MANAGING HIGH-RISK, TECHNOLOGY-INTENSIVE COMPANIES IN HEAVILY REGULATED ENVIRONMENTS: TWO CASE STUDIES IN THE NUCLEAR INDUSTRY

by

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ABSTRACT

Managing technology-intensive companies is becoming increasingly complex, particularly in highly regulated environments, as in the case of nuclear power utilities. One of the key issues for a successful management practice and a reliable, safe and profitable operation in such an environment is the correct management of the communications process with the government regulator. In the case of the nuclear power industry, the most relevant regulatory body is the Nuclear Regulatory Commission (NRC).

This study seeks to describe how communications and relationships with the NRC have evolved in some recent real situations in the nuclear power industry. Two case studies have been selected in the US nuclear industry. The first is a predominantly "positive" one, with a generally accepted good record of communications with NRC. The second is a predominantly "negative" one, with a generally accepted complex communications process with the NRC.

Personal interviews have been conducted with key players regarding the issues at the utilities, NRC and Public Interest Groups. A simple survey has been used as a complementary tool to "objectivize" often complex perceptions, feelings and opinions, on sometimes deeply emotional issues. The present thesis is within the "MIT International Program on Enhanced Nuclear Power Plant Safety", a comprehensive research program at MIT's Energy Lab and Sloan School of Management, aimed at enhancing safety of operating nuclear power plants.

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Table of Contents

CHAPTER 1: INTRODUCTION

1.1 MIT International Program for Enhanced Nuclear Power Plant Safety

The present thesis is included in MIT's International Program for Enhanced Nuclear Power Plant Safety. This is a large, multidisciplinary research program, begun in June 1990, involving the Sloan School of Management, the Energy Laboratory and the Department of Nuclear Engineering. The Program is sponsored by nuclear utilities and suppliers in the USA, Japan, France, Korea, Switzerland, Finland and Russia, and international agencies and foundations.

The final aim of the Program is to enhance the safety of operating nuclear power plants, in ways that are compatible with profitable operation. The Program has clearly stated its objectives to conduct research that is relevant to safety, that is credible to the international nuclear community, and whose results are available to everybody interested in nuclear safety issues.

Avenues of research include the technology of service and maintenance, the management of nuclear plants, and the analysis of policy decisions on plant safety. This thesis is included in the management research that is being conducted at Sloan by Professor John S. Carroll and his colleagues in the organizational and management study group.

The Program intends to create both new knowledge and insights in the fields of nuclear safety as specialists in different fields interact with each other in different and creative ways, while pursuing the goals of their specific lines of research. The Program must be multidisciplinary to reflect the true dimensions of the problem of safe operations.

The MIT Program is international in its scope and participation because the issue of nuclear safety is itself an international issue: a serious accident at any specific nuclear plant will have a profound effect on every nuclear plant in the world.

There are other national and international organizations (apart from Regulators and public interest groups) with deep interests in nuclear safety. Within the United States some of the most relevant are the Electric Power Research Institute and the Institute of Nuclear Power Operations.

At the International level the most prominent organizations are the World Association of Nuclear Operators, The Nuclear Energy Agency of the OECD, and the International Atomic Energy Agency. All of these organizations are major contributors to improved plant safety and operations. The Program intends to fill an important niche and is complementary to these existing efforts. The MIT Program cooperates with other programs.

1.2 Organization and Management Study Group Research

The Organization and Management Study Group of the MIT International Program on Enhanced Nuclear Power Plant Safety conducts research to address the following question: How can nuclear power plants organize and manage their human and technological resources to maximize their safe and efficient operation?

The overall goals of the Organization and Management Study Group research have identified the impact and audiences for the research work:

- To help utility and plant management attain a deeper understanding of ways in which their organizational and managerial systems can enhance safety while maintaining a balance with efficiency and profitability.

- To identify organizational learning processes and self-improvement methods that are central to safe performance.

- To help governments evaluate how their policies and practices affecting organization and management work for and against the public interest in safety and affordable electricity.

- To contribute theory and findings that advance the science of safety and risk in high-reliability organizations in general by complementing understandings of trial-and-error organizations which now form the basis of most management science research.

The strategic objectives identified comprising the activities and products of the research program are:

- To develop a conceptual framework that is consistent with the distinctive features of the nuclear power industry, identifies the social and cultural characteristics of the nuclear power industry, identifies the social and cultural characteristics of nuclear power plants and their plant-level and institutional context, and provides principles underlying the relationships among these characteristics.

- Develop products for utility and plant managers and employees to use to create their own programs addressed to their specific concerns. These self designing tools consist of examples, principles, and prototypes that interrelate a type of problem, features of the technical and organizational context, and a range of options. Plant staff could use these to simulate processes under various constraints, just as a plant would have to reengineer its own solutions in the context of its particular resources and coordination systems. Other products would include published papers and "case-like" materials that would be presented in workshops and seminars with sponsors.

- Disseminate knowledge to appropriate audiences and assist in technology transfer of the various products. The published papers, conference presentations etc. are necessary steps to transfer new knowledge to practitioners and the scientific community. The Research process itself can also serve this purpose when site employees adopt some of the viewpoints and methods of the research team to view their problems in a new light or when collaborative research focuses directly on plant issues.

The first three years of research have enabled the Study Group to expand and deepen the base of observations and the conceptual framework. Continuing data collection in the US. and abroad will concentrate on evaluating and extending the preliminary conceptual framework with a focus on performance enhancement and organizational learning activities, and the work processes and organizational resources that underlie improvement. The group is also working toward additional modes of collaboration with sponsors, research sites, and an international network of researchers studying safety.

The issues that remain on the agenda for collaborative efforts and the continuing development of the conceptual framework are:

- Compliance and autonomy. A difficult trade-off is perceived in industry between blind adherence to procedure and autonomous self-regulation.

- Cost Control and safety. Contradictory pressures are experienced by industry to spend money and control costs.

- Plant aging and workforce changes. Aging of workers and lack of upward mobility create morale, boredom and commitment problems. Decommissioning of plants is rapidly becoming an issue.

- Cross-Functional and Multi-Site Complexity

- Regulatory Demands. Communications, mutual understanding, and mutual trust problems appear to exist between Regulators and Operators. NRC is a special case with a strong perception problem. The present thesis is precisely centered around this issue as will be explained below.

- Learning from Experience vs. Blaming for Mistakes. Learning from incidents that did not became accidents and "near miss" situations is extremely important, and special emphasis should be placed in the involvement of all the layers of the organization.

CHAPTER 2: THESIS OBJECTIVES AND METHODOLOGY

2.1 Thesis Objective

The main objective of this research is to analyze in some detail the current state of affairs in the relationships, particularly the communications process, between the nuclear utilities and the principal regulatory body in the USA: the Nuclear Regulatory Commission (NRC).

2.2 Methodology: The Case-Study Approach

The work methodology that has been selected is that of the case-study, in which an important issue is described and analyzed. It is very important to clarify that in this methodology, cases are selected for their potential for learning, and in no way are they representative of any general state of affairs, either in the particular company selected, or in the industry.

Actual names and dates have been disguised following standard practices in the Management Study Group at the Sloan School, in order to maintain confidentiality and neutrality. All relevant information of general applicability has been retained.

The procedure that has been followed to analyze the case has been to identify the key players, both in the utility and the NRC, and to interview them with regards to their perceptions of events that took place, and their roles in the relationships and communications process between the plant and the NRC.

An event-history map, or time-line, has been drawn in the case to help in the analysis of the roles of key players and the time frame of the decision making processes (See Appendix 1).

As a means of objectivizing subjective and sometimes emotional perceptions, a survey has been presented to the interviewees in which they were asked to rate the relative importance of several of the factors involved.

2.3 Selection of the Case-Study

The case-study was selected with the intention of highlighting the circumstances and factors influencing and interfering in a "negative" scenario, in which the relationship between the NRC and the nuclear utility has generally been perceived by the utility, the NRC and industry in general as dysfunctional.

It must be repeated that in no way has this been the normal state of affairs in the relations and communications process in general and, we must report that every person interviewed at the NRC and the utility has insisted on this very point.

With the purpose of benchmarking and highlighting differences and similarities, additional data in the form of a survey has been collected at a "positive-scenario" plant and a small sample of nuclear executives at US and foreign utilities. This additional information is presented together with the survey results for the "negative" case in Chapter 4.

The "positive-scenario" plant is called the Wildcat Plant , belonging to the Wildcat Public Service. This plant has a smooth and constructive relationship with the NRC in the opinion of the Plant, the NRC and Industry in general.

The "negative-scenario" case selected was the Pontes plant of the Eagle Co. This case was quickly accepted to be a typically complex one, in which the relations between the utility and the NRC were strained, difficult and plagued by differences of opinion , approach and understanding. People at Eagle, the NRC and nuclear power industry agreed that the case was definitively worth studying due to the problematic issues involved, perceived interferences in the

communications process and high impact that the case had in the public and in the nuclear industry[1].

2.4 Relationships and Communications between the NRC and the Operators

The relationships and communications between the NRC and the nuclear operators are continuous and maintained at different levels in the organization. In some companies a person may receive the assignment of channeling the communications process with the NRC and may act as a point of reference for NRC staff members willing to communicate with the utility.

Some utilities keep very good communications records with the NRC and generally behave in a cooperative and open way in the opinion of the NRC. Other utilities however boast of an adversarial approach to their communications with the NRC, and claim that keeping NRC distant and misinformed may actually result in enhanced operational reliability and safety.

It is generally accepted that communications may change abruptly when a new and complex issue arises in which technical opinions may differ, or the best course of action may not be evident. This is especially true in "first of a kind" issues, for which no previous experience is available.

Underlying the communications problems is the issue of reconciling the diverging mandates and cultures of the NRC and the nuclear utilities. The NRC has a responsibility towards the general public, and sometimes perceives utilities as opponents in the march towards safe operation. Nuclear safety is their only concern, and this fact creates a different perception of plants and their operations; on the other hand, utilities have additional economic and operational pressures that NRC may be reluctant, slow or openly unwilling to acknowledge in many situations.

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[1]Complete disguise of this case is impossible due to its uniqueness, but it has been felt that the utility and the persons involved at the NRC staff, should be protected from hasty judgments by casual readers.

No wonder then, that the relationship is perceived as being dysfunctional by some of the operators[2]. Executives complain that the NRC is not consistent across regions in rule-making, fault-finding, and assigning penalties. NRC requirements shape the organization in ways that may limit approaches to safety. The NRC is perceived by some utilities to be staffed with people who lack operating experience, and there is little transfer of staff between industry and regulators. Detailed analysis by management can receive unthoughtful responses, the NRC can get away with quirky behaviors, and there are no grievance procedures or appeals from contested decisions[3].

Some public interest groups, however, claim that NRC is far closer to utilities than it should be, and suspect continuous collusion between the NRC and the operators to keep safety problems away from public scrutiny. In their opinion, the NRC needs continuous public monitoring to push them in the right direction of protecting the public interest, instead of the particular economic interests of stakeholders in the nuclear industry[4].

From all the above, it can very quickly be realized that, given the current situation and pressures of all kinds to which all players in the communications process are submitted, the communications process will always remain potentially conflictual. This, by the way, is a frequent situation in the communications processes of any kind of regulator with the regulated.

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[2]Davis, A. B. and Pederson,C.D. "Industry Perceptions of the Impact of the US Nuclear Regulatory Commission on Nuclear Power Plant Activities"

[3]Carroll et al. "Excerpts from the Progress Report of The MIT International Program for Enhanced Nuclear Power Plant Safety".

[4]Adato, M. et al. (1987) "Safety Second: The NRC and America's Nuclear Power Plants"

CHAPTER 3: THE PONTES PLANT CASE

3.1 Description of the Case

As explained above, the Pontes plant case was selected because it was generally perceived as being a particularly problematic case in terms of communications, understanding and relationships with the NRC.

The Pontes plant case arose some years ago when the technical staffs at the NRC and at the plant sharply collided on the safety interpretation of an issue for which everybody agreed that key technical data was missing. Differences in organizational culture, approach to technical issues and degrees of conservatism quickly appeared between the utility and the NRC as economic constraints added extra pressure to the utility management. The final outcome was the plant shut-down by the operator due to economic uncertainties created by the technical uncertainty in the safety-related issues.

In Appendix 1 a simplified time-line of events may be seen. The Pontes case was of such a complex and emotional nature that no easy simplification can be made. Complete reading of the time-line in the Appendix is thus suggested for fully understanding of the actors, issues and turns of the "plot".

This case is also an extremely interesting and difficult case to study for a number of reasons:

- Technical issues involved were very complex, technical consensus among the different technical players was never achieved.

- The technical problem faced by NRC and the operators was of the "first-of-its-kind" type. There was no previous experience on the main technical issues and the degree of technical uncertainty was substantial to the very end of the case and continues to this day.

- NRC shifted its position from a positive response to a negative one regarding the safety of continued operation almost overnight from an outsider's point of view.

- The issue received very intense media coverage, particularly, but not exclusively, in the local press.

- The issue was followed very closely by public interest groups that played a major role, at least in the public's perception and in the media coverage.

- The issue got quickly political. Congress and, to a lesser extent, local and state authorities, got deeply involved in the discussions and the decision processes and put considerable pressure on the NRC.

- The nuclear industry, as a body, withdrew from the public discussion and emph- ized its distance from the issues being discussed.

- Time and financial constraints were very tough from the utility point of view and got superimposed and mixed with the strict technical and safety issues.

- The final outcome was the permanent closure of the plant by the nuclear operators. This resulted in layoffs and painful restructuring decisions in the utility that provoked and continue to provoke very emotional responses from all the persons involved in the process in one way or another. Within the NRC, a lingering public perception that they might have been forced to change their decisions due to media and political pressure still provokes some very emotional responses on the part of some of the staff members who were involved in the process.

- The case has somewhat conditioned the approach that the whole nuclear industry has followed to similar technical, regulatory and licensing issues.

3.2 Interview Results at Eagle

Eight persons at Eagle were interviewed during the data gathering period, and were asked to give their personal and subjective opinions in hindsight regarding the main issues, events and perceptions in the whole Pontes case. The interviews

were conducted in a mixed open/structured manner and both open-ended and issue-addressed questions were asked.

Throughout the interview process it became very evident that the Pontes issue is still too close in time for people involved to give unemotional "objective" responses. For almost every one interviewed it was a "bad experience" with lots of stress and overwork. On the other hand memories are fresh and lots of information came quickly to the interviewees' minds as the conversations progressed.

With regard to personal opinions about the **main issues** involved in the case, the following are some paraphrased statements made by Eagle **technical staff** during the interviews:

- Lack of key technical experimental data and information on the main technical issues from the beginning to the end of the case, but despite that, Eagle and NRC technical staffs did a very good technical job. There was a continuous need to rely on indirect sources of technical information.

- Lack of technical expertise in the world on comparable issues. "First of a kind" technical situation. Many different technical disciplines involved in the problem and very difficult to coordinate and synthesize their interrelationships. Too many technical issues being dealt with at the same time. NRC and Eagle were "technically overwhelmed" on the issue.

- Eagle technical staff believed the plant was safe but it was very difficult to prove it technically within a year. Time constraints, technical complexities and unfavorable communications circumstances of the case, made it totally impossible to solve the issues within the time frame imposed. Could have been perfectly solved with more time (and more technical data).

- Technical issue was brought to NRC before Eagle was technically ready to deal with it. Some technical "mistrust" on the part of NRC technical staff members towards the reliability of Eagle's technical data started to build from the very beginning of the issue. Eagle technical staff failed to answer properly technical questions that they themselves had raised in a presentation to NRC technical staff (related to another technical and regulatory issue).

- Non-technical (management) persons from Eagle and NRC involved (and "messing") in the technical discussions. Would have been better with a more "candid" and technical approach. Pressures from Eagle management to NRC management in order to influence NRC's staff technical decision making process.

- Very disruptive and annoying open, fully transcribed communications process with the NRC technical staff. (NRC's Chairman imposed a "total transcription" requirement on any communications NRC-Eagle at a certain point in time). Despite the requirement, some NRC staff members were helpful at times "off-the-record", but remained adversarial and difficult "on-the-record". Without the "total transcription" requirement, technical communications would have been much better and the technical issues might have been resolved.

- Unnecessary and totally negative ban on direct communications of Eagle staff with NRC's technical consultants.

- Continuously changing and shifting demands and requirements from NRC's staff. New questions were being asked all the time with little apparent connection with earlier requirements. Uncertainty about NRC's next requirements and questions. Continuous situation of indefiniteness in the key stages of the process.

- Continuously changing NRC counterparts in every meeting.

- Perceived defensive situation among NRC technical staff (afraid of setting clear criteria).

- Strong emotional pressure through the process to avoid damage to Eagle employee's careers.

Managers within Eagle, in turn, stated the following issues as being the most relevant through the case:

- Communication was one-way only, from Eagle to the NRC. There was very little feedback from NRC to Eagle. The full-transcription requirement in the communications process was annoying and frustrating for Eagle people, but not so much for NRC people. It hindered the communications process particularly from the Eagle point of view, but it also made NRC still more defensive. It also slowed down greatly the technical exchange process and added to the time (and financial)

constraints. NRC was pushed to criticize because of the public record. NRC did not want to engage in a technical dialogue, just made demands and asked questions. Eagle felt that they were open with NRC and "showed them their cards" whereas the NRC hid their cards. Feedback was always incomplete. After the date the NRC staff shut-down decision was made public, communications failed completely.

- The ban on direct talks with the NRC technical consultants was very damaging for the chances of getting the technical issues solved: it complicated the communications process, delayed and made very complex the technical information exchange, and added to the time and financial pressures on the utility. Due to the lack of actual two-way technical information exchange and the lack of appropriate technical feedback, Eagle never could know which were the real technical issues that concerned NRC. NRC behaved in a "bring me a rock" manner: "you speak and I'll tell you if I like it or not", particularly in the critical months that came after the shut-down decision. No real communication took place in that context.

- NRC did not deliver clear criteria, particularly to restart operations. They eventually recommended the shut-down but up to now Eagle does not know, nor understands, the real technical reasons for their change of opinion. The NRC never said it clearly. First they recommended to continue operation and then they reversed their decision without explaining the reasons.

- NRC was under heavy pressure and scrutiny from the public, public interest groups and the politicians and was very defensive through the communications process. NRC's credibility was at stake through the process and they reacted in an overly conservative and narrow manner.

- Eagle had trouble understanding the NRC culture.

- Eagle failed to understand that its former excellent technical credibility was eroding quickly as the issue progressed.

- Communications with NRC were additionally difficult due to NRC's lack of a single team with a responsible leader for the issue. Correspondents within the NRC changed continuously as people were assigned in and out of the case. New issues were raised in a random manner, and no one at NRC provided the

leadership and coordination necessary to clarify the multiple implications and interrelationships and focus on final solutions. There was no evidence of any kind of managerial purpose to solve the issue within the NRC. There was no senior integrator of dispersed information within the NRC. NRC's system and management procedures for technical problem resolution failed totally. There was also no formal system of issue resolution within the NRC.

- People within NRC with decision-making capability were "too busy" to pay attention to the Pontes issue. There seemed to be big internal communications problems within the NRC. No internal coordination existed between the various technical groups within NRC leading to excessive conservatism. Technical people were too narrow, lacking the "big picture" of safety.

- NRC failed to distinguish between short-term operation and long-term operation for safety purposes.

- Discussions evolved beyond the technical arena and into other areas (politics, etc.), due to external interferences. NRC commissioners, under political pressure, distorted the NRC staff technical discussion process. Eagle wanted to keep the issue strictly technical, but felt that it was being politically attacked and tried to counterattack in the political arena also. If the issue had not been politicized by public interest groups the final outcome would have been favorable and the technical issues would have been resolved. It is OK for the public in general and public interest groups to be involved in the communications and decision making processes if their true interests are safety, but that was not the case in the Pontes issue. Some public interest groups had hidden agendas and were not interested in the issues. They were interested in interfering with and delaying the communications and decision-making processes.

- NRC staff interpreted too strictly and narrowly the commissioners' mandate of safety improvement by a factor of 10, and that eventually lead to the plant shut-down recommendation. The base for the rejection of the improvements in safety suggested by Eagle remains unknown to Eagle management.

- External interferences were too important for NRC commissioners. That was felt through the reactions of the technical staff. The appointment of the new chairman created a state of anxiety within the NRC. He created a lot of confusion

through his actions due to his lack of experience and novelty in the industry. He paid far too much attention to outsiders.

- The issue looked technically tough from the start. Data and information were not available as would have been desired. Too many technical uncertainties were involved for the time frames considered. Confidence was put on a new technical methodology that eventually did not work. Technical people in NRC and Eagle were very competent and deserve recognition for that. Eagle felt totally secure about their superior technical competence throughout the process.

- Technical and financial uncertainties due to NRC's lack to provide clear restart criteria were too big to handle and conditioned the closure decision. Financial questions were important for Eagle from the beginning. The economic and power situation in the region helped to make the closure decision. NRC was unduly and excessively conservative. They never considered the financial aspects linked to safety decisions. They did not consider the financial situation of the company.

3.3 Interview Results at the NRC

Six people were interviewed at the NRC during the research process in a similar manner to the Eagle interviews. They were all asked to give their personal opinions on the main issues that configured the Pontes case. They had all been personally involved in one way or another in the Pontes issue and belonged to the Office of Nuclear Reactor Regulation and the Office of Nuclear Regulatory Research. They all communicated frequently with Eagle during the Pontes issue.

The same emotional problems that appeared in the Eagle interviews, appeared again in the NRC interviews. The Pontes case was also a very bad experience for all the NRC people involved in the issue, and as one NRC staff member put it, "it was not the kind of issue that looks good in your resume and advances your career within the NRC". Actually, at the time of the interviews the NRC was conducting an audit with external consultants to learn from the management or mismanagement in the Pontes case.

Some of the NRC interviews made were emotionally intense, to put it mildly, and again, the closeness in time of all the main events seemed to hinder objective judgment of the issues.

Some of the main issues quoted by NRC staff members were:

- There were some serious technical concerns within the NRC technical staff with regard to the issue from the beginning of the case. Following a presentation by Eagle staff related to another technical and regulatory issue, it became evident that there was a lack of essential safety-related technical data. It also became evident that NRC had overlooked some important technical issues and had made some mistakes in their judgment of some technical information. Technical mistrust started to build from this date on and the technical credibility of Eagle went down quickly. Basic problem: Eagle and NRC had no clue as to the real status of the technical issue. Most of the essential technical information was indirect. Technical safety calculations performed by NRC and Eagle gave different outcomes in key safety issues through the whole case.

- The technical arena in which Eagle committed itself to prove the safety enhancement, was the Probabilistic Risk Analysis (PRA) arena. When PRA is mixed with licensing requirements it gets very difficult and tricky due to the subjective nature of many of the risk evaluations. NRC technical people got very conservative in their assumptions but Eagle had no proper technical answers itself to counterbalance these assumptions. Eagle also did not always face the problems technically and tried to cover them up with smoke screens when they felt that the technical issue was not resolvable.

- Technical communications with Eagle were generally good. However "a good deal of mistrust existed between the NRC and Eagle at the managerial levels": Eagle management distrusted the new chairman of the NRC, and NRC staff top management distrusted Eagle management. The outcome would have been very different if the energy and efforts had been focused on resolving the technical uncertainties and gathering technical data. Eagle denied that they had a problem and refused to study it seriously until the shut-down recommendation.

- NRC found a way out in order to permit continued operation in the short-term through a risk argument not very solidly based. That was probably an NRC

staff mistake at that time. Nevertheless, NRC staff recommended to shut-down the plant after a meeting in which Eagle presented alternative safety enhancement measures, and failed to demonstrate to the NRC staff that they had met the commissioners' requirement for an improved safety factor.

- After NRC's shutdown recommendation, Eagle got "bogged down in the swamp of detailed PRA" and had no time to get out of it. It was the feeling of many NRC staff members that they were doing an excellent job, and that they were close to getting a solution when they decided to throw in the towel (they felt that Eagle was probably less than 6 months away from the final solution). Many within the NRC felt that had some more time and resources been committed, an acceptable solution would have been quickly reached. Technical people within the NRC were actually very disappointed with the final Eagle decision, because they felt that strong technical progress was being made when Eagle decided upon permanent closure of the plant.

- A petition by a public interest group was received and denied. Once the petition was received, the operating, decision making and formal communications procedures within the NRC, with the utility and with the public had to be changed to adapt to the new requirements. Also, a new NRC chairman came in with very little experience in the nuclear industry and in the NRC operation procedures and, probably wrongly, decided to give the issue a high profile. He decided to install a new "open door" policy at the NRC to boost public support for the nuclear energy. Eagle failed to understand the implications of the petition and the new policies of the Chairman for NRC's operating procedures.

- Some people within the NRC felt and still feel that Eagle failed to understand the regulator's situation and prospective. Eagle also failed to understand that NRC's internal decision making process is more of a group consensus, collegial kind, particularly when faced with new, first-of-a-kind issues, for which no previous experience exists. NRC's internal decision making process is very different from a corporation's own decision making procedure.

- NRC views itself as neutral with regard to the industry: it is neither pronuclear nor antinuclear. NRC believes in the technical viability of nuclear technology but does not endorse industry's attitudes. Eagle management might have felt that the NRC would fall on their side against the anti-nuclear groups.

- The Pontes case highlighted some shortcomings within the NRC from the technical capabilities point of view and from the management and decision making processes points of view.

- Some NRC's technical staff members felt that they were very independent from external pressures in their decision making and technical communications with Eagle. They did not like the full transcription system of communication but they felt that this particular communication system benefited or harmed both sides the same amount. Total openness of the communications to the public and to public interest groups did not impede at all the communications process, particularly the technical aspects. Communications were fluent in spite of that. Some other staff officials, however, suspect that the full-transcription requirement might have hindered "true" communication and might have made the information exchange process a lot more complicated.

- The amount of communications that took place throughout the issue was phenomenal. NRC made a great effort to maintain openness to the public, as required by the commissioners in all communications.

3.4 Interview Results at the Public Interest Union

During the Pontes case, the Public Interest Union (PIU) was very vocal and involved in the course of events (see Appendix 1). The group got considerable media attention and was able to influence a considerable part of the public's perceptions on the case.

They also filed a petition with the NRC that seriously conditioned the way that communications between NRC and Eagle took place.

Two interviews were held with PIU members that were involved in one way or another in the Pontes case: the CEO of the group, and the nuclear safety specialist who was in charge of the technical aspects of the case. The same phenomenon of strong emotional responses that happened in the NRC and Eagle was repeated at the PIU on an even more intense scale with the nuclear safety specialist, that was

the PIU member with a higher degree of personal involvement in the case. The CEO, instead, showed unemotional self-confidence in PIU's role through the whole issue and how PIU had fulfilled its mission of serving the public.

While the CEO insisted upon the general public interest motivation of the group and its neutrality in the nuclear issues, the nuclear expert showed a strong emotional personal position against the Pontes plant, the whole nuclear industry and particularly the NRC (of which he had previously been a staff member). He showed openly a strong personal bias against the NRC, which he said was the nuclear industry in disguise, and whom he accused of being "paid to lie". He added that NRC lies systematically "by omission", and he pointed out that his own career in the NRC was "ruined" when he was "forced to lie or resign".

The following are some of their remarks:

- The NRC is pronuclear. They assume that the utility is right and the public has to prove that they are wrong, when according to their charter it should be the other way around. NRC's customer is the public and not the utilities according to the Atomic Energy Act. There is too much "coziness" between the NRC and the utilities. This brings problems in the long run. The public is easily left out. NRC staff is more objective, but gets overruled frequently by cozy commissioners. NRC commissioners should be chosen to represent society as a whole: some should be pro-nuclear, some skeptical with nuclear power and some should represent the public. In the Pontes case, the issue became evident because an NRC staff official who was very close to retirement (and was not therefore afraid to speak out and ruin his career) declared against Pontes and the NRC. "Lessons learned" document from the NRC, written as a review of the case at its conclusion, showed that they had not learned anything from the Pontes issue. They still keep the intention of letting new Pontes-type problem plants operate unsafely.

- Sutherland (the new NRC chairman) gets mixed reviews: much better than former chairmen in one opinion, a "prostitute whose only asset is having contributed to political campaigns" in the other opinion. Gave PIU a role throughout the issue and sent to them a copy of the transcripts of every Eagle-NRC communication. He thanked PIU officially for the role that they played. For a PIU member Sutherland is also: "arrogant", has "no intention of improving safety", has no technical background and has been "trained to lie" in the State Department.

According to this view, he has only brought a change in rhetoric, but he certainly provided, after all, a neutral ground to discuss technical matters.

- Nuclear industry easily falls into overconfidence: "if it has operated well in the past, it will operate well in the future" reasonings are too often heard. The fact that it did operate well in the past never should imply that it will continue to operate well in the future. This was Eagle's basic assumption through the whole Pontes case.

- Nuclear industry should "weed out their own bad apples" for the industry's sake. They should be more openly critical of themselves. They should be more open with the public and tell the truth to create a climate of confidence. Past secrecy of the utilities and the NRC has been the best "combat weapon" of groups like PIU. PIU tried to discuss the Pontes issue directly with Eagle's management before going to the public and the NRC and got eventually rejected

- In the beginning of the case, it was clear from the minutes of Eagle-NRC meetings that NRC accepted continued operation of Pontes in spite of two regulation violations. Technical facts were clearly on PIU's side in the Pontes issue. Pontes and the utilities in general should always face first and mainly the technical problems and not play public relations games. In the Pontes case, Eagle tried to cast a smoke screen to hide the technical issues (because maybe they could not address them), and tried to fight a political and public relations "battle", but the strategy backfired. They kept saying till the end that they lost the political and public relations battle and not the technical battle.

- The public may be wrong in many perceptions of risk as is the case with the nuclear storage facilities (the public perceives a higher risk level than the actual level), but in the Pontes issue the public's pressure was one of the keys for the eventual "success".

- Utilities may be right sometimes when they complain about the NRC.

- Media understood very well the problems and gave appropriate coverage and local residents reacted correctly. Congressmen were often contacted by PIU and showed a very favorable answer to PIU's concerns. There may have been political pressure on the NRC from politicians and Congress members.

- Pontes issue was a very important test-case for the whole nuclear industry in very important partially related matters.

CHAPTER 4: ADDITIONAL DATA: THE SURVEY STUDY

4.1 The Individual Perceptions Survey

A simple one-page survey was presented to the members of the NRC, Eagle and PIU who were interviewed in connection with the Pontes issue. The intention was to summarize the diverse existing individual perceptions and to "objectivize" them in some way for comparison purposes.

In order to provide a "benchmark" or reference point, a "positive-scenario" case was selected (the Wildcat plant) and some surveys were presented to NRC and Wildcat staff members that regularly communicate with one another. Finally, similar surveys were given to an international group of executives from the nuclear industry and US vendors of nuclear power equipment who attended a small meeting.

4.2 Pontes Case Survey Results

The complete results of the Survey appear in Tables 1 and 2. In these tables the numbers of the questions in the left column correspond to the numbers of the questions in the survey sheets. In Appendix 2 the actual survey sheets that were presented to the participants in the Pontes case are presented. The identification codes of the different individuals interviewed are included in the top rows of the tables. Their organizational levels (1 is the conventional "top" of the organization) and a code of the frequency of their communications are included for each individual in brackets. The average of the ratings of the individuals is also included for each organization for comparison.

TABLE 1: EAGLE INDIVIDUALS (PONTES CASE)

("L#" means the level of the individual in the organization starting with 1 from the top. "d,w,m,f,n" indicate frequency of communications with EAGLE/NRC: daily, weekly, monthly, few times, never)

QUESTIONS	1EAGLE(L3/w)	2EAGLE(L3/w)	3EAGLE(L?/w)	4EAGLE(L4/m)	5EAGLE(L4/w)	6EAGLE(L4/d)	7EAGLE(L3/n)	8EAGLE(L2/w)	EAGLE AVERAGE
LEVEL IN THE ORGANIZATION	**3**	**3**	**?**	**4**	**4**	**4**	**3**	**1**	**na**
QUESTION 1	**w**	**w**	**w**	**m**	**w**	**d**	**n**	**w**	**na**
QUESTION 2									
Question 2.1	5	2	0.01	3	3	5	na	3	3.00
Question 2.2	6	2	na	5	4	5	na	3	4.4
Question 2.3	7	2	na	5	5	7	na	3	5.2
QUESTION 3									
Politicians	7	9	7	5	7	10	6	9	7.28
Local, State, Federal Authorities	4	2	0.01	2	3	10	3	6	3.43
Media	3	7	9	1	5	9	7	8	5.85
Local Residents	2	8	1	1	2	8	6	6	4
PIU	5	8	10	10	7	10	9	10	8.42
Pro-nuclear Groups	0.01	7	0.01	0.01	0.01	0.01	0.01	0.01	1.01
QUESTION 4									
Politicians	0.01	8	10	7	6	10	1	8	6.00
Local, State, Federal Authorities	0.01	4	1	4	6	10	3	4	4.00
Media	0.01	7	7	2	3	9	4	7	4.57
Local Residents	0.01	8	1	2	2	8	4	4	3.57
PIU	5	9	10	10	5	10	9	7	8.28
Pro-nuclear Groups	0.01	7	0.01	0.01	0.01	0.01	0.01	0.01	1.01
QUESTION 5									
Tech-Safety Basis	9	2	5	8	8	9	7	2	6.86
Political Basis	7	9	9	9	2	3	3	8	6
Financial Basis	0.01	0.01	0.01	0.01	1	0.01	0.01	0.01	0.13
QUESTION 6	**0.01**	**0.01**	**0.01**	**4**	**5**	**10**	**4**	**0.01**	**2.90**

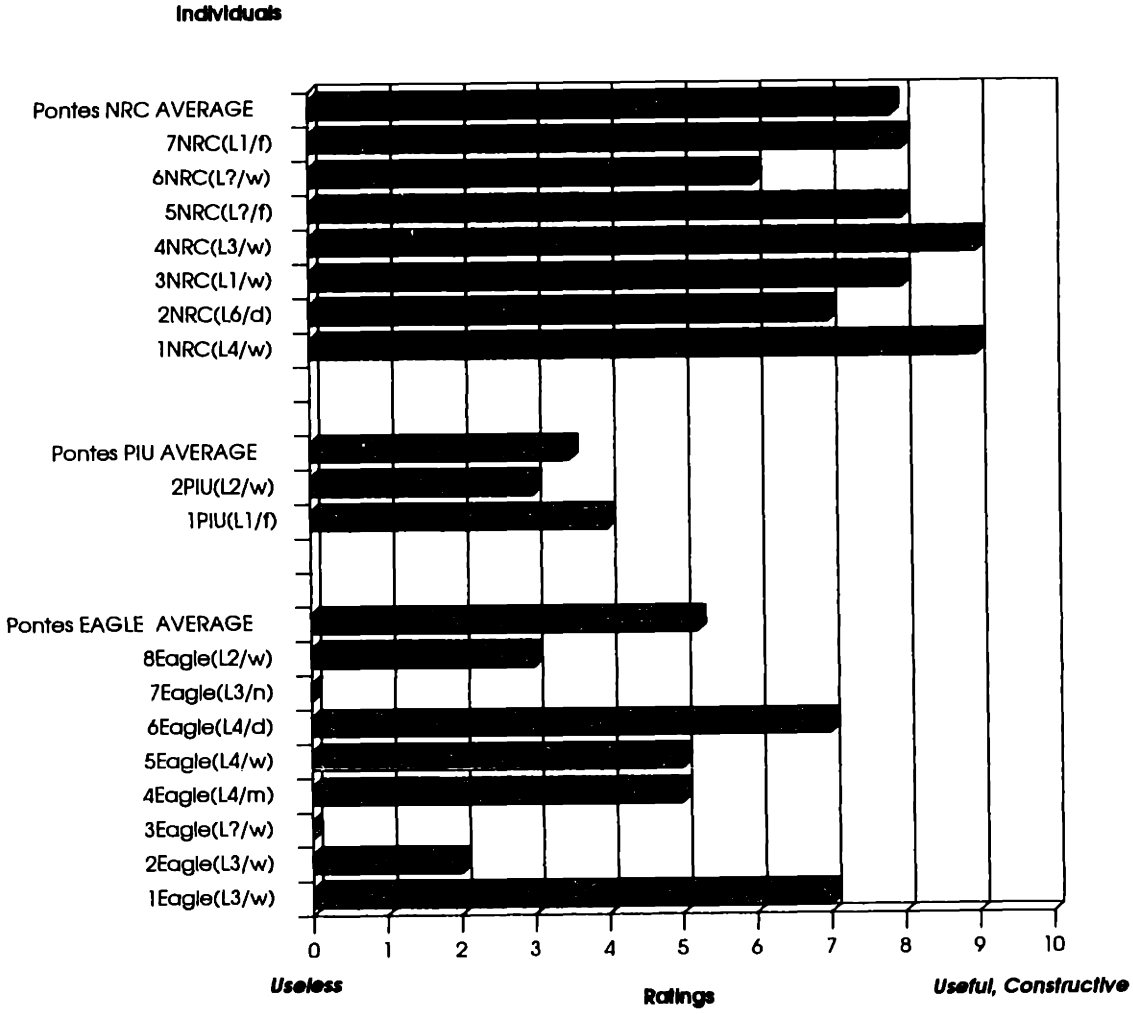
TABLE 2: PIU AND NRC INDIVIDUALS (PONTES CASE)

("L#" means the level of the individual in the organization starting with 1 from the top. "d,w,m,f,n" indicate frequency of communications with EAGLE/NRC: daily, weekly, monthly, few times, never)

QUESTIONS	1PIU(L1/f)	2PIU(L2/w)	PIU AVERAGE	1NRC(L4/w)	2NRC(L6/d)	3NRC(L1/w)	4NRC(L3/w)	5NRC(L?/f)	6NRC(L?/w)	7NRC(L1/f)	NRC AVERAGE
LEVEL IN THE ORGANIZATION	**1**	**2**	**na**	**4**	**6**	**1**	**3**	**na**	**na**	**1**	
QUESTION 1	**f**	**w**	**na**	**w**	**d**	**w**	**w**	**f**	**w**	**f**	
QUESTION 2											
Question 2.1	1	0.01	0.505	8	9	3	8	4	4	3	5.57
Question 2.2	1	0.01	0.505	9	9	6	9	7	4	3	6.71
Question 2.3	4	3	3.5	9	7	8	9	8	6	8	7.86
QUESTION 3											
Politicians	8	10	9	1	5	5	0.01	0.01	0.01	0.01	1.58
Authorities	6	1	3.5	1	5	2	0.01	0.01	0.01	0.01	1.15
Media	10	3	6.5	2	2	5	1	3	0.01	0.01	1.86
Local Residents	10	2	6	3	2	6	1	0.01	0.01	1	1.86
PIUs	10	2	6	6	5	8	7	2	0.01	8	5.14
Pro-nuclear Groups	3	0.01	1.505	1	5	2	0.01	0.01	0.01	0.01	1.15
QUESTION 4											
Politicians	6	9	7.5	0.01	2	6	0.01	0.01	0.01	0.01	1.15
Authorities	8	0.01	4.005	0.01	2	2		0.01	0.01	0.01	0.58
Media	10	8	9	0.01	0.01	2	0.01	0.01	0.01	0.01	0.30
Local Residents	7	0.01	3.505	1	0.01	6	0.01	0.01	0.01	0.01	1.01
PIU	10	8	9	0.01	4	6	1	0.01	0.01	0.01	1.58
Pro-nuclear Groups	5	10	7.5	0.01	2	2	0.01	0.01	0.01	0.01	0.58
QUESTION 5											
Tech-Safety Basis	9	10	9.5	10	10	9	10	10	10	na	9.83
Political Basis	10	0.01	5.005	0.01	4	2	0.01	0.01	0.01	na	1.01
Financial Basis	9	0.01	4.505	0.01	0.01	2	0.01	0.01	0.01	na	0.34
QUESTION 6	**10**	**10**	**10**	**8**	**9**	**9**	**10**	**10**	**10**	**10**	**9.43**

Some particularly interesting graphic summaries of survey data are presented in figures 1,2 and 3.

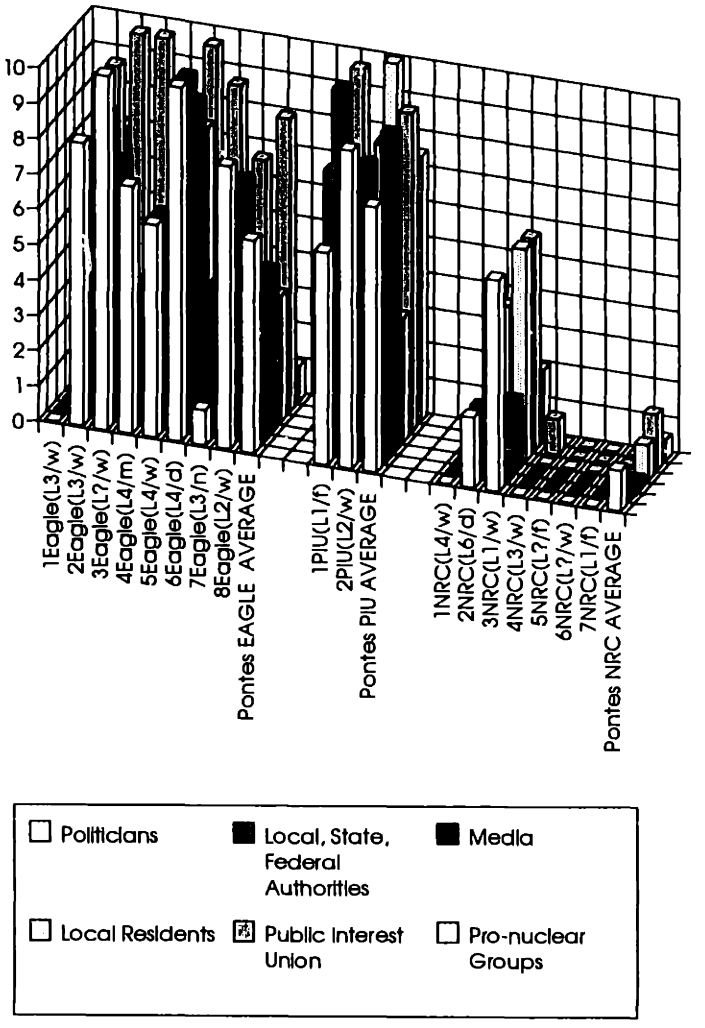
FIGURE 1. Subjective individual ratings of the COMMUNICATIONS PROCESS IN GENERAL with NRC/Eagle during the Eagle-Pontes case period from Useless (0) to Useful(10) (Question 2.3)



In figure 1 we can see the individual ratings of the communications process in general with the NRC (for individuals at Eagle and PIU) or with Eagle (for the individuals at the NRC). This corresponds to question 2.3 in the survey. The question referred to the usefulness or uselessness of the communications process in general during the Pontes case period. As is evident in the figure, individuals at

the NRC rate the communications process in a more positive way than individuals at PIU or the utility.

FIGURE 2. Pontes case. Individual ratings of the relative influence of external interferences in NRC's internal decision-making process (Question 4). 0 means irrelevant influence and 10 indicates strong influence.



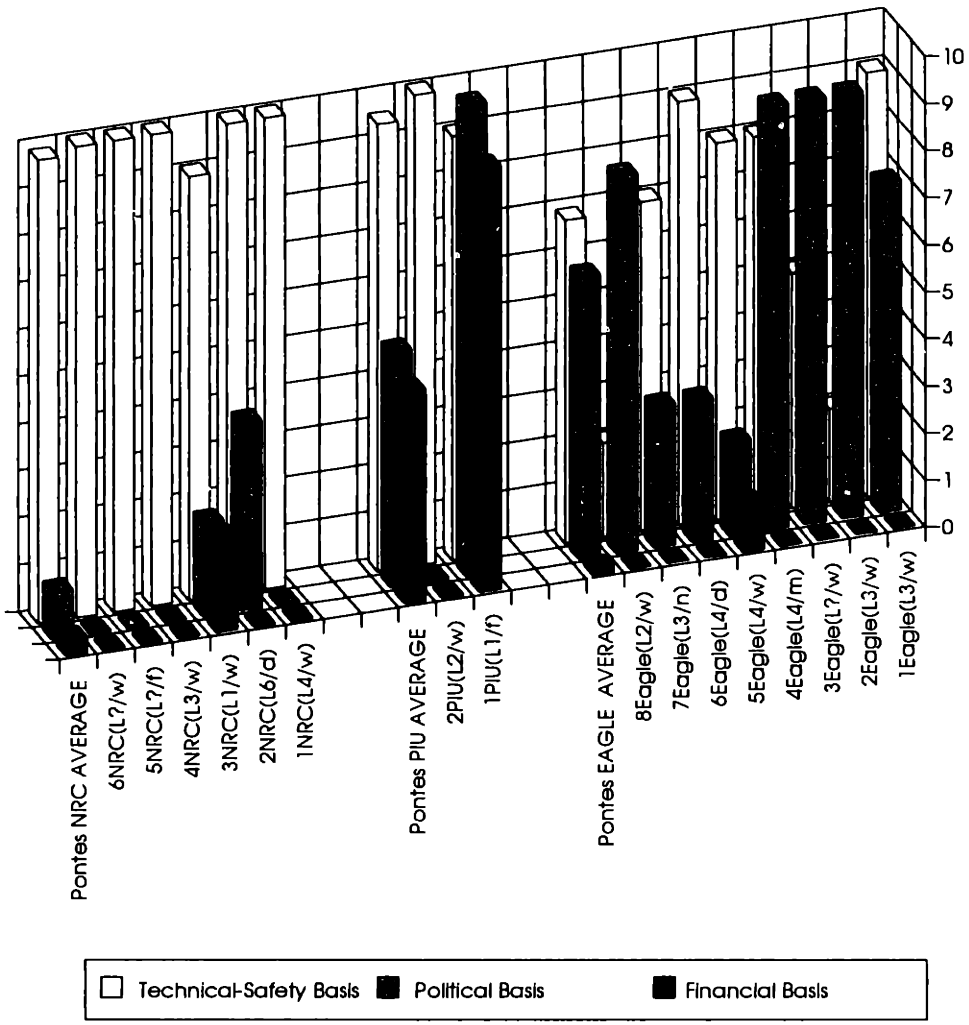
In figure 2 we can see a graphic three-dimensional summary of the survey results for question 4 in the questionnaire. In this question individuals are asked to rate the perceived relative influence that a series of external elements had on NRC's internal decision-making process in the Pontes case from 0 (irrelevant influence) to 10 (strong influence). With some exceptions, it is clear that outsiders

to the NRC perceive the NRC as having been much more liable to yield to external pressure.

Interestingly, however, one of the highest ranking NRC officials (individual 3NRC in the graph, with conventional organizational level 1) in the Reactor Regulation Office perceives the NRC as much more susceptible to external influence than his colleagues. The other high ranking NRC official (7NRC, level 1, communicated few times) belongs to a much more technical and research-oriented NRC office.

As could be expected, the Public Interest Union perceives, on average, much more external interferences than the NRC or the utility. It is also important to notice the considerable individual differences of perceptions, particularly within Eagle.

FIGURE 3. Individual ratings of the relative importance of some possible basis for NRC's final Pontes recommendation and decision (Plant shut-down). 0 means irrelevant and 10 indicates most important.



In figure 3 we can see the individual answers to Question 5 of the questionnaire. In this question individuals were asked to rate their perception of the main basis for NRC's final recommendation for shut-down in the Pontes case (it was a final recommendation-decision because the plant was eventually closed after the shut-down).

It is interesting to see how perceptions again differ between the NRC on one side and PIU and Eagle on the other: the NRC members perceive an almost purely

technical decision, whereas the rest see a much more complex picture (with the exception of PIU's nuclear expert who looks much more like his former NRC colleagues on this particular question).

We also see important individual differences among Eagle and PIU members. We can observe how the most senior person at Eagle (8Eagle) perceives an almost pure political decision as opposed to the opinions of many of his own Eagle colleagues.

In Appendix 3 a graphic summary and a table are presented of a consistency of response test. The same survey was presented to one individual at two different points in time 4 months apart. The answers to the questions at the two different moments have been compared, and can be observed to be very similar. Differences in the ratings average less than 10%. Though further, more detailed studies should be carried out to verify the strict statistical validity of the survey, its representativeness in the Pontes case is probably very good due to the fact that well above 50% of the individuals who communicated with Pontes, NRC or PIU was sampled.

4.3 Wildcat Survey Results

The Wildcat plant belongs to the Wildcat Public Service Corp. It was selected because of its excellent record of communications with the NRC and because it was perceived as a "positive" scenario situation: no major technical issues involved, good opinion within the NRC of the plant's management and of their communications process, etc. In total, 3 persons who communicate frequently with the NRC submitted the survey from Wildcat and their two main correspondents within the NRC were also able to submit it on time for this study.

The intention, as stated above, was to use this case as a benchmark against which to compare the Pontes results. From that point of view the results obtained are very valuable to calibrate and compare the Pontes survey results to the "rosy world scenario". The comparison has not been free of surprises however, as described in section 4.5.

In Appendix 4 the sheets used for the survey are presented. In Appendix 5, the results of the survey are given in a table form.

4.4 Other Utilities and Vendors Survey Results

Additional information was gathered from other US utilities during an international executive panel meeting at MIT's Sloan School of Management. Executives attending the meeting were presented with the survey sheet that appears in Appendix 4. The results of that survey appear in Appendix 7.

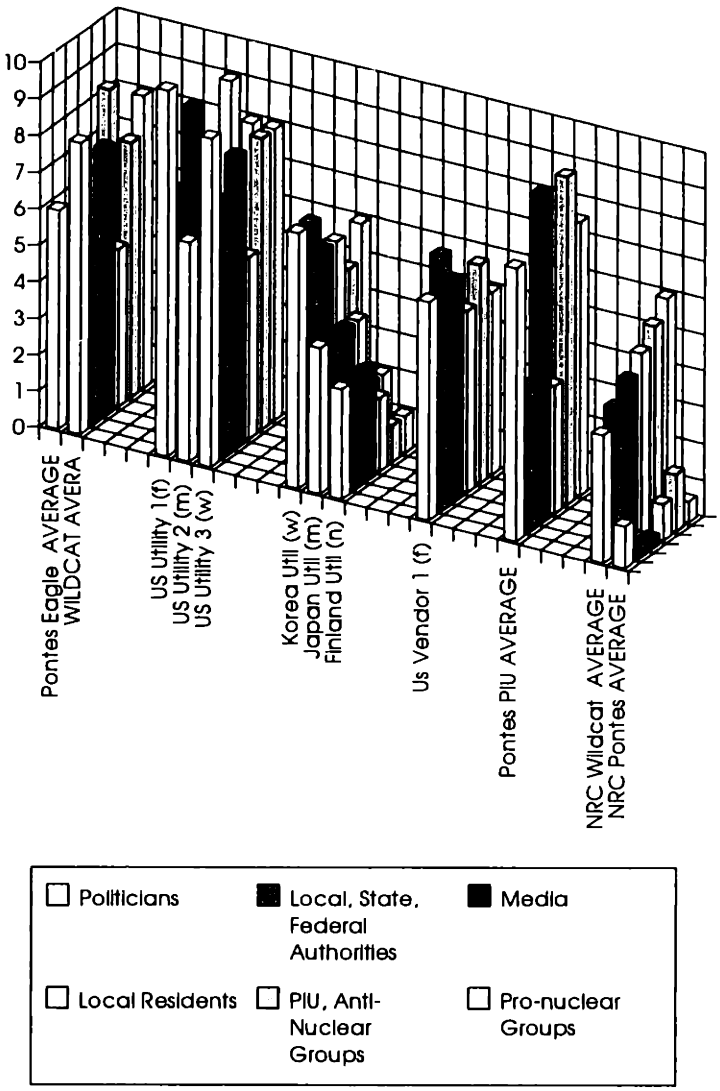
These results are also used to compare the Pontes survey results with what may be more "normal" situations of typical relations and communications with the NRC.

Also interesting are the results included in Appendix 7 for a Korean, a Japanese and a Finnish utility. These results were obtained at the same international executive panel meeting. The answers are too few to have any statistical significance, but again they provide additional information and insight, and give extra benchmarking information about utilities in "normal situations".

4.5 Summary of Survey Results

When reading and interpreting the summary of survey results included in Appendix 7 it is important to remember that the Pontes case individuals are answering questions related to the Pontes case, whereas the rest of the individuals interviewed are answering questions of a more general nature with regard to the regulation process.

FIGURE 4. Summary of individual ratings of the relative influence of external interferences in the Regulator's internal decision making process (Question 4)

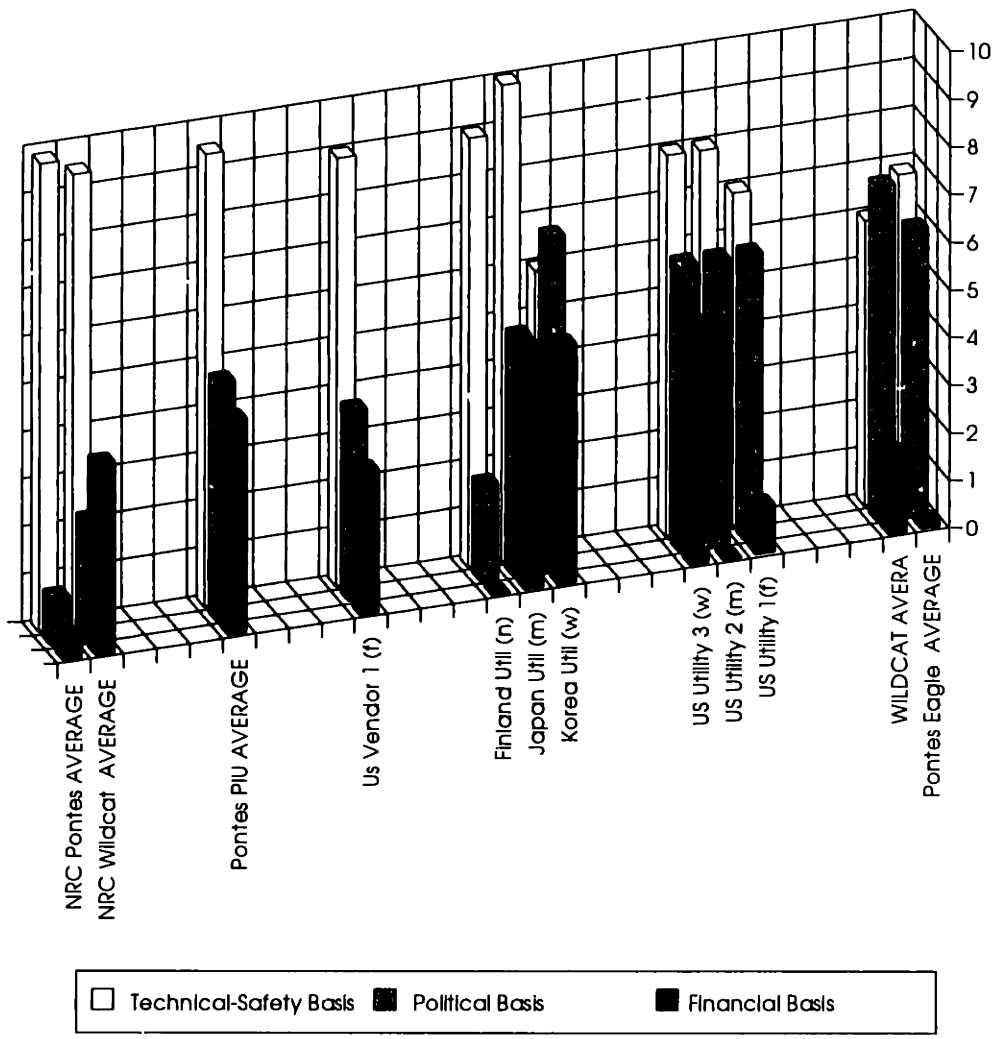


In figure 4 we observe that when asked to rate their perceptions of the relevance of external interferences in the NRC's internal decision making process, there is some difference between the utilities and the NRC. Surprisingly, however, the difference is negligible when we compare the Eagle results in the "negative" Pontes case with the "positive scenario" Wildcat results and the other US utilities results. It seems that the nuclear power industry in general has the perception of an NRC that yields to undue external pressure, independently of the particular situation that the utility is going through.

Also interesting are the foreign utilities results. Not many conclusions can be obtained, because of the small sample size, but the Korean utility employee seems to distrust his regulator as much as do the US utilities. The person in the Finnish utility, on the other hand, seems to put a lot of confidence in the technical independence of his regulator.

A last remark can be made with regard to the NRC staff members. It is curious that the NRC members who intervened in the "unpleasant" Pontes case trust their agency's independence (in obviously difficult circumstances) more than the NRC staff members who handle a "good" situation. Also remarkable is the fact that the levels of "distrust" by the utilities and the public interest group surveyed seem to be equivalent.

FIGURE 5: Summary of the perceived relative weights of different basis for the NRC's (or the Regulator's) decision making (Question 5). 0 means irrelevant influence and 10 indicates strong influence.



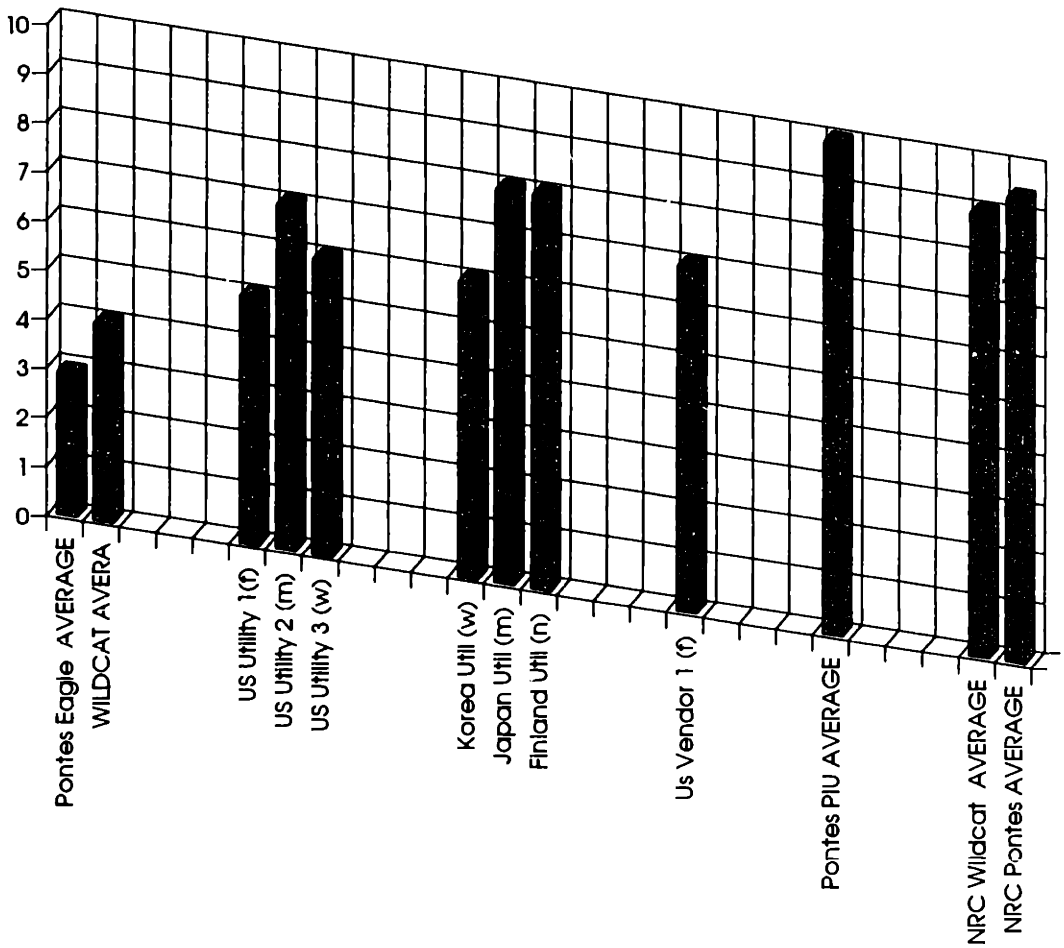
In figure 5 we can see the summary of the survey results for Question 5 in the questionnaire. In this question individuals were asked to rate their perceptions of the relevance of different basis for NRC's (or the Regulator's) decision-making. From the interviews with utility staff members it became clear that, for them, NRC should theoretically be making their decisions solely based on technical reasons. The rating of the influence of politics in the regulator's decision making highlights and "quantifies" in some way the "level of distrust" that individuals have with regard to the NRC overall "technical neutrality".

In this graph we find again the same fact that we mentioned above. US utilities in "smooth" circumstances seem to "distrust" the "technical neutrality" of the NRC's decision making process as much as utilities like Eagle that have just undergone a negative experience. The level of perceived "lack of technical neutrality of the regulator" in the US utilities is considerably high and that seems to be also the case in the small sample of foreign utilities included in the study (with the remarkable exception of the Finnish utility).

NRC's staff members are generally confident about the level of technical independence in the Agency's decision-making process.

The Public Interest Union seems to be rather pleased with the Pontes decision though some of this "distrust" undoubtedly remains and is shown in high ratings for the relative weights of financial and political considerations in the decision-making process.

FIGURE 6. Summary of the individual ratings of the overall perceived quality of the NRC's (or the regulator's) decisions and recommendations (Question 6). 0 is the worst possible perceived overall quality and 10 is the best possible



In figure 6 we have the graphic presentation of the summary of the survey results for question 6. In this question individuals were asked to rate their overall perception of the general quality of NRC's decisions and recommendations except persons included in the Pontes case study, who were asked to rate their perception of the overall quality of the NRC's final recommendation in that particular case. NRC's staff members are again the most confident in the ability of the NRC to

arrive to the best possible solutions. PIU is very optimistic about the final outcome in the Pontes case.

With regard to the utilities, they are far less enthusiastic about the NRC's capabilities and, interestingly again, Eagle-Pontes (the "negative scenario") and Wildcat (the "positive scenario") share a similar pessimistic view.

5.1 Some Final Conclusions

Though the purpose of this research is not to obtain conclusions or make recommendations, some very evident outcomes emerge from a quick analysis of the summary of all the survey data presented in Chapter 4. Some of these conclusions are:

- There is a strongly divergent perception of the communications process between the NRC and the licensees, independently of the existence or not of a controversial issue.

- There is also an even larger divergence in the perception of the NRC internal decision making process that is also independent of the existence of a specific controversy. Utilities perceive NRC as a highly political body subject to all kinds of negative external interferences that are not based on technical facts. On the other hand, the NRC staff members perceive their agency as a basically technical regulatory body. The perception gap about NRC's internal functioning between the NRC and the licensees is probably wider than would be expected and, interestingly, is very similar to that of the public interest group. From the results of the survey, both nuclear power industry and this public interest group perceive the NRC as liable to yield to any external pressure, whereas NRC staff views itself (and the whole NRC) as highly independent of external interferences. Exceptions to the rule do appear, however, within the NRC: some top managers are more ready to acknowledge outside influence in the decision process, and, interestingly, the NRC staff members who relate to the utility in a "smooth" environment feel that NRC is more susceptible to outside interference than the NRC staff members who were involved with the "negative", publicly scrutinized, Pontes case.

- Interesting also is the strong perceptual gap between NRC and utilities with respect to the quality and adequacy of NRC's recommendations and decisions both in the Pontes case and in general (where applicable). If communications and

relationships between the NRC and the licensees are to be improved, this is certainly one of the first areas to work on.

- A remarkable (but neither new, nor surprising) conclusion from the research, is the fact that controversial nuclear regulatory issues can become deeply emotional and even passionate. It was surprising to encounter the degree of personal involvement and emotional responses that many of the people who were involved in the Pontes case still show years after the conclusion of the case. It must not be forgotten that it is extremely difficult to isolate the strictly technical "rational" aspects from the behavioral and social "irrational" ones in most safety and risk evaluation situations. Up to date no single technique has been generally accepted by the scientific and technical community to define "acceptable risk" or "objective risk evaluation". Some of the demands of regulators (who may not have technical qualification), attorneys, sectors of the public and public interest groups to "evaluate risk" or "quantify risk" may be nonsensical from a purely technical standpoint. As an old Spanish mining regulator body staff member put it: "the safe mine is the closed mine". On the other hand, the lack of generally accepted safety and risk evaluation criteria should never be used as an excuse by a negligent operator to unduly risk people's lives and well-being. An open, informed, honest and **qualified technical discussion** should be the adequate forum to reach a consensus on safe practices that permit humankind's progress. But we must also acknowledge that some degree of subjective and emotional judgment and political pressure will always be present in technical discussions about safety and risk.

- Some degree of consensus exists between the NRC and Eagle staff members with regard to the negative impact that the new NRC chairman's policies had in the technical communications process in the Pontes case. His lack of former nuclear industry experience is perceived by NRC staff, licensee and even PIU members as a rather considerable liability that complicated technical matters. The utility perceives itself, however, as the main loser in the application of these policies.

5.2 Further Research

Suggested further lines of research are:

- Expand survey study to additional US and non US utilities. Expand also data gathering to foreign utilities and regulators for international comparison and benchmarking.

- Develop the Wildcat case further, including some personal interviews with the NRC and utility staff members. A different case for comparison as a "positive scenario" could also be chosen. For example, a plant could be studied that had a bad record of relations and communications with the NRC but that was capable of giving a very good, quick, serious and technical answer to a technical issue similar to the one that Pontes faced.

- Perform a similar survey analysis with the relationships and communications problems between the airline industry, the mining industry or other high hazard industries and their respective federal regulation bodies. Any results obtained when compared to the ones obtained for the nuclear industry, would highlight aspects inherent in the relationships between regulator and regulated and peculiar aspects of the nuclear power and the other industries.

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Appendix 1: Time-Line of Events in the Pontes Case[5]

[5]The names of the plant, utility, specific individuals, dates and the exact nature of the technical issue have been changed to provide a degree of confidentiality.

Time	Eagle	NRC	Other
Earlier		NRC's Freixo states in a report that Pontes's and 13 other plant's special valves were more weak than previously thought. This led to a special regulation (1)(7).	
3/Year 1	Members of Eagle's technical staff make a presentation to NRC staff to summarize the status of the valve and the situation regarding the renewal of the operation expansion. (Weakening of the valve and valve inspection procedures are among the topics included in the presentation). Differences of opinion appear between members of NRC and Eagle technical staffs regarding the interpretation of the available technical information, and some conservative technical assumptions that should be made.(5) (7)		
5/Year 1		NRC sends a letter to Eagle requesting to perform additional Valve analysis and to submit it within 60 days (5)	
8/Year 1		NRC's Freixo allows Pontes to operate one more fuel cycle until March Year 3 stating the "low risk" of an accident. Eagle must sample, inspect and irradiate specimens before next restart.(1)(5)	

8-9/Year 1		• Reynolds, from NRC's Nuclear Reactor Regulation Office, writes to Freixo a memo in which he criticizes Freixo's decision of approving Pontes's continued operation as being in opposition to the staff's technical assessment (This is a standard procedure for handling technical opinion discrepancies within the NRC) (7).	
9/ Year 1		NRC's Advisory Committee on Nuclear Reactor Safeguards concludes that "operation for one more fuel cycle is acceptable" (4).	
2/Year 2			PIU holds a Board of Directors meeting in which Pontes was not on the agenda. After Ross (PIU's CEO) raises the issue, the Board decides to pursue the Pontes issue strongly, despite Perez's (PIU nuclear safety engineer) recommendations to the contrary (6). Pontes is perceived to be an important test-case for the operation expansion process in the whole nuclear industry(6).
4-5/Year 2	Eagle staff makes a presentation at NRC's headquarters in Rockville, Md., and explains its technical opinion of why the plant is safe to operate. (5)	NRC staff clearly states to Eagle staff that they no longer trust Eagle's technical data and calculations, particularly safety coefficients and conservative assumptions. NRC staff requests further and more detailed technical information.(5)	

3/Year 2	Gregory Corella (Eagle's CEO) approaches PIU's Ross during a ANS meeting, and proposes a technical meeting between Eagle and PIU officials to discuss the Operation Expansion procedures.(5) (6)		
4/Year 2			PIU answers to Corella's suggestion with a letter accepting the meeting, but proposing the Valve issue as the main topic to be addressed. (5) (6)(9)
4/Year 2	Corella answers PIU's letter expressing disappointment about PIU's shift, and repeats his suggestion of holding a meeting to discuss the Operation Expansion Rule. (5)(6)(9)		
5/Year 2			PIU insists, in a letter to Corella, that the meeting be held to discuss the Valve issue as the main topic. In the letter they also state that they are considering to file a petition with the NRC. (5)(6)(9) Following this letter, direct communications between Eagle and PIU eventually break down.(5)(6)
?/Year 2?			PIU declares in their fund-raising mailing, that funds are needed to provide support for the case against Pontes in order to attack the whole Operation Expansion Process (5).
6/Year 2		A spokesman for NRC and its advisory committee declares that Pontes is safe to operate.(1)	

6/Year 2	An Eagle Pontes spokesman, declares that the PIU petition is part of a broader political campaign against the operation expansion of nuclear plants, and the nuclear industry in general.(1)	One anonymous senior NRC official publicly declares that Pontes is in a "extremely serious and very dangerous" situation.(1)	•A spokeswoman for the US Department of Energy declares that up to 50% of Pontes's operation expansion costs could be provided by her Dpt. and the Electric Power Research Institute. •PIU's Perez (Former NRC engineer) rejects accusations of politically motivated action and declares that their petition is based solely on "very strong technical" evidence: NRC staff documents say that some safety requirements and regulations are not being met. • A spokesman for the US council for Energy Awareness (lobbying and public relations group for the nuclear industry), declares that the PIU petition is politically motivated.(1)
6/Year 2		NRC staff denies PIU petition and says operation is safe (no "undue risk")(1)	6 senators and congressmen ask by letter NRC chairman to review the staff decision and "formally demonstrate that Eagle Pontes is in full compliance with NRC's safety requirements".(1)
7/Year 2		The new chairman of NRC, Sutherland, an outsider to the nuclear industry, takes Office(1)	

7/Year 2		•NRC's Sutherland agrees to review the staff's Pontes decision and hear arguments about the safety of Pontes's valve on a joint NRC, PIU, Eagle meeting on 7/Year 2 at NRC's headquarters. •NRC's Sutherland also schedules an unprecedented field fact-finding visit to Pontes with congressmen.(1)	

7/Year 2		NRC's Chairman Sutherland goes to Pontes with four congressmen and PIU's Perez (who appeared uninvited) on a fact-finding visit and declares at the end of the tour that the plant is safe to operate.(1)	•Rep. Capela, Head of the House Subcommittee on energy and the environment, declares after the Pontes visit that available information on safety is not enough and that he is planning hearings in Congress on the issue. •Rep. Sanchez, opponent of nuclear power, declares after the tour that the plant should be shut down immediately. •Adams, newly elected representative from the district that includes Pontes, declares after the tour that he received signed petitions from people calling for him to investigate the safety of the plant. •PIU's Perez declares that the NRC continues to be more concerned about the nuclear industry financial interests than the safety of the general public despite the change in its leadership. •Demonstrators gather in front of Pontes asking for its immediate shut-down.(1)
7/Year 2		NRC commissioners hear presentations from Eagle, PIU and NRC staff in NRC headquarters (Rockville, Md.)(1) Sutherland orders NRC staff to perform a sensitivity analysis on their decision following PIU petition. (5)	

7/Year 2	Eagle staff show NRC commissioners that the plant is safe to operate (5)	NRC commissioners hear presentations from NRC staff, Eagle and PIU. (5) NRC staff affirms its recommendation of keeping the plant open(1)	
7/Year 2	Corella praises NRC's decision as a confidence vote in the plant and announces a quick answer to NRC's demand for additional accident analyses. He also announces a "crash program" to perform the necessary measurements to reduce the technical uncertainties.(1)	•**NRC votes 4-0** to uphold the staff's decision to allow the plant to continue operating until 4/Year 3, denying PIU petition to shut it down. "Significant unknowns" in basic plant safety data are, however, cited in the decision. •NRC asks Eagle to present additional accident analysis by 8/Year 2 and says that it will not permit operation beyond 4/Year 3 without further testing. •Sutherland declares that a plant shut-down would not solve uncertainties and would cost rate payers' money. •In an unrelated action, NRC's Region I Office notifies Pontes officials of several safety and procedures violations.(1) (5) •NRC issues a Commissioner Order by which NRC staff is to produce and keep a **public written record** of every NRC-Eagle communication. Copies of the transcripts of the communications were to be immediately sent to Eagle and PIU. (7)	•Capela, Head of the House energy investigations subcommittee, declares that he wants to learn about NRC's procedures in approving the operation of the plant in next day's hearing. •Adams, Rep. from the district including Pontes, criticizes NRC's decision and asks for the plant's immediate shut down calling NRC's conclusion a "best guess" that is not enough. •PIU's Perez criticizes NRC's decision and blames both NRC and Eagle for the safety problem.(1) He also declares that he would be satisfied if the issue was technically addressed in a correct way. (6)

8/Year 2	Gregory Corella explains Eagle's position in a House hearing, and underlines the safety of Eagle to operate. He declares that robotic testing programs are under way to gather new technical data during the spring of Year 3 . (4)	Sutherland rejects charges against the NRC stated by congressmen and angry critics in a House hearing. He declared "more than conceivable" a possible shut-down decision by end of August if Eagle failed to implement safety measures that would reduce the risk of certain accidents. He also insisted in the decision of NRC of shutting it down by mid-April due to lingering "uncertainties".(1)	•The House energy investigations subcommittee held a hearing on the plant. NRC, PIU and Eagle testify.(5)(1) •Rep. Capela declares in the opening that he thinks NRC is "gambling" with the public's safety (1), but is satisfied NRC acted appropriately when the hearing concludes (5). •Rep. Adams asks why the plant is safe until April and not after that. •Corney, attorney for PIU, said the decision dealt a blow to NRC's "fragile credibility". •Wasserfest, environmental activist with Greenworld, called NRC's decision a "national insult", and said NRC is the top federal agency in raising "grassroots anger and distrust".(1)
8/Year 2	Eagle Pontes Officials submit to NRC the requested analysis (5) and propose to keep emergency systems operating in case of an accident to reduce the chance of catastrophic accident and increase the safety margin (1) (5)	Eagle's technical position starts to weaken seriously in the eyes of NRC technical staff.(7)	
9/Year 2		NRC requests that Eagle provide new calculations on the proposed actions to respond to certain accidents (1).	
9/Year 2	Eagle-NRC meeting to discuss the analysis. (5) Eagle answers to NRC petition and presents the modified calculations. .(1) (5) (7)		

9/Year 2		•NRC staff reverses its 3 previous recommendations and decisions and **recommends**, in a memo sent to NRC commissioners, an **immediate shut-down** for safety reasons. The plant is declared susceptible to a catastrophic accident. According to the staff memo, change came as a result of the analysis of Eagle's latest calculations related to the proposed accident response measures. (7) No explanations are given to the plant in the recommendation about the technical analysis performed to base the conclusions (5) (6) or about the path to follow to resume operations. (1)	

10/Year 2	•NRC notifies Eagle of the shut-down recommendation (5). •Eagle staff and management is totally surprised by NRC's staff shift of opinion "out of the blue".(5) •Top management of Eagle voluntarily **decides to shut down** Pontes temporarily, without waiting for an NRC commissioners vote, a few hours after the content of NRC's staff memo was known (5) (7). •A plant spokesman expresses surprise at the decision and announces that Eagle will request a meeting with NRC to discuss the possibility of resuming operations until 4/Year 3. He criticizes both the way information is presented in the memo and the conclusions that are obtained. He also expresses confidence in a quick reopening of the plant. •Eagle's Terry (Responsible for the valve project at Pontes) criticizes NRC's memo citing lack of technical information and understanding on how calculations were done and conclusions obtained. He also expresses eagerness to "sit down and discuss" the decision with NRC's staff.(1)	•Sutherland cancels an NRC vote scheduled for 10/Year 3 on the shut-down issue and orders the plant to remain closed until NRC approves its restart.(1)	•"Utility executives nationwide" suggest that Pontes was a much more problem-plagued plant than others. •"Industry analysts" say that Pontes's shut-down may benefit the industry, and is unlikely to pose immediate problems for other plants. They also say that NRC's "troubled image" may be enhanced by the shift, thus increasing public confidence in nuclear power. But others point to new risks for other, more important, plants applying for operation expansion. •PIU's Perez "congratulates" NRC for "discovering its error", and doing what PIU "had asked them to do". He also acknowledges that Pontes's situation is "unique" due to the amount of uncertainty involved. He, however, criticizes NRC's memo as "vague and cagey", and admits that not enough information is provided to Eagle to solve the problems.

10/Year 2 (continued day)	•Eagle's management gets particularly disappointed at NRC's total lack of explanations so as to resume operations.(5) • Eagle's Stephens explains that given NRC's adversarial position, Eagle had no alternative but unilateral shut-down to restart the communication process with NRC (5)		•Several Congressmen hail NRC's new position and the closure decision. •The Exec. Dir. of the antinuclear group "Pontes Citizens for Safe Energy", hails NRC's shift and argues that risk must be very high for NRC to reverse 3 previous decisions. •Wass (American Nuclear Association), suggests that NRC's staff was pressed by the Chairman of the Commission. •Pontes's residents react in diverging ways to the shut-down decision: while some hail it and continue to distrust NRC, others say NRC gave in to pressures from politics and anti-nuke groups.(1)
10/Year 2	•William Brent, Pontes's technical director, declares that a quick restart is likely, and says that the present shut-down is similar to one in last June due to a lightning hit, that lasted for one week. Pontes has had 24 shut-downs in its operation life (2). •Bienvenue, plant supervisor, declares that Eagle's officials hope to persuade NRC to permit a restart in coming weeks (2).		
10/Year 2	Meeting of NRC staff with Eagle Officials to discuss the issues that led to NRC staff's new recommendation.(1) (5)		

10/Year 2	•Eagle officials make a three hour presentation to NRC staff to convince them that reopening the plant is safe. •NRC and Eagle Pontes technical teams spend six hours reviewing technical safety issues. • Corella declares after the meeting that Eagle has provided NRC with "a great deal of new information", and "sufficient basis to change their decision and allow restart". He also declares that Eagle could appeal to NRC commissioners after 10/Year 2.(1) (5)	•Freixo confirms the shut-down recommendation decision after a three-hour meeting with Eagle officials. He also declares that NRC "needs to see new data" to reconsider the shut-down decision. •Anonymous NRC sources indicate that NRC staff has lost confidence in the reliability of data produced by engineers at the plant, and no risk will be taken without new "tangible evidence".(1)	•Experiments to replicate conditions are under way at a university, but results are not expected for three months.(1)
11/Year 2	Meeting of Gregory Corella with Eagle's technical staff to assess the situation. A number of staff members suggest the likelihood of a negative outcome for the valve issue, given the technical uncertainties and the time pressures involved. (5)		
11/Year 2	Eagle's managers explain to the Advisory Committee on Reactor Safeguards (ACRS) the differences between some technical opinions of NRC staff and Eagle staff.(5) Meetings with NRC staff on restart criteria continue until 2/Year 3 (5)		

2/Year 3	NRC-Eagle meeting. Corella urges NRC to resolve quickly on the regulatory hearing question citing economic impacts(1). Eagle management loses confidence in the possibility of NRC fixing reasonable technical criteria to restart operations, when they are confronted by NRC staff with 4 pages of technical questions just when final restart criteria were supposed to be available (5)	NRC's Freixo attends the meeting(1). NRC demands from Eagle to answer 4 pages of additional questions on issues that had been previously addressed by Eagle, and fails to provide clear criteria to restart operations (5).	
2/Year 3	Eagle has no comment on the "pressure on the NRC" issue (1).	NRC publicly denies that they are being pressured by Eagle 's management(1)	"Citizens Awareness Network", PIU and "Pontes Citizens for Safe Energy" publicly claim that Eagle management is putting pressure on NRC(1)

2/Year 3	•Eagle 's Board of Directors unanimously vote to **close Pontes permanently** and not to apply for operation expansion. Reasons adduced for the closing are of economic nature and the uncertainty about the cost of meeting unclear federal safety standards with regard to the valve issue (3) (5). •Corella declares to Wall Street Journal that the shut-down decision was based on the cost of restarting the plant and the availability of lower-cost electricity sources in the region, together with lingering uncertainties in connection with the ultimate cost of the safety measures. He points that the decision was not based on technical or safety issues(3). •An Eagle spokesman declares that the current cost of producing electricity at Pontes was higher than that of other sources. The cost of the electricity produced after the required testing would have risen (3).		
3/Year 3	"Lessons learned" meeting of Eagle and NRC staff. Members of Eagle staff complain about the format of the meeting (all opinions and speeches will be fully transcribed and made available to the public). In their opinion that kind of format hinders the communications process when dealing with sensitive and complex issues.(5)		

10/Year 3	"Lessons learned" meeting of Eagle and NRC officials with the ACRS. Eagle states that "an opportunity was lost to demonstrate that the NRC, the licensee and the scientific community can move towards consensus on a real, critical and complex problem in a professional and technical way"(8)		

(1) means The Pontes Journal
(2) means The New York Times
(3) means The Wall Street Journal (WSJ)
(4) means Gregory Corella's Testimony to the US. House of Representatives (August 1, Year 2)
(5) means interviews with Eagle staff or Eagle internal documents
(6) means interviews with PIU members
(7) means interviews with NRC staff members
(8) means "Lessons learned document" issued by Eagle
(9) means correspondence between PIU and Eagle

Appendix 2: Survey Sheets for the Pontes Case

MIT International Program on Nuclear Safety Sloan School of Management

Date:_____

Name:_____ Position, Title:_____

Organization:_____ Division, Branch:_____

Address:_____ Phone #:_____

COMMUNICATIONS NRC-UTILITIES: EAGLE-PONTES CASE

1.- How often did you communicate with NRC during the Eagle-PONTES case period ? (Please check best answer)

* Never _____
* A few times _____
* About monthly _____
* About weekly _____
* About daily _____

2.- How would you rate your communications with NRC through the whole period in general? (Please circle one number in each case for approximate rating)

* Difficult	0 1 2 3 4 5 6 7 8 9 10	Fluent
* Adversarial	0 1 2 3 4 5 6 7 8 9 10	Cooperative
* Useless	0 1 2 3 4 5 6 7 8 9 10	Useful, constructive

3.- Did you feel that there were external interferences which influenced the **communications** process with NRC? (Circle one number in each line)

	Irrelevant Influence	Strong influence
*Politicians	0 1 2 3 4 5 6 7 8 9 10	
*Local, State, Federal authorities	0 1 2 3 4 5 6 7 8 9 10	
*Media	0 1 2 3 4 5 6 7 8 9 10	
*Local residents	0 1 2 3 4 5 6 7 8 9 10	
*PIU	0 1 2 3 4 5 6 7 8 9 10	
*Others, please state _____	0 1 2 3 4 5 6 7 8 9 10	

4.- Did you feel that there were external interferences which influenced **NRC's decision making** process? (Circle one number in each line)

	Irrelevant Influence	Strong influence
*Politicians	0 1 2 3 4 5 6 7 8 9 10	
*Local, State, Federal authorities	0 1 2 3 4 5 6 7 8 9 10	
*Media	0 1 2 3 4 5 6 7 8 9 10	
*Local residents	0 1 2 3 4 5 6 7 8 9 10	
*PIU	0 1 2 3 4 5 6 7 8 9 10	
*Others, please state _____	0 1 2 3 4 5 6 7 8 9 10	

5.-Do you think that NRC's final recommendation and decision (Plant shut-down) was taken on a:

	Irrelevant	Mostly
Technical-Safety Basis	0 1 2 3 4 5 6 7 8 9 10	
Political Basis	0 1 2 3 4 5 6 7 8 9 10	
Financial Basis	0 1 2 3 4 5 6 7 8 9 10	

6.- Do you think that the final NRC decision was the best that could have been taken in Pontes's case?

No 0 1 2 3 4 5 6 7 8 9 10 Yes

MIT International Program on Nuclear Safety Sloan School of Management

Name:_____ Organization:_____

COMMUNICATIONS NRC-UTILITIES: EAGLE-PONTES CASE

1.- How often did you communicate with Eagle during the Eagle-Pontes case period ? (Please check best answer)

* Never _____
* A few times _____
* About monthly _____
* About weekly _____
* About daily _____

2.- How would you rate your communications with Eagle through the whole period in general? (Please circle one number in each case for approximate rating)

* Difficult	0 1 2 3 4 5 6 7 8 9 10	Fluent
* Adversarial	0 1 2 3 4 5 6 7 8 9 10	Cooperative
* Useless	0 1 2 3 4 5 6 7 8 9 10	Useful, constructive

3.- Did you feel that there were external interferences which influenced the **communications** process with Eagle? (Circle one number in each line)

	Irrelevant Influence	Strong influence
*Politicians	0 1 2 3 4 5 6 7 8 9 10	
*Local, State, Federal authorities	0 1 2 3 4 5 6 7 8 9 10	
*Media	0 1 2 3 4 5 6 7 8 9 10	
*Local residents	0 1 2 3 4 5 6 7 8 9 10	
*PIU	0 1 2 3 4 5 6 7 8 9 10	
*Pro-nuclear groups	0 1 2 3 4 5 6 7 8 9 10	
*Others, please state _____	0 1 2 3 4 5 6 7 8 9 10	

4.- Did you feel that there were external interferences which influenced **NRC's internal decision making** process? (Circle one number in each line)

	Irrelevant Influence	Strong influence
*Politicians	0 1 2 3 4 5 6 7 8 9 10	
*Local, State, Federal authorities	0 1 2 3 4 5 6 7 8 9 10	
*Media	0 1 2 3 4 5 6 7 8 9 10	
*Local residents	0 1 2 3 4 5 6 7 8 9 10	
*PIU	0 1 2 3 4 5 6 7 8 9 10	
* Pro-nuclear groups	0 1 2 3 4 5 6 7 8 9 10	
*Others, please state _____	0 1 2 3 4 5 6 7 8 9 10	

5.-Do you think that NRC's final recommendation and decision (Plant shut-down) was taken on a:

	Irrelevant	Mostly
Technical-Safety Basis	0 1 2 3 4 5 6 7 8 9 10	
Political Basis	0 1 2 3 4 5 6 7 8 9 10	
Financial Basis	0 1 2 3 4 5 6 7 8 9 10	

6.- Do you think that the final NRC decision was the best that could have been taken in Pontes's case?

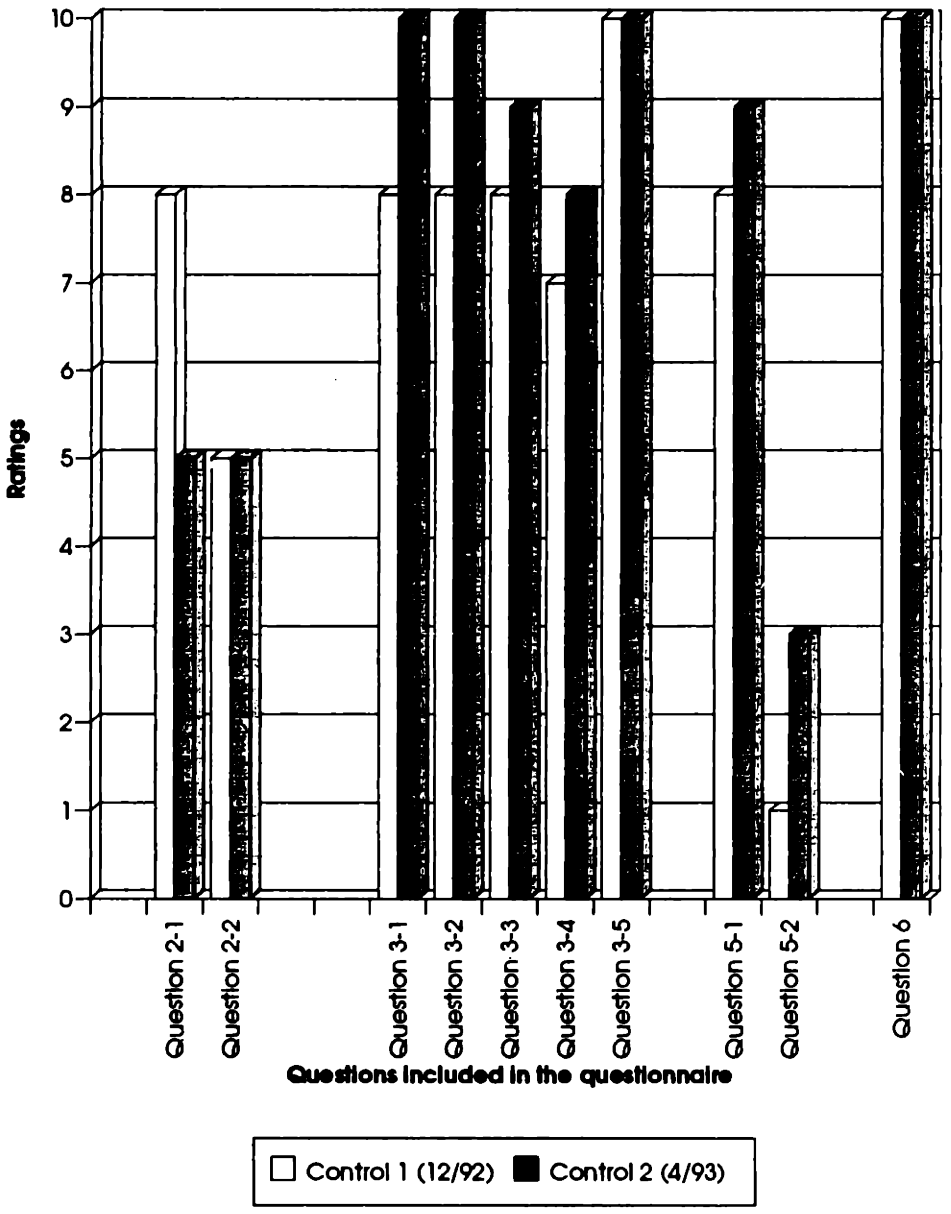
No 0 1 2 3 4 5 6 7 8 9 10 Yes

Appendix 3: Pontes Survey Control Study

Comparison of answers to the same survey questions by the same individual at two different points in time

	Control 1 (12/92)	Control 2 (4/93)
Question 2-1	8	5
Question 2-2	5	5
Question 3-1	8	10
Question 3-2	8	10
Question 3-3	8	9
Question 3-4	7	8
Question 3-5	10	10
Question 5-1	8	9
Question 5-2	1	3
Question 6	10	10

Comparison of answers to the same questions by the same individual at different points in time (answer consistency test)



Appendix 4: Survey Sheets for the Wildcat Case

MIT International Program on Nuclear Safety-Sloan School of Management

Date:_____ Name:_____

COMMUNICATIONS NRC-UTILITIES

1.- How often do you generally **communicate** with Wildcat? (Please check best answer) *

* Never _____
* A few times per year _____
* About monthly _____
* About weekly _____
* About daily _____

2.- How would you rate your **communications** with Wildcat in general? (Please circle one number in each case for approximate rating)

* Difficult	0 1 2 3 4 5 6 7 8 9 10	Fluent
* Adversarial	0 1 2 3 4 5 6 7 8 9 10	Cooperative
* Useless	0 1 2 3 4 5 6 7 8 9 10	Useful, constructive

3.- Do you have the feeling that there are external interferences which influence **your communications** process with Wildcat? (circle one number in each line)

	Irrelevant Influence Strong influence
*Politicians	0 1 2 3 4 5 6 7 8 9 10
*Local, State, Federal authorities	0 1 2 3 4 5 6 7 8 9 10
*Media	0 1 2 3 4 5 6 7 8 9 10
*Local residents	0 1 2 3 4 5 6 7 8 9 10
*Anti-nuclear groups	0 1 2 3 4 5 6 7 8 9 10
*Nuclear Industry groups	0 1 2 3 4 5 6 7 8 9 10
*Others, please state _____	0 1 2 3 4 5 6 7 8 9 10

4.- Do you feel that there are external interferences which influence **NRC's internal decision making** process in general? (circle)

	Irrelevant Influence Strong influence
*Politicians	0 1 2 3 4 5 6 7 8 9 10
*Local, State, Federal authorities	0 1 2 3 4 5 6 7 8 9 10
*Media	0 1 2 3 4 5 6 7 8 9 10
*Local residents	0 1 2 3 4 5 6 7 8 9 10
*Anti-nuclear groups	0 1 2 3 4 5 6 7 8 9 10
*Nuclear Industry groups	0 1 2 3 4 5 6 7 8 9 10
*Others, please state _____	0 1 2 3 4 5 6 7 8 9 10

5.-Do you think that NRC's recommendations and decisions are generally taken on a

	Irrelevant Mostly
Technical-safety basis	0 1 2 3 4 5 6 7 8 9 10
Political Basis	0 1 2 3 4 5 6 7 8 9 10
Financial Basis	0 1 2 3 4 5 6 7 8 9 10

6.- Do you think that NRC's final recommendations and decisions are generally the best that could have been taken? No 0 1 2 3 4 5 6 7 8 9 10 Yes

MIT International Program on Nuclear Safety-Sloan School of Management

Date:_____

Name:_____

COMMUNICATIONS NRC-UTILITIES

1.- How often do you generally **communicate** with NRC? (Please check best answer)

* Never _____
* A few times per year _____
* About monthly _____
* About weekly _____
* About daily _____

2.- How would you rate your **communications** with NRC in general? (Please circle one number in each case for approximate rating)

* Difficult	0 1 2 3 4 5 6 7 8 9 10	Fluent
* Adversarial	0 1 2 3 4 5 6 7 8 9 10	Cooperative
* Useless	0 1 2 3 4 5 6 7 8 9 10	Useful, constructive

3.- Do you have the feeling that there are external interferences which influence **your communications** process with NRC? (circle one number in each line)

	Irrelevant Influence Strong influence
*Politicians	0 1 2 3 4 5 6 7 8 9 10
*Local, State, Federal authorities	0 1 2 3 4 5 6 7 8 9 10
*Media	0 1 2 3 4 5 6 7 8 9 10
*Local residents	0 1 2 3 4 5 6 7 8 9 10
*Anti-nuclear groups	0 1 2 3 4 5 6 7 8 9 10
*Nuclear Industry groups	0 1 2 3 4 5 6 7 8 9 10
*Others, please state _____	0 1 2 3 4 5 6 7 8 9 10

4.- Do you feel that there are external interferences which influence **NRC's internal decision making** process in general? (circle)

	Irrelevant Influence Strong influence
*Politicians	0 1 2 3 4 5 6 7 8 9 10
*Local, State, Federal authorities	0 1 2 3 4 5 6 7 8 9 10
*Media	0 1 2 3 4 5 6 7 8 9 10
*Local residents	0 1 2 3 4 5 6 7 8 9 10
*Anti-nuclear groups	0 1 2 3 4 5 6 7 8 9 10
*Nuclear Industry groups	0 1 2 3 4 5 6 7 8 9 10
*Others, please state _____	0 1 2 3 4 5 6 7 8 9 10

5.-Do you think that NRC's recommendations and decisions are generally taken on a

	Irrelevant Mostly
Technical-safety basis	0 1 2 3 4 5 6 7 8 9 10
Political Basis	0 1 2 3 4 5 6 7 8 9 10
Financial Basis	0 1 2 3 4 5 6 7 8 9 10

6.- Do you think that NRC's final recommendations and decisions are generally the best that could have been taken? No 0 1 2 3 4 5 6 7 8 9 10 Yes

Appendix 5: Wildcat Survey Results

INDIVIDUALS: WILDCAT CASE

("L#" means the level of the individual in the organization starting with 1 from the top. "d,w,m,f,n" indicate frequency of communications with WILDCAT/NRC: daily, weekly, monthly, few times, never)

QUESTIONS	1NRC WILD(L6/d)	2NRC WILD(L5/m)	NRC WILDCA AVERAGE	1WILDCAT (L?/d)	2WILDCAT (L?/d)	3WILDCAT (L?/w)	WILDCAT AVERAGE
LEVEL IN THE ORGANIZATION	**6**	**5**	**5.5**				
QUESTION 1	**d**	**m**		**d**	**d**	**w**	
QUESTION 2							
Question 2.1	10	8	9	5	7	8	6.666666667
Question 2.2	10	4	7	3	6	9	6
Question 2.3	10	9	9.5	6	5	9	6.666666667
QUESTION 3							
Politicians	0.01	5	2.505	2	5	1	2.666666667
Authorities	0.01	9	4.505	2	5	4	3.666666667
Media	0.01	7	3.505	2	5	6	4.333333333
Local Residents	0.01	8	4.005	0.01	4	6	3.336666667
Anti-Nuclear Groups	2	5	3.5	0.01	7	4	3.67
Pro-nuclear Groups	0.01	7	3.505	4	8	5	5.666666667
QUESTION 4							
Politicians	3	4	3.5	10	7	7	8
Authorities	3	5	4	6	7	3	5.333333333
Media	2	7	4.5	9	7	6	7.333333333
Local Residents	1	9	5	8	4	1	4.333333333
Anti-Nuclear Groups	3	8	5.5	5	8	8	7
Pro-nuclear Groups	3	9	6	7	9	8	8
QUESTION 5							
Technical-Safety Basis	10	9	9.5	3	8	7	6
Political Basis	0	5	2.5	10	6	5	7
Financial Basis	3	5	4	0.01	4	1	1.67
QUESTION 6	**8**	**10**	**9**	**3**	**6**	**3**	**4**

Appendix 6: Survey Sheet for Foreign Utilities

MIT International Program on Nuclear Safety-Sloan School of Management

Date:_____

Name:_____ Position, Title:_____

Organization:_____ Division, Branch:_____

Address:_____ Phone #:_____

COMMUNICATIONS REGULATOR (GOVERNMENT)-UTILITIES

1.- How often do you generally **communicate** with the Safety Government Regulating authority ? (Please check best answer)

* Never _____
* A few times per year _____
* About monthly _____
* About weekly _____
* About daily _____

2.- How would you rate your **communications** with the Safety Government Regulating Authority in general? (Please circle one number in each case for approximate rating)

* Difficult	0 1 2 3 4 5 6 7 8 9 10	Fluent
* Adversarial	0 1 2 3 4 5 6 7 8 9 10	Cooperative
* Useless	0 1 2 3 4 5 6 7 8 9 10	Useful, constructive

3.- Do you have the feeling that there are external interferences which influence **your communications** process with the Regulating Authority? (circle one number in each line)

	Irrelevant Influence Strong influence
*Politicians	0 1 2 3 4 5 6 7 8 9 10
*Local, State, Federal authorities	0 1 2 3 4 5 6 7 8 9 10
*Media	0 1 2 3 4 5 6 7 8 9 10
*Local residents	0 1 2 3 4 5 6 7 8 9 10
*Anti-nuclear groups	0 1 2 3 4 5 6 7 8 9 10
*Nuclear Industry groups	0 1 2 3 4 5 6 7 8 9 10
*Others, please state _____	0 1 2 3 4 5 6 7 8 9 10

4.- Do you feel that there are external interferences which influence the **Government Regulator's internal decision making** process in general? (circle)

	Irrelevant Influence Strong influence
*Politicians	0 1 2 3 4 5 6 7 8 9 10
*Local, State, Federal authorities	0 1 2 3 4 5 6 7 8 9 10
*Media	0 1 2 3 4 5 6 7 8 9 10
*Local residents	0 1 2 3 4 5 6 7 8 9 10
*Anti-nuclear groups	0 1 2 3 4 5 6 7 8 9 10
*Nuclear Industry groups	0 1 2 3 4 5 6 7 8 9 10
*Others, please state _____	0 1 2 3 4 5 6 7 8 9 10

5.-Do you think that the Regulator's **decisions** are generally taken on a

	Irrelevant Mostly
Technical-safety basis	0 1 2 3 4 5 6 7 8 9 10
Political Basis	0 1 2 3 4 5 6 7 8 9 10
Financial Basis	0 1 2 3 4 5 6 7 8 9 10

6.- Do you think that the Regulator's **final decisions** are generally the best that could have been taken? No 0 1 2 3 4 5 6 7 8 9 10 Yes

Appendix 7: Additional Survey Results and Summary of Results

SUMMARY OF SURVEY DATA FOR THE PONTES STUDY, THE WILDCAT STUDY, THE ADDITIONAL US AND FOREIGN UTILITIES AND THE US VENDOR

	Pontes Eagle AVERAGE	WILDCAT AVERA	US Utility 1(f)	US Utility 2 (m)	US Utility 3 (w)	Korea Util (w)	Japan Util (m)	Finland Util (n)	Us Vendor 1 (f)	Pontes PIU AVERAGE	NRC Wildcat AVERAGE	NRC Pontes AVERAGE
LEVEL IN THE ORGANIZATION	na		?	?	?	?	?	?	?	na	5.5	
QUESTION 1	na		f	m	w	w	m	n	f	na		
QUESTION 2												
Question 2.1	3.0016667	6.666667	3	5	7	6	5	8	8	0.505	9	5.5714571
Question 2.2	4.4	6	7	2	5	7	5	9	9	0.505	7	6.7145714
Question 2.3	5.2	6.666667	8	8	7	5	5	8	9	3.5	9.5	7.8542857
QUESTION 3												
Politicians	7.28571	2.666667	0	0	7	5	0	1	0	9	2.505	1.5771857
Federal Authorities	3.43	3.666667	0	8	8	5	2	2	0	3.5	4.505	1.1481429
Media	5.8572857	4.333333	2	8	9	6	1	3	3	6.5	3.505	1.86
Local Residents	4	3.336667	0	7	2	6	5	2	0	6	4.005	1.86
Anti-Nuclear Groups	8.4281429	3.67	0	0	8	7	2	1	5	6	3.5	5.1442714
Pro-nuclear Groups	1.0081429	5.666667	4	10	5	7	2	1	8	1.505	3.505	1.1485429
QUESTION 4			0									
Politicians	6.00428571	8	10	6	9	7	4	3	6	7.5	3.5	1.15
Federal Authorities	4.0428571	5.333333	7	6	7	7	4	2	7	4.005	4	0.5771429
Media	4.5728143	7.333333	9	3	8	6	4	3	6	9	4.5	0.2985714
Local Residents	3.5757143	4.333333	4	3	5	6	4	2	5	3.505	5	1.0071457
Anti-Nuclear Groups	8.2854286	7	5	3	8	5	2	1	6	9	5.5	1.5142857
Pro-nuclear Groups	1.0571429	8	9	8	8	6	2	1	5	7.5	6	0.5771429
QUESTION 5												
Technical-Safety Basis	6.8542857	6	7	8	8	6	10	9	9	9.5	9.5	9.8333333
Political Basis	6	7	6	6	6	7	5	2	4	5.005	2.5	1.0066667
Financial Basis	0.13	1.67	1	0	5	5	5	0	3	4.505	4	0.3416667
QUESTION 6	**2.90**	**4**	**5**	**7**	**6**	**6**	**8**	**8**	**7**	**10**	**9**	**9.4271429**