, the organisation of the operator itself can sometimes give free rein to circumstances that are difficult to manage. This second hypothesis proposes that before analysing the subcontracting system itself, careful consideration should be given to the credibility and clarity of the decision-making process of the operator's own intermediate management. This is precisely one of the issues addressed by the present study, which asks how the decision to reorganise the plant could, at the same time lead to a radical transformation of decision-making processes.

It is clear that the value of this study for other decommissioning research does not lie so much in the problems that were addressed or the results that emerged, but rather in the research approach itself. This turned out to be a powerful tool for organisational risk management in the context of end-of-life of nuclear installations.

Co-Construction of the Study and Co-Production of Knowledge

The study should not be seen as an order placed between an industrial sponsor and a consulting firm. Rather, it is an example of a collaboration that is closer to a research-action or research-intervention [17, 18] approach. The nature of the approach was the driver for a number of requirements that guided us throughout the study.

The first requirement was twofold: the production of valid scientific knowledge and "the generation of practical knowledge that can be acted upon" [18]. The study did not solely aim to produce scientific knowledge; it also aimed to provide support for the understanding of an ongoing change management process. At the same time, research of this type seeks to avoid either

interfering with the organisation's own objectives, or providing an assessment of choices in terms of a "one best way" solution. On the contrary, it aims to highlight the specific situations encountered in the field and to facilitate the interpretation of the key elements that emerge from a careful analysis of the data collected. Moreover, the aim of data collection was not to give the plant management, looking for an indirect validation of their choices, a feeling for the situation on the ground. Instead, it sought to provide an understanding of the meaning given by actors to the changes they were facing and to provide ways to improve, as far as possible, the structures put in place.

The second requirement concerned the concepts of cooperation and co-production of knowledge between researchers and the industrial partner [18]. The actors at the plant were seen as central to the study and they were involved in the construction of the interpretation. The study developed collaboration at several levels: data collection, through the facilitation of access to actors at the plant; feedback that consisted of detailed discussions of the intermediate and final conclusions of the study [19]; and the focus groups that formed phase 2 of the study [20]. Collaboration between researchers and industry in the context of research-intervention was a transversal element that began with needs analysis and was maintained throughout the research process. The preparation of minutes of meetings, intermediate feedback and summary documents stemmed from an express desire to preserve both the scientific rigor of the study and the industrial partner's objective of operationalization.

The third requirement concerned the question of directly operational solutions. The aim of the study was not to ask researchers to propose or impose technical "turnkey" solutions. In this respect, the roles of the researcher and the industrial partner need to be distinguished. On the one hand, the role of the researcher was to support the thought process initiated by the industrial partner concerning its changing organisation. It was to co-construct the study aims, to collect data (ensuring confidentiality) and to produce a theorisation that led from results arising from simple facts towards new meanings that were relevant to the organisation. It is a process that may lead to the formulation of thoughts and actions that go beyond the strict framework of the original request. As for the industrial partner, they provided optimal access to the field, established expectations for the study and took responsibility for any actions required.
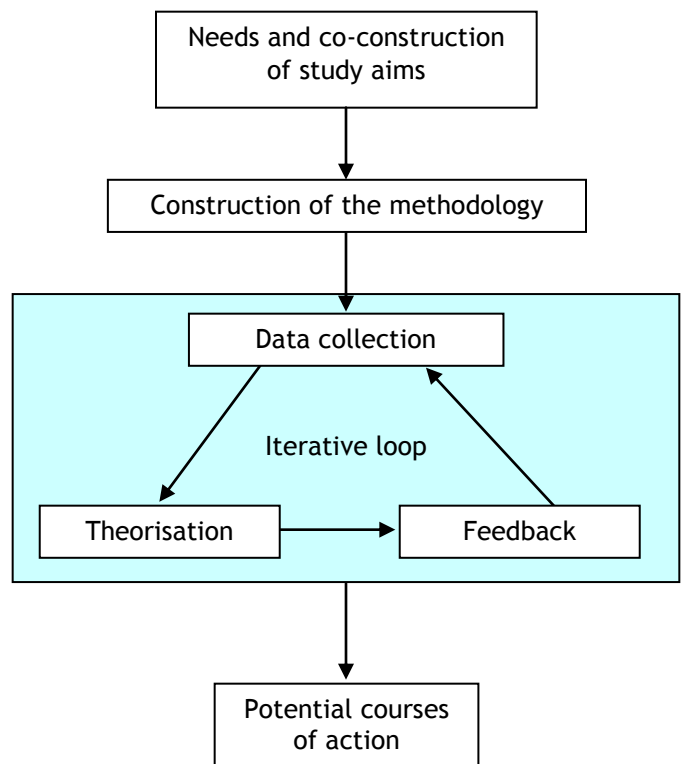

Fig.1 The co-construction process. Potential courses of action, which are not immediately operational, emerge from an iterative process where members of the organisation fully participate in arriving at an understanding of the changes made.

Research, in the form it took at Phénix was more the result of collaboration between two partners with complementary objectives than an immediately executable order. This type of research does not limit itself to the production of solutions and/or the identification and resolution of unwanted phenomena. Rather, it aims to go beyond the framework provided by the requirements and identify consequences of organisational change that were not expected at the beginning of the study. It aims to make sense and give overall meaning to the data collected.

The strength of such a study is that it is able to reveal elements the actors were conscious of but unable to express. It puts their contribution into the perspective of a theoretical framework that lead to the extraction of unknown or undetected elements. The approach is consistent with the observation of von Szent-Gyorgyi, "Discovery consists of seeing what everybody has seen and thinking what nobody else has thought" [25]. It is precisely at this level that the co-construction of meaning between researchers and industry has most value.

From Research Goals to Research Devices: the Selection of Data Collection and Processing Tools

The choice of data collecting methods stems from the research strategy, its objectives and the empirical conditions surrounding its execution [20]. The research presented here draws upon four methods of data collection namely, a literature review [17, 21], in situ observation [23, 21], individual interviews [22] and group interviews [20].

The literature review enabled the acquisition of a technical culture [17] necessary for an understanding of the field. It is difficult for an outside observer to gain an understanding of the constraints of actors belonging to a world as complex as the nuclear industry. Internal company documents provide a view of the way the organisation wishes itself to be, i.e. the formal organisation. Knowledge of this formal organisation, both in its past and present states provides ground to understanding the organisation as it is actually functionning, namely the informal organisation. Although internal documents have many advantages, such as ease of access and robustness in comparison process, they must usually be supported by an explanation of how they exist in the organisational system as it is known. Otherwise an understanding of their purpose within the organisation may be lost.

In situ observations come in different forms, from working with the actors studied [9] (participant observation) to an on-site presence without participation [19] (non-participant observation). The decision to implement a particular type of observation depends on the research context and the objectives of the study. In this case, participant observation was not particularly useful. Non-participant observation enabled a fuller technical understanding of the organisation and allowed questions to emerge that were explored in subsequent phases, in particular in interviews. Observation brought researchers closer to the situation in the field and helped in the co-construction of the study. It also enabled actors to informally raise issues that were subsequently used in other research methods. However, in situ observation has two significant limitations: it can lead researchers to focus on elements that are not particularly relevant with respect to the organisational investigation (for example, the expression of simple emotions) and may change the behaviour of actors when observed by the researcher (the Hawthorne effect).

The interview, whether individual or collective, is the qualitative study method of choice, both because it can be easily reproduced and because of the time that elapses between completion and analysis. Interviews can consist of a list of very specific questions, use a broad guide or be completely unguided [22]. The recording of interviews (the case here, made clear to the actors that participated) enables a particularly careful analysis of the data collected, notably as a result of the ability to re-read and cross-check the data. However, recording is also a constraint, and from this point of view the guarantee of confidentiality is very often an absolute prerequisite for relevant researches of this type.

While the group interviews and individual interviews have recording and processing procedures that are broadly comparable, their purpose and the sort of data collected differ significantly. While individual interviews establish the position of a particular actor according to a list of specific points, the focus group identifies the shared knowledge and experience of the organisation. Each group offers their own interpretation of the items discussed. In the group interviews that made up the second phase of the study, the comparison of different points of view enabled a clear and reasoned expression of differences of opinion with regard to the constraints and objectives of the organisation [20].

As for data analysis, this is a function of data content and origin. Each type of data collected contributes to the construction of the overall interpretation; different sources provide specific insights into the organisation in question. In the study, documents and observation were used to support and complement the analysis of data collected from interviews. As we have already mentioned, internal documentation helped both to understand the construction of the model of the organisation as currently desired, and to put it in historical perspective. Observation provided data in the form of notes taken while in the field, and together with other internal documentation was analysed in the same way as interviews, namely using the "conceptualising categories" method developed by Paillé and Mucchielli [24]. This method follows traditional methods of data encoding [20] supplemented by the meaning that is to be given to the identified categories.

The "conceptualising categories" method is based on a thorough reading of all interviews (in no particular order), field observation notes and supporting documentation provided by the company. The purpose of the analysis was to extract categories, which aimed not only to describe what was observable but also to clarify the meaning of events in the mind of the speaker. "Conceptualising category" analysis therefore draws upon the principle of a round-trip between data and conceptualisation. The iterative development of an interpretation forms the heart of the method. Different points of view do not negate the interpretation; rather they clarify its meaning relative to the actual situation.

All of these methods were implemented in the Phénix study. Next, we will describe the execution of the study and its contribution.

STUDY EXECUTION AND ITS CONTRIBUTION

The Phénix study can be divided into two phases. In the first phase we aimed to familiarise ourselves with the situation in the field, understand and model the informal organisation and to assess differences with respect to the formal organisation. The second phase aimed to enable actors to take ownership of the material produced in the first phase and to explore areas of improvement for the organisation as a whole.

First Phase: from Requirements Analysis to Modelling a Changing Organisation

The first phase of the study ran over a relatively long period. The first contacts between CRC and Phénix took place in late 2010, and it ended at the beginning of 2012 with a final round of feedback and the launch of the second phase.

The Co-Construction of Study Aims

The transition from operations to decommissioning was a new situation from every point of view for the actors at Phénix. The plant management therefore requested support on both the organisational aspects of safety management that were caused by the transformation of the service architecture, and the understanding of the effects of the establishment of a unit responsible for coordinating activities: the Work Coordination Unit (3C).

The lead-up to the development of a research strategy involved discussions between CRC researchers and the management at Phénix that resulted in the framing of the general problem, which was stated as, "what are the safety issues related to decommissioning that are the result of the creation of 3C and changing the organisational structure at Phénix?"

The objective was therefore not to measure but to understand. The overall study took as a starting point the principle that the relationships between the various actors at the plant were unknown. Although this assumption may seem extreme or challenging it constituted a naive approach of the organisation that would prove to be useful in modelling the actual relations between actors. It provided a way for researchers to avoid a limited investigation of "what should be" in order to observe "what actually is".

Typically, a company models its organisation in the form of organisation charts. As they are a form of self-analysis, the orgnisation chart often conveys the idea that the work of teams and the

relationships between them are known. In reality, organisation charts are actually a description of the company as it is desired: what actually happens is something different. The question is therefore, what form does this difference take? This question was at the heart of the study. Safety management must not be based on an idealised vision of staff activities. On the contrary, it must operate through direct knowledge of the work situation, its debates, its tensions and its power balances.

The study therefore consisted of two complementary rationales. For the management at Phénix, it was to improve knowledge of the organisation from the point of view of the regulatory requirements resulting from the decommissioning decree. For researchers, it was also to bring new material to research on the effects of organisational transformation.

An Iterative Research Strategy

The first phase of the study was characterised by the iterative construction of the research strategy. This iterative approach can be seen as several sub-phases that alternated data collection with design and analysis.

The first step was to prepare access to the field. This happened soon after and – in part – while the requirements were still being established. Specifically, it involved obtaining a technical understanding of the system [17]. This sub-phase consisted of many informal discussions with the actors at Phénix and analysis of the plant's internal documentation. It enabled CRC researchers to familiarise themselves with Phénix, its history, and particularly to compare the organisation of the plant while it was operational with the new organisation. It also provided an opportunity for actors at Phénix to get a better understanding of the objectives and methods of researchers.

These initial familiarisation activities made it possible to prepare, in conjunction with the Phénix management, a first list of actors to be interviewed. This list was later added to by the researchers themselves, again in agreement with management. Senior staff members who had experience of the two organisations, namely the ancient and the new one, were given priority. A first campaign of individual interviews was launched, together with the on-site presence of a researcher who undertook observations. Interviews were based on a list of relatively general themes, discussed in no particular order. These themes were complemented as the research continued by issues that emerged from earlier interviews.

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1. Objective: To understand the position of the participant in the organisational structure during the operational period and the current period (change of job, change of service, when they

arrived on-site) and establish individual career paths, e.g.
- *Can you briefly recall the circumstances that led you to take on these functions?*
- *Can you describe your career at the Atomic Energy Commission, Marcoule and Phénix?*
- *What were you doing at Phénix before the organisational change? How was this change perceived by your team?*

2. Objective: To understand the constraints of actors in the new organisation, e.g.
- *What are the main constraints you face on a daily basis, with respect to the current organisation and the changes that have taken place?*
- *Who do you ask for advice? Help? Who do you talk to most?*

3. Objective: Understanding the current organisation, e.g.
- *Can you describe the current organisation and your position in it?*
- *What do you think of this organisation?*
- *With hindsight what would you change (sticking points, delays, deadlines, etc.)?*
- *When trade-offs have to be made between several competing elements, how you do you decide priorities and who do you consult?*
- *What do you think of the Work Coordination Unit (3C)?*

4. Objective: Understanding the challenges of the actor's job, e.g.
- *What are your critical challenges in the short, medium and long term?*
- *What challenges are you expecting to face?*

Fig. 2: Overview of the list of initial questions.

Fifteen interviews were carried at the beginning of the first phase. These interviews led to the emergence of a first set of themes, detailed in a preliminary research report and presented to the Phénix management. Data confidentiality of all the material collected in interviews was preserved.

From these initial themes, a second interview campaign was organised. This second round of interviews helped to explore in more depth several themes that were judged to be of particular interest by both researchers and the Phénix management. The first phase of the study (first and second rounds of interviews) consisted of 23 interviews, each lasting an average of 75 minutes. All interviews were recorded and transcribed; this was to enable analysis using the "conceptualising categories" method described above. Although interview transcripts were voluminous (they filled approximately 900 pages) the amount of material made it possible to examine a wide range of issues

relevant to the original research question. As a whole, the interviews helped to highlight the interrelationships between groups at the plant. These relationships were represented by a sociogram.

The Sociogram, a Tool for Modelling Informal Relationships in the Organisation

One of the objectives of the study was to draw out the informal organisation at work in the process of decommissioning. The sociogram does just that: it is a representation that highlights the relationships between groups of individuals in an organisation. Its construction reveals the difference between the formal organisation (the organisation charts) and the informal organisation (actual relations between people). The sociogram is built in several steps, explained next.

The first step was to identify the relevant actors in the organisation. The actors shown in the sociogram do not necessarily correspond to those seen on an ogranisation chart. Fieldwork and analysis determined which actors should appear in the way they were shown on the organisation chart, and which could be integrated into a more abstract grouping. For example there were groups that no longer appeared on the new organisation charts but who were explicitly referred to by actors, in which case they had to appear on the sociogram.

The second step aimed to clearly represent the relationships between the groups that had been identified. It determined what relationships a given group had with other groups. This representation must explain both why a particular relationship exists, and the nature of the relationship. The sociogram was linked to the explanation of the relation showed and the content of the exchange between groups it represented. This information was contained in the various reports provided to Phénix management during the study. The sociogram indicated green (expected) relationships and red (unexpected) relationships. The aim was to highlight both potential sticking points, areas of friction or to monitor, and alternative channels of communication and good relationships that enabled the system to operate. It should be noted that the idea of unexpected relationships does not indicate a hazard. It simply indicates a relationship that was not planned, as such, by the organisation's designers or managers and which is based on challenges that should be kept in mind when management choices are made.

The third step highlighted the challenges of the various groups. Challenges are what underlie the relationship between two actors. They are obviously a function of the group itself, its position within the organisation and its environment. Different challenges may provide an explanation for

certain difficulties experienced by the organisation.

Finally, the sociogram aimed to show the big picture, i.e. the principal ways in which relationships were organised and the meaning that should be given to them in order to understand the organisation as a whole.

The sociogram is therefore a tool that makes it possible to represent an *interpretation* of the relations between actors in the organisation. This interpretation came about as a result of visible challenges, identified in interviews and during observation. The sociogram enabled the Phénix management and the actors themselves, during feedback sessions, to obtain a more accurate vision of the actual relations that existed in the new plant organisation.

Final Deliverable, Feedback and Contributions from the First Phase at Phénix

This first phase of the study resulted in a report provided to the Phénix management in January 2012. It contained the themes emerging from the first and second rounds of interviews as well as the overall focal points of the study. It explained the methodology and presented the sociogram, its construction and explanation.

From this report, a feedback session was organised with thirty people who were involved in the organisation and the execution of the first phase. The study, its objectives and methodology were presented, the findings were explained and time was given for discussion that enabled a deeper investigation of the interpretations of CRC researchers.

This final step of phase 1 of the study gave the actors at Phénix the opportunity to better understand some of the effects of organisational changes at work in their plant. Some elements that had sometimes been foreseen by staff were highlighted, either because they had historically been present in the organisation and were accentuated by the reorganisation, or they had appeared in the transition from operations to decommissioning.

This first phase of the study also enabled staff to speak freely on several issues concerning the organisation, including misunderstandings or sticking points. The fact the exercise highlighted constraints specific to particular groups that were generally ignored by other groups or services enabled a better understanding of the overall functioning of the new organisation. It is a striking reminder of the words of Moisdon; the actor "can only have at any given time a limited representation of both what the organisation is and a sense of their own actions, i.e. their efficiency with respect to the overall operation" of the system [17]. The relevance of this type of study is directly based on the opportunities it offers to highlight the position of inter-individual and inter-group relations in the overall organisation.

The actors who participated in this first part of the study all did so with the objective of improvement. Feedback of the results led to the establishment of a second phase. This was more focused on the future and actors from the first phase were generally keen to continue participating.

Second Phase, Actors Take Ownership and a Forward Look

The second phase of the study was shorter and more prospective-focused than the first. It started in June 2012 and was scheduled to end in September 2012.

Results of the Working Group Study

A Working Group was launched at Phénix to look at the points arising from the final report of the first phase of the study. The aim was to provide a small group of people with the opportunity to look more deeply into the interpretation of the research themes. Participants were also expected to come up with proposals for improvements to the organisation itself.

Working Group participants did not have access to the transcripts of the earlier interviews, which remained confidential.

The Working Group was composed of a dozen people. It met three times to discuss three themes considered by Phénix management and CRC researchers to be most relevant. Participants mostly consisted of the same actors who had participated in the first phase of the study, but they also included new members. Management was not included in order for participants to feel as free as possible to express their opinions and develop ideas.

Each meeting lasted about two hours and included a brief review of the main points arising from phase 1 of the study, a presentation of the objectives of the meeting and the opening of the debate. It met on-site, every two weeks. The period between meetings was used by CRC researchers to prepare reports, hold individual interviews that explored in more depth particular items discussed by the group, and develop elements that could be fed into subsequent meetings.

Most participants attended two or three meetings and generally sent a representative if they could not attend. Between meetings, participants who would be unable to attend the next meeting were interviewed individually on the upcoming theme.

CRC researchers facilitated the Working Group. They supervised discussions, ensured that the group focused on the theme in question and encouraged the expression of ideas for organisational improvements. They also summarised the points made by participants in order to clarify their position and advance the general discussion.

As in the individual interviews, all Working Group meetings were recorded and the recordings were transcribed. Recording helped in the interpretation of discussions and enabled links to be made between each meeting. Transcriptions were particularly useful in the interpretation of the meetings. They are of course confidential and were not disclosed either to the Phénix management or participants.

Deliverables, Feedback and the Contribution of the Second Phase

As in the first phase of the study, the second led to the preparation of a report.

This report summarised the most relevant issues put forward by participants in the Working Group, based on the discussions, individual interviews and inter-meeting observations. The group identified many specific issues, which made it possible to establish a list of potential actions. These issues were explained in detail in the report and they gave plant officials material that they could use to implement actions in the near future to improve their control over organisational changes. Unlike the themes highlighted at the end of the first phase of the study, these action points had not initially been directly identified by the actors themselves; they emerged from ideas grounded in the debate.

The final report also contained a list of short, medium and long-term actions that had been specifically expressed during the second phase.

It can be seen that the process occurring in this second phase of the study not only enabled actors to engage in debate about the organisation, but also enabled proposals for concrete actions to emerge to overcome organisational difficulties or sticking points. These potential courses of action did not come directly from CRC researchers, but instead constituted proposals originating from the Working Group itself, i.e. the plant's actors that were involved in the study. Both the Working Group and accompanying individual interviews made it possible to augment efforts at managerial level and made members of staff an actor in a process of change that was originally initiated at a higher level. Observation during this second phase also showed that some of the questions raised in the Working Group were later discussed by the services themselves, evidence that actors had taken ownership of the research process.

CONCLUSION

This type of approach to research is still too rare, particularly in at-risk systems such as the nuclear sector. Nevertheless it constitutes a significant element of organisational learning for safety management. The original effort to be open, as shown at Phénix is a real echo of the wish expressed by Bourrier in 2000, who lamented the fact that researchers were only asked to suggest interpretations and provide diagnoses following a major disaster [11].

At the same time, we must not lose sight of the fact that, as Moisdon said, "the researcher does not hold the truth about the organisation" [17]. The study presented above shows the benefits for an organisation of this type of research, which brings together researchers and operational staff in a collaborative approach to human and organisational factors. Obviously researchers cannot directly resolve the problems an organisation in transition is subject to. However, they can provide a particular vision on the organisation, a vision that does not try to find immediate solutions, but rather seeks to shed light on a more detailed understanding of the organisation and the anticipation of the effects of organisational change. This type of collaborative research has the potential to give birth to a real understanding of the challenges associated with nuclear decommissioning in terms of human and organisational factors. To understand what changes an organisation means being there.

REFERENCES

1. D. VAUGHAN, The Challenger Launch Decision, Chicago, IL, The University of Chicago Press (1996).
2. C. PERROW, Normal Accidents, Living with High Risk Technologies, New York, NJ, Basic Books (1984, 1999).
3. M. BOURRIER, Le nucléaire à l'épreuve de l'organisation, Coll. Le Travail Humain, Paris, Presses Universitaires de France (1999).
4. M. BOURRIER (dir.), Organiser la fiabilité, Coll. Risques Collectifs et Situations de Crises, Paris, L'Harmattan (2001).
5. J. REASON, "The Chernobyl Errors", Bulletin of the British Psychological Society, 40, 201-206 (1987).
6. P. SHRIVASTAVA, Bhopal: Anatomy of a Crisis, Cambridge, MA, Ballinger (1987).
7. G. De TERSSAC, J. MIGNARD, Les paradoxes de la sécurité, le cas d'AZF, Coll. Le Travail Humain, Paris, Presses Universitaires de France (2011).
8. P. FOURNIER, Mobilisation industrielle et position sociale. Deux générations de travailleurs sur un centre nucléaire, Thèse soutenue à l'EHESS (1996).

9. P. FOURNIER, "Attention dangers ! Enquête sur le travail dans le nucléaire", Ethnologie française, 1, 69-80 (2001).

10. P. OEDEWALD et al., "Managing Safety in Subcontractor Networks: The Case of Olkiluoto3 Nuclear Power Plant Construction Project", Proceedings of the Fourth Resilience Engineering Symposium, Sophia Antipolis, June 8-10 (2011).

11. M. BOURRIER, "La fiabilité est une question d'organisation", in M. BOURRIER (dir.), Organiser la fiabilité, Coll. Risques Collectifs et Situations de Crises, Paris, L'Harmattan (2001).

12. M. CROZIER, E. FRIEDBERG, L'acteur et le système, Paris, Seuil (1977).

13. M. BOURRIER, "The Contribution of Organizational Design to Safety", European Management Journal, 23, 1, 98-104 (2005).

14. M. CROZIER, Le phénomène bureaucratique, Paris, Seuil (1963).

15. J.D. REYNAUD, "Pour une sociologie de la régulation sociale", Sociologie et sociétés, 23, 2, 13-26 (1991).

16. B.G. GLASER, A.L. STRAUSS, The Discovery of Grounded Theory: Strategies of Qualitative Research, Chicago, IL, Aldine (1967).

17. J.C. MOISDON, "Recherche en gestion et intervention", Revue française de gestion, septembre-octobre (1984).

18. A. DAVID, "Le recherche intervention, un cadre général pour les sciences de gestion ?", Communication à la IXème conférence internationale de Management Stratégique, Montpellier, 24-26 mai (2000).

19. N. FLAMANT, "Observer, analyser, restituer. Conditions et contradictions de l'enquête ethnologique en entreprise", Terrain, 44, 137-152 (2005).

20. S. DUCHESNE, F. HAEGEL, L'entretien collectif, Paris, Armand Colin (2012).

21. R.M. FRANKEL, K. DEVERS, "Qualitative Research: a Consumer's Guide", Education for Health, 13, 1, 113-123 (2000).

22. K.J. DEVERS, R.M. FRANKEL, "Study Design in Qualitative Research-2: Sampling and Data Collection Strategies", Education for Health, 13, 2, 263-271 (2000).

23. B. JOURNE, "Etudier le management de l'imprévu : méthode dynamique d'observation in situ", Finance Contrôle Stratégie, 8, 4, 63-91 (2005).

24. P. PAILLE, A. MUCCHIELLI, L'analyse qualitative en sciences humaines et sociales, Paris, Armand Colin (2008).

25. I. GOOD, The scientist speculates: an anthology of partly-baked ideas, Portsmouth, NH, Heinemann (1962).