SAFETY CULTURE IN NUCLEAR POWER OPERATION AND REGULATION IN SWITZERLAND. ANALYSIS AND PROPOSITION OF AN ACTION PLAN TO MITIGATE THE GAPS

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ABSTRACT

This report presents the results and a corrective action plan of a research regarding the relations, mismatches and tensions between operators and the regulator in Swiss nuclear power industry. It reviews the culture and safety culture of operators and regulator from 1986 until 2010.. Not included is the third player, the nuclear research institute, represented in Switzerland by the Paul Scherrer Institute (PSI). Semi-structured interviews on the highest management level, the plant managers of the nuclear power stations, the members of the Board of Directors of the regulator (BoD) called Eidgenössisches Nuklearsicherheitsinspektorat (ENSI), and all members of the Board of Management (BoM) of ENSI including experts of the human factor section, were conducted.

It explores the different attitudes and approaches to find an explanation for the existing mismatches between the regulator and the licensees. In the light of the strong freedom of information act in Switzerland confidentiality had to be guaranteed to all interview partners, due to the sensitivity of the given information. The results reflect the different cultural backgrounds of relevant employees of the regulator and the operators. Some differences are rooted in national or ethnic discrepancies in problem solving attitudes between German and Swiss citizens. Other tension fields are the growing density of the regulatory framework and the laws forcing the regulator into a punitive attitude, influencing by that the reporting and a just safety culture. An action plan containing different steps in different areas is included with the goal to mitigate the potentially resolvable problem areas. It targets all levels; the board of directors, the board of management and some collaborators of ENSI, as well as management and part of the collaborators of the operating nuclear power plants. Basically there are two areas of tensions between regulator and operators: A normal or healthy tension , due to the different duties, which helps to enhance safety, or an unhealthy which puts the system under undue and avoidable load. The thesis is aiming at a mitigation of the second area.

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INTRODUCTION

Preliminary words

In preparation to the thesis work presented in this report, a deep literature review about Safety culture in the nuclear industry has been conducted. The main findings are presented hereafter and have to be considered by the reader as a general introduction on the subject.

Literature review

With the first constructions of nuclear power stations for a generation of electric energy in the middle of last century, safe operation was in the focus of operators and regulators, carefully watched by a public divided in different groups of interest.

Some dangerous turning point events over the years have influenced the attitude of all stakeholders in the operation of nuclear electric generating plants. The industry got its first significant and widespread wake-up call in 1979 because of the accident at Three Mile Island nuclear station. Seven years later, in 1986, the Chernobyl accident was a very painful reminder of the hazards of nuclear technology. The investigations revealed that many of the same weaknesses that lead to the Three Mile Island accident contributed to the accident at Chernobyl.

The response on the operator, but also on the regulator side to these accidents was profound. In all areas, hardware and software, procedures, processes and mainly in training, improvements were made. Emergency preparedness, design adaptations, configuration control were reviewed and adapted. Human performance and mainly the attitude toward safety got a new focus. For this purpose, the International Atomic Energy Agency (IAEA) invited leading experts in nuclear

safety to form an International Nuclear Safety Advisory Group (INSAG). Besides being a forum for the exchange of information, INSAG envisage formulating common safety concepts. Shortly after the accident in Tchernobyl INSAG held its Post-Accident Review Meeting in 1986 (IAEA, 1986). The term 'Safety Culture' appeared here for the first time in nuclear power industry and has been used increasingly, becoming more elaborated, but had still some room for interpretation (IAEA, 1988). Therefore, INSAG focused 1991 specifically on this topic and published a report with the intent to define Safety Culture and to stimulate discussion not only by the nuclear industry and its supporting organizations but also by governmental authorities (IAEA, 1991).

Complacency and a phenomenon which was later described as "drifting into failure", was recognized. These deficiencies are also known in other high risk industries like aviation, air navigation service provider or chemical industries (Dekker , 2005, pp. 35 – 43).

All those reports made very clear, that the operator is responsible for safe operation. But the attitude of the regulator towards safety has nonetheless an important influence, how safety culture can or should be realized. In contrast to the operators, the regulator acts in at least three different roles: the expert role while inspecting the power plants, the authority role for giving permission to operate, and the public role in the bridging function between the operators, the government and the society.

A safety-conscious work environment with the freedom to raise concerns without fear of retribution is not only an important element of a strong nuclear safety culture for the operator, but also for the regulator. Therefore ENSI, the Swiss regulator of the four operating nuclear power stations in Switzerland, has the interest that the existing power plants are operated at the safest possible level, and also that projects for new nuclear power stations consider all the industrial and academic knowledge during the planning, construction and future operation phase.

ENSI with the obligation to analyze all events with negative outcome, incidents and accidents is fully aware of the fact, that culture is a key ingredient in the overall success of the industry including operators and the regulator. Discussions with some of the leading managers of the Swiss Nuclear Power Plants (NPP) and ENSI uncovered tensions between the licensees and the authority. As tensions and mistrust are mostly counterproductive to a safety culture, this review has the goal to answer the question if the tensions are the result of differences in the definition and interpretation of safety and safety culture between the operator and the regulator in Switzerland. Only if the gap is known and defined, a remedial action program can help to enhance safety further in the nuclear industry in Switzerland.

Further elaborations about culture and safety culture can be followed in Annex A. Properties of safety on the operator's side as well as the regulator's side are discussed thoroughly, the latter on an international level as well as the safety culture promoted by the Swiss regulator.

Safety culture and the issue of power is a central aspect while judging the relationship between regulator and licensees. A study of Anderson (2009) clearly shows, that power has to be included when analyzing safety culture. A summary is formulated in Annex B.

The thesis question

The literature review summarized and referenced here above has guided me towards the formulation of the following thesis question:

" What are the mismatches in understanding 'safety culture' between operators and the regulator in Swiss nuclear power industry? How do these mismatches express themselves and what can be done to mitigate this? "

Historical perspective

As in other industries, major learning steps are often achieved after events with severe negative outcome. The loss of the space shuttle Challenger triggered also a large safety enhancement program at NASA. Improvements were made in the area of procedures, decision-making processes, in hard- as software and the attitudinal question was thoroughly discussed internally and externally (Nicollier, 1998). Vaughan (1996) analyzed the disaster and created the term 'normalization of deviance'. 17 years after Challenger another shuttle, Columbia was lost. Gehman (2003) investigating this loss came to comparable conclusions as Rogers (1986) analyzing the loss of Challenger. Both reports proved that risk based reasoning was used to justify the applied risk acceptance.

The shock of the crucial event in nuclear industry, the Three Mile Island accident 1979 went far beyond the United States. Most of the nations using nuclear power for the generation of electricity were under tremendous pressure from the public and tried to enhance their nuclear safety concepts for a safer operation of the plants independent of the different technical concepts. It was Lepecki (2002), an INSAG member, who described the genesis of the safety culture concept in the nuclear industry. One year before the accident of Chernobyl, the International Nuclear Safety Advisory Group (INSAG) was created. In his reminiscences, Lepecki reported that the main topic during the first INSAG meeting was "Human Element". Obviously, this topic resulted from the investigations done after the accident in Three Mile Island. The group also developed tools to deal with the analysis of accidents and when Chernobyl happened one year later, the elaboration of the official IAEA report could be delegated to INSAG. With these prerequisites it was possible that within only three weeks time a first report could have been produced despite the Soviet experts being only available for that short period

due political reasons. To quote Lepecki, the conclusion of the presented report was: "The question of the creation and maintenance of a safety culture in plant operation seems to me a vital lesson from Chernobyl."

This was the origin of safety culture in nuclear industry and considered as 'Priority 1' task for INSAG to establish commonly accepted fundamental safety principles. These principles were further elaborated and the safety culture concept was considered so important that it was adopted as one of the fundamental management principles for the operation of nuclear power plants.

Conclusion regarding the review

Comparing the existing documentation regarding safety and safety culture for operators and regulators, we have to realize that there are only very marginal differences. Both sides show an open mind towards the new way to enhance safety. Expressions like "no blame culture", 'just culture', 'reporting culture', 'learning culture', etc. are widespread. Regulators as operators seem to be open and supportive of a common basic definition of safety culture. Both sides use the same documentation, refer to the same definitions and use similar wordings.

As already mentioned, the goal of the present thesis work is to identify differences in the definitions and interpretations of safety and safety culture between the regulator and the operator. Those differences could have been explanations of the remarkable tensions between the authority and the licensees. However, as the literature review proved, those differences apparently do not exist in literature. Therefore, there must be other reasons to explain the actual situation, which was identified by the board of directors of ENSI, the Swiss regulator.

It could be assumed, based on the model of Schein (1992), that on the level of artifacts no relevant differences regarding safety culture exist between the operators and the regulator in

Switzerland. Tensions might have deeper routes and could perhaps be located on the espoused level or even on the third level where different basic assumptions could exist.

Contrasting to the formulated intent of the regulator to provide some space of self-regulation for the operator, the actual growing density of rules and regulations leave reduced space for initiatives on the operator's side to develop its own solutions and tools. Another hypothesis could be that tensions result from an increasing frustration about lost freedom to develop its own solutions and tools, leading finally to a decline of flexibility in the adaptation and use of system know how.

As conflicts potentially endanger the efficiency of the nuclear industry and jeopardize the level of safety, further research is needed to identify reasons of the observed mismatches.

This thesis analyzes and assesses this problem so proposals for mitigation can be derived. The topic is approached with the help of an empirical work, based on specifically developed semi-structured interviews for stakeholders on both sides.

METHOD

Setting

Surveys are the most used tool to capture safety culture or safety climate during the last 20 years (Hopkins, 2006). In this context researches are mostly focused on safety climates as they are easier to measure (Cox & Flin, 1998). Snapshots describe the actual situation of safety (Tharaldsen et al., 2008), mostly in the form of safety related attitudes, convictions and perceptions of the employees. This trend continued with the surveys of Ek et al. (2007) and Fernandez-Muniz et al. (2007). According Guldenmund (2007) the wide use of these methods are

mainly pragmatic, they can be used in an economic way, are standardized, have quantitative results and are statistically usable. But doubts exist if the content is adequate, relevant and valid. Guldenmund supports the opinion that surveys are not very successful to reach the core of the basic assumptions of an organization and, that they are not able to make relevant connections to safety outcomes.

According Antonsen (2009) survey methods should allow to judge how safe or unsafe an organization is, and with what probability accidents or incidents will happen. The predictive value of surveys is only discussed and included in a few empiric studies such as Cooper & Phillips (2004), Mearns et.al. (1998), and Zohar (2000). The empiric research focused mainly on the connection between safety culture and occupational accidents and not on connections with major organizational accidents.

Antonsen (2009) remarked that the inclusion of qualitative methods, during the last few years, had a growing importance (e.g. Richter & Koch, 2004; Haukelid, 2008) mainly with ethnographic methods questioning the adequacy of the used surveys. In the methodological view, more sophisticated methods, with a broader analytical scope, seem to be needed. A holistic approach, how cultural and other elements of an organization interact with each other is more relevant than a study based only on a quantitative structured questionnaire which is not likely to provide the depth of a causal investigation. More interactive assessment is needed to uncover cultural assumptions as this could be reached by interactive unstructured inquiry. Safety culture surveys invite to give acceptable answers and sometimes it is too obvious what the acceptable answer is. Interviews on the other side contain open questions and have by that the potential that the information exceeds the basic requirements. According Grote (2007) it is important to include the practices of an organization in the research. Grote assumes that no questionnaire could ever capture the complexities of unconscious beliefs and assumptions making up an organization's

culture. Results of surveys should be regarded as artifacts of the safety culture, but the interpretation is difficult without knowledge of the basic assumptions. Compensation by qualitative methods should be envisaged.

New path

The present study is not build on a previous survey. The participants were asked to help to find causes for the mismatches between the regulator and the operators of nuclear power in Switzerland and all were in favor to contribute in finding the gaps and to work out propositions to smoothen the relationship. Both sides, operator and regulator, are aware that different positions are normal and have also a great potential of enhancing a safe operation and a safety culture as different points of view are the basis for creative discussions. But those discussions should not be stressed by unnecessary tension. Being aware of the difficulties and shortfalls of surveys, the questionnaire used in this case study concentrates on semi-structured qualitative questions hoping to come closer to an understanding of basic assumptions of the interviewed personalities.

Interview participants

For the purpose of collecting data, the following groups were interviewed:

Operators side

All plant managers and part of their deputies.

Regulator's side, (ENSI)

Board of Directors (BoD): President and deputy, and all members of the board.

Board of management (BoM): CEO and its deputy, all members of the board.

Members of the section Human Factors and Organization.

The interviews concentrated on the top level of the organizations as this level is basically responsible for the relationship. They are also the main pillars of the culture in their domains and any potential change needs them as flagship.

Interview questions

The set of open questions is grouped in 4 different areas: the area of relationship, the area of justness, the area of regulations and the area of audit. Each interview required two up to four hours.

Area of relationship:

1. How do you see the general relation between the regulator and the operators?

2. How are the positive points of reference expressed?

3. How are the negative points of reference expressed?

4. How do you judge the level of trust between the regulator and the operator? How is this expressed and to what extent is the safety culture of the power plant influenced?

5. How would you describe the safety culture within ENSI/the nuclear power plants?

6. In what areas, since the transformation from HSK to ENSI, have the relations between operator and regulator improved/changed for the worse?

Area of justness:

7. What do you think are the ingredients of a just culture?

8. Does your view of a just culture coincide with the one of the regulator/operator?

9. Where are the differences in drawing the line between tolerable and intolerable behavior of the collaborators?

Area of regulation:

10. In the sequence, law – decree – guiding principle; are those regulations coherent?

11. What are the strengths/ weaknesses of the regulations on the different levels?

12. What is your feeling about the density of the regulations, is this helpful/restrictive?

13. Is the opinion of the operators included in the formation of the regulations, do they have a word? What would be adequate?

Area of audit/inspection:

14. Are the audits essential and objective, are they adjusted to the situation?

15. Are the inspectors/auditors in the possession of the required knowledge?

16. Are the audit-reports reflecting the reality in the plant? If not, where are the differences and where do those differences originate?

Procedure

The quality of the answers depends predominantly on the level of trust between the interviewer and the interview-partner. As questions and answers could be politically compromising, the managers needed an adequate protection. The answers were coded, which means de-identified to any potential user. Initial discussions showed clearly that taping the interview was not accepted. A tape recorder generates a tense atmosphere, especially with the responsible managers, which potentially degrades the content of the answers to a "political correct level". The interviews were recorded by writing. To verify the notes reflect the attitude of the interview-partner, critical parts were confirmed by back-reading.

Data analysis

As an extended literature review showed, no comparable research could be found. The gathered data of the qualitative survey were analyzed hermeneutically. The result form a basis to make propositions to the already existing platform (CEO's of the power plants and ENSI), in how to enhance the relationship between operators and regulator. All efforts of harmonization shall however respect that the operator's role and the regulator's role are definitely different. An amalgamation has to be strictly avoided, as this could be detrimental to the overall level of safety. Certain differences are needed and might also stimulate the safety culture in the right direction. Additionally, the public could loose trust if an interweaving would become apparent. The oversight function must be maintained and the roles of the operators and the regulator have to stay clear.

RESULTS

Due to the sensitive content of the transcript, the resulting 16 pages had to be classified as confidential.. Only the interview participants, the supervising professor and the mentor will be in possession of the detailed statements. The following highlight as a synthesis the reflections of the interview partners.

Findings

The findings are grouped in 4 different areas: Relationship, Just culture, Regulations and Audits/Inspections. They reflect the main substance of the interviews. The conclusions contain the analysis of the findings. An action plan to mitigate the findings will be proposed to the BoD and together with the BoM and the heads of the nuclear power plants, steps will be taken to enhance the situation and the safety culture.

Relationship

Basically the relationship between operators and regulator is described as open and fair by all three categories. All participants indicate that safety is the highest principle on both sides. The Board of Directors (BoD) describes the relation as a mix of professional distance. Even if the ground rules are the same, the interpretation by licensees and authority, is rather different. Tensions seem to increase in lower hierarchical levels. Members of the Board of Management (BoM) indicate that the understanding of safety culture is close, but a drift in different directions could be notified. BoM also mentioned that the relationship is getting more and more formalistic and the atmosphere between both sides is getting cooler, but it was also added that this development is not detrimental to safety, it even might enhance safe operation. BoD stated that the regulator needs to have a critical profile and that there is a mutual problem solving attitude. The different roles of operators and regulator are mentally understood but emotional tensions can not be denied.

All except one of the interview partners mentioned the increasing tensions resulting from the fact, that ENSI is hiring new staff, mainly from Germany. Nine of ten new entries are German citizens, which is due to the current market situation in central Europe. Switzerland has very limited personal resources with specific nuclear knowledge, and those resources are absorbed by the operators. Additionally the future of nuclear energy in Germany is at least unsure, so young highly trained academics look for alternatives with a promising future. The operators mentioned that the knowledge of inspectors has room for improvement. This, mixed with the cultural differences between Germany and Switzerland, which include the different problem solving attitude, create mistrust and unwanted tensions. But also members of the BoM highlighted this gap, articulating, that the harsh style of communication and problem solving coming into ENSI is problematic. On the other hand BoM criticized also the sensitivity of some of the operators

management. Another point is that operators have the feeling, that ENSI is hiding behind the new nuclear energy law, that inspectors insist on guidelines in every detail. For the operators guidelines are paths which should be followed leaving, due to their width, some room for interpretation. Operators have the impression that inspectors with limited operational experience cover their own uncertainties by following the guiding information word by word. Regarding the level of trust, BoD and BoM state that it is good on the top level. Operators do a good job and carry the full responsibility for the safety of the plant. On lower hierarchical levels tensions seem to increase. Safety cultures in the different plants are well established. The challenge will be to keep this alive with the new freedom of information act (Öffentlichkeitsgesetz) as this law is potentially influencing the reporting culture in a negative way. Operators have the feeling that ENSI has no unified safety culture. This sight is backed with remarks from the BoD stating that ENSI is in a stage of development, that a formalistic attitude is growing, weakening common sense and common understanding. The attitude in the BoM is very divers and statements like "safety culture is not a topic for the regulator" stand beside "ENSI's safety culture is on a very high level".

Just culture

There are major differences in the state of knowledge regarding the topic 'Just culture'. The answers to question number seven: What do you think are the ingredients of a just culture? Were widespread and range from: 'Can not answer that question', to a detailed description of Dekker's book 'Just culture' (2007). On the operator's side it is agreed, that people are the most important element for a safe operation, but that they are not free of errors. Operators highlight the fact that people have abilities no machine has and that they should not suffer by making mistakes. In operator's view, ENSI has a contrary perspective which has the tendency to emphasize on human weaknesses and not on human strengths and that the regulator still has a punitive culture. The

knowledge of just culture amongst the BoD is rather weak. Also the BoM has limited knowledge. One statement was, that the just culture concept is only known by Dekker, but a basic problem is, that law and justice is contradicting. It is the duty of the regulator to observe and to intervene, but he should not be obliged to punish individuals. The new law and the ordinance oblige ENSI in case of negligence to intervene and punish. This duty is questioned by members of the BoM. In operator's view, ENSI is acting as in a police function since the new law is active. Parallel to that the density of regulations is increasing. For the operators, the regulator seems to be focused on an error culture, restricting himself on the search for weaknesses. Also here the problematic situation with the different cultures was popping up. It is the wish of the operators that ENSI as a body with international ambitions should make further progress in this topic.
The question about "who draws the line" was mainly answered by: the law. But the topic is so far not on the current agenda. ENSI is driven from outside and appropriate research is not taken into account as the concept is rather unknown – until now. ENSI has to protect itself from negative publicity damage and this has to be taken into account when judging the attitude.

Regulation

Operators have the impression, that regulations are introduced before the resulting effect is known and discussed. The density of regulations is constantly increasing mainly driven by the integration of international guidelines. Coordination and logic is missing in the understanding of the operators.
On the regulator's side comments pointed in the direction that the new regulations (law – decree – guidelines) reflect the international standard, which has it's value. The degree of details might be too deep or too formalistic, mainly in the guidelines, but simple solutions are not available any more. On one hand the operators have the impression that the guidelines are too restrictive, on the other hand the project leaders for new power plants ask for more detailed rules and

descriptions. Generally the BoM rates the regulative package as correct, stating that ENSI might go a bit too far in the detailed description of the guidelines. Responsibilities are splinted, but the package is politically influenced leaving some limits rather restrictive. According to legal people the guiding principle are too weak, but this is an ENSI internal conflict.

Contradicting inputs were made on the operator's side regarding strengths and weaknesses of the regulations. In one respect guidelines are too tight and the description should be less detailed, in an other respect the whole set of regulations leave room for interpretation, is incomplete and is inconsistent.. The BoM states that ENSI should have a united opinion, and indicate that a weakness is in the historic growth, but they see that any change is resisted by the operators. "Operators basically do not want changes", is a quote from the interviews.

All three parties judge that the density of the regulations is too high, and the freedom to move is very restricted due to the international harmonization. A possible unequal treatment of the different plants was also articulated. The process of the formation of new guidelines, due to the international harmonization, is currently being questioned and in a revision status, so that the contribution of the operators is welcomed already in an early stage of development.

Audits/Inspections

The need for inspections is generally accepted, they are essential and basically correct. The personality of the inspector seems to be the key factor. The concept of the training of ENSI inspectors should be reevaluated. Inspections in the area of safety culture are done on the level of artifacts, but judgment is based on the level of basic assumptions. In this area again the topic of different cultural background (German – Swiss) was mentioned, leading to tensions as the respective approach and the attitude influencing this approach is different.

Operators question the level of knowledge of some inspectors, but also amongst the BoM inputs were given, that operational experience and detailed knowledge of the processes in a plant is missing.

The resulting reports seem to be rather realistic in the view of the operators and also the BoM.

CONCLUSION

Analyzing the statements made by the different interview partners, lead to the following conclusions:

The main problem in the area of relationship is a cultural one. The problem results from different mentalities of Swiss personnel, working mostly in the power plants, and German inspectors, working for ENSI in an oversight function. This problem, creating continuous tensions, was mentioned in all except one interview. ENSI is actually in a phase of generation change and a phase of remarkable growth (up staffing from around 90 to 120 positions) due to the planned construction of up to three new nuclear power stations. As the Swiss labor market of engineers, physicists, chemists and mathematicians with a knowledge and interest in nuclear energy is very limited, the overwhelming majority of newly hired specialists is coming from Germany with their own cultural and academic background. The 'German way' of handling problems or verbalizing critique is quite different or even opposed to the 'Swiss approach'. In extensive discussions with German residents working in Swiss nuclear power plants the following main differences leading to misunderstandings and tensions cumulating in mistrust, were elaborated. The Swiss approach to solve problems or eliminate differences is the search for a consensus. The goal is even to find a win-win solution, and if this is not possible, both sides are moving to the center. This approach is widely used in Swiss politics, Swiss business and negotiations. The German way of solving

problems is characterized by an open conflict. This approach is also reflected in German politics and labor negotiations during which strike is a common way of finding a solution. These mental cultural differences influence the relationship between the operators with a predominantly Swiss mentality and ENSI inspectors with a German background. The resulting emotional status on the operator's side, when differences have been bridged via conflict, burdens the general relationship between regulator and operators. This gap reflects according Schein (1992) the second and partly even the third level, the level of basic assumptions.

The knowledge of the content of a just culture is rather limited. Safety culture could more easily be defined, but also this concept leaves room for improved knowledge. For half of the top managers on the operator's side, just culture is not only a known term, they also try to lead their team accordingly. They all mentioned the severe problem of the restricting law forcing the regulator to intervene in a punitive way already in minor cases. The members of the BoD of ENSI have a general idea of a safety culture but the term "just culture" was unknown. The will to know more about that concept is present and all of them showed a genuine interest to expand their knowledge. Amongst the members of the BoM of ENSI the state of knowledge was different. One member read the book Just culture (S. Dekker, 2007). and only this person and the members of the human factor group have a clear view of just culture. Safety culture is not only known as an expression, but also the strong will to anticipate the content is the common goal of ENSI's managers. Also among this group, the restricting law is a main concern. The knowledge of the human factor section reflects the constant exchange with academia and active participation in research and development. Their members are pushing safety culture in a fruitful direction, but they have to fight an uphill battle.

The great majority of all interview partners mentioned the dense level of regulations. Mainly the obligation to follow the detailed guidelines is a burden for the operators. This topic is also

recognized in literature; so S. Dekker remarks in The Field Guide to Understanding Human Error (2006), what lies behind practical drift is amongst others, "rules that are overdesigned (written for tightly coupled situations, for the worst case) do not match actual work most of the time". The argument of the regulator is that he is forced to follow the new law, according which ENSI is obliged to revise the whole network of guidelines. Actually only 40% of the guidelines are released and the transition phase will take one more year. The process of consultation is questioned and improvements are discussed. A main problem is the law which forces ENSI not only to investigate incidents, but also to enforce sanctions against employees in cases of negligence. As the law was accepted by parliament, an adaptation in the sense of just culture is a difficult and time consuming endeavour.

Inspection is the core business of the oversight organization. At least 300 audits are performed per year in the 4 nuclear power station. This high number is justified by the potential risk of this industry and is not questioned. In this area the cultural problem is the main concern. An area of critique is also that the young inspectors have, despite their high academic education, no operational experience.

ACTION PLAN

General

Due to the different obligations, on one side oversight and control as a regulator to guarantee safe operation and protection of the public, and on the other side safe but also economic production of electrical energy as an operator, a certain amount of tensions, different opinions or judgments are not only normal, but also healthy. Attention and wariness are stimulating for a high level safety culture and help to enhance operational safety in this high risk industry. But there are tensions which put the relationship under undue stress, absorbing energy on an emotional level and by that influence the system counterproductive to a high safety standard.

The following plan serves to mitigate the weaknesses detected in the tension field between the regulator ENSI and the four nuclear power plants in Switzerland.

First phase

- Information of all interview partners in full transparency on the basis of the confidential transcript in three different groups: BoD ENSI; BoM ENSI; plant managers of the four power plants.
- Coaching of the BoD and the BoM in the area of safety culture and just culture to form a common base of knowledge on the operator's side. Coaching by internal expert.
- Proposition and planning of further steps

Second phase

After that information phase bringing all stakeholders on the same platform of knowledge, a phase of high level discussion between the plant managers, ENSI BoD and ENSI BoM has to take place. The outcome must contain the following topics:

- Relationship: Find common ground in the area of safety culture and just culture; define a short seminar lead by an internationally accepted external expert.
- Relationship: Establish a program mitigating the cultural differences between German and Swiss collaborators. Definition of participants. Realization by an external expert knowing the situation.
- Just culture versus punitive culture: Establish mutual understanding and formulate common goals. Verify the actual legal situation and define further steps if a change is anticipated. Analyze the progresses made in the relationship between civil aviation authority and operators (airlines as the air navigation service provider) in Switzerland.

- Regulations: Exchange of attitudes, definition of common interests and differences. Find commonly accepted definitions of processes
- Audit/Inspections: Define steps to enhance operational know-how of inspectors, e.g. initial training in a nuclear power plant.

Control and time line

The different activities have to be defined and controlled by a process manager and an agreed time-line with fixed milestones supporting the realization of the program. One year after the implementation of the program a verification of the success has to be performed, so that corrections or adaptations can be accomplished.

The execution of the mentioned steps and the controlling mechanism should guarantee an enhancement of the relationship between operators and the regulator and a mitigation of the detected threats. Production of nuclear generated electric power is a high risk endeavour and any step to reduce the potential risk should be undertaken.

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Annex A

Characteristic of culture and safety culture

Culture

There is no consensus regarding a unanimously accepted definition of culture. The variety of the different perspectives result also from the fact, that culture is studied and defined by different academic disciplines, such as sociology, philosophy, social psychology, ethnology and anthropology.

The definitions of culture range from very simple, as 'culture is the way we do things around here', and of not much practical use, to very broad definitions, like: 'culture is the human-made part of the environment' and reminds us that ecology shapes a boundary on one side and the social behavior the other side.

With the intent to find differences in the definition of safety culture that could be the reason for the tensions between the operators and regulator in Switzerland, the review part concentrates on official bodies within the nuclear industry, regulator as well as operators. The result of this examination revealed, that both sides base their concept of culture on the theory of Schein (1992). He developed a model of culture of three levels categorizing their range from very visible to the tacit and finally to the invisible level. On the first, the visible level, artifacts and behavior become visible. The apparent manifestation can be seen e.g. in architecture, dresses, rituals, and at this level, culture seems to be obvious.

On the second level we find, according to Schein, the espoused values, values that are adopted or supported by a person or an organization. Examples of espoused values in an organization are: 'frontline empowerment', 'safety as the highest priority' or 'team oriented work processes'. But inconsistencies between the visible and the espoused level can be observed. Despite the core value 'Safety is our number one priority', employees take risks to meet the timeline or make shortcuts in processes to reach production goals. Such inconsistencies uncover that a deeper level of thought and perception is driving their behavior. An impressive example for those inconsistencies was described in the analysis of the Challenger disaster (Vaughn, 1996).

According to Schein, in order to understand the culture, the first step is to decipher what is going on at a deeper level and establish the basic assumptions. The basic assumptions shape the third and deepest level of culture. Here are the fundamental beliefs that most people of a cultural group take for granted. One of the most basic assumptions is the underlying assumption about human nature. Schein postulates that any group or organizational culture can be studied at these three levels. To understand a culture we have to know the basic assumptions first, otherwise we will not be able to understand the espoused values and can neither decipher the artifacts nor can we deal with them.

Schein's model of culture is referenced in IAEA, Nuclear Energy Agency (NEA) and in Swiss regulators documentation. Cultural and safety cultural views have expanded and differentiated over time. Having looked at the different publications of IAEA, it is obvious that their view of culture, safety and safety culture has developed in stages (IAEA, 2002). In the first stage, the authors concentrated on the definition of safety culture (INSAG, 1986). The topics in the second stage were the assessment of the safety culture (IAEA, 1994).The proposal to develop key indicators to determine the effectiveness belong to the third stage (IAEA, 1996), and in the

fourth stage IAEA concentrated on the attempt to obtain a deeper understanding of the actual concept of culture in nuclear installations (IAEA, 2002).

The authors quote and apply as a base for their concept the most widely accepted definition given by Edgar Schein (1992):

> Culture is a pattern of basic assumptions – invented, discovered or developed by a given group as it learns to cope with its problems of external adaptations (how to survive) and internal integration (how to stay together) – which have evolved over time and are handed down from one generation to the next.

According Schein there are also inherent risks when judging cultures; the biggest one is oversimplification, by ignoring different matters, which matter. Culture is not only deep, that means nearly impossible to change, it is also broad, which makes it very difficult to decipher. In addition, culture is stable; people do not like to change as a change leads them into an unknown or even chaotic situation.

Normally there is a dominant culture that shapes values and basic assumptions, but the existence of sub-cultures will also influence humans. Sub-cultures can be found, as Schein points out, on different levels, starting in small teams and workgroups, but also in departments and companies. Due to shared occupational background, it can also be found at the level of a whole industry. Especially the nuclear energy industry has, as IAEA (2002) mentions, a high integrity of cultural aspects which are identical around the world. Even if the political situation between those countries, the education, language and religious background, is rather different, the way of thinking and acting in a plant is very similar.

According to the concept of IAEA there is no differentiation between a right or wrong culture except in relation to what a group or organization is trying to do and what the environment of operation allows. Therefore, Schein's theory seems to be a meaningful concept in the nuclear industry.

Properties of safety culture on the operator's side

The expression 'Safety Culture' provokes different reactions in the mind of today's safety experts. In the nuclear industry, this idiom is still commonly used, and the definition of safety culture postulated by INSAG is still valid (IAEA, 2002, p 14): "Safety culture is that assembly of characteristics and attitudes in organizations and individuals which establishes that as an overriding priority, nuclear plant safety issues receive the attention warranted by their significance."

The intent of the following review is to find out if safety culture in other high-risk industries apart from nuclear is defined and described equally or different. Researchers use various definitions and characteristics describing safety cultures of organizations. The most widely used characteristics are the four identified by Reason (1997): Safety culture is reporting, just, flexible and learning. The base for a reporting culture is trust and commitment. A just culture, according Reason, is a well-balanced blame approach, enhancing the employee's willingness to report, and seeks to establish a clear line between what is an acceptable and an unacceptable behavior concerning safety. The capability to adapt effectively to changing environment and demands create a flexible culture. The learning culture needs the will and the competence to learn from experiences to be ready to implement improvements.

Hudson (2003) added the dimension wariness to the characteristics which means that the organization and its individuals should be on a constant look out for the unexpected. Ek (2006)

added to the four characteristics used by Reason (1997) and the wariness identified by Hudson, four additional ones: working situation, communication, attitude towards safety, and safety related behavior and risk perception. The aspect of the working situation contains issues which can affect the employees work performance in general and by that the possibility to live up to agreed safety rules.

Wiegmann, Zhang, von Thaden, Sharman and Mitchel (2002) defined five global components of safety culture: organizational commitment, management involvement, employee empowerment, reward system and reporting system. The reporting system corresponds to Reasons reporting culture, the reward system relates to Reasons just culture. Management involvement in the context of safety culture refers to the level of engagement of the upper- and middle-management, about their contribution in safety related training and seminars and the organizational commitment refers to the extent to which management identifies safety as a guiding principle of the organization. Employee empowerment gives everybody in an organization not only a voice in safety decisions but also the leverage to initiate safety improvements and therefore help to create a learning culture.

Summarizing these properties, it can be said that safety culture is reflected according to those authors by:

- The level of communication of safety related information in an organization
- A just and consistent evaluation of safety related behavior
- The risk awareness of the organization's members towards risks to themselves as well as to others
- The readiness to put changes in place if they result in an enhancement of safety
- The organizations attitude reflected in a forward looking commitment to safety

Guldenmund (2002) and Wiegmann et al. (2002) made a synthesis of the numerous definitions of safety culture used in nuclear power, aviation, industrial gases, offshore oil and gas and mineral industry. Two different assumptions result from the analysis of these definitions. The first one represented by Eiff (1999) or Hudson (2003), both from aviation industry, suggests that safety culture is something that an organization has or does not have. Other definitions tend to the observation that every organization has inherently a safety culture, but of different depth and quality, it might be poor but not non-existent.

In Resilience Engineering (Hollnagel, Woods & Leveson, 2006, p. 2), the authors give an overview of different descriptions of 'safety culture', 'human error' and 'organizational failure'. These expressions can therefore be taken as examples for unexplained variability and underlying basic assumptions according to Schein (1992). In Resilience Engineering (2006, p. 229), Flin states:

> Whether or not managers make sacrificial decisions in favour of safety depends not only on their skills and personal commitment to safety but on the general level of commitment to safety in the managerial ranks of the organization. This is the essential ingredient of the organizations safety culture, which affects behaviours such as balancing production and safety goals, implementing safety systems, spending on safety.

The review above highlighted definitions and descriptions of safety cultures used in other high-risk industries formulated by psychological and sociological scientists. The following part concentrates on the view of the International Atomic Energy Agency's (IAEA) perspective to find out if the properties of safety culture in nuclear industry are understood differently.

The publication by IAEA (2002) postulates, that safety culture on the operator‘s side cannot be mandated, but rather safety culture evolves. However, there are some essential prerequisites. Safety has to be integrated into all aspects of an organization's activity. Therefore, a powerful safety management system is a tool, which can form a safety network in a nuclear power plant. One part of a safety management system is the organization's risk control system. The risk has to be assessed in all the activities of the plant. The assessed risks have then to be recorded and mitigated. According IAEA the presence and quality of recorded risk assessments, that cover all the organization's activities, provides an indication of a positive safety culture. A positive approach to safety is the review of the assessed risk with a full involvement of the persons who actually undertake the operational activities, IAEA (2002).

As IAEA (2002) states, job training, safety training and continuous recurrent training are other important key elements. A proper record of the training received, for all the employees, is a requirement. The content of the training has to be constantly adapted to the need created by changes in the utility. IAEA points also out, that psychometric surveys can be used as an indicator of the attitude to safety among the employees of an organization. This will at least give a reference how employees perceive the organization's safety efforts. A survey in this area sends also a clear message that the organization is willing to consult its members. Such an effort, as the authors conclude, has to be followed distinctly not only by a respective action plan but also by adequate actions, otherwise the basis of mutual trust between workforce and management, and by that safety culture, is strongly in danger.

Active involvement in safety on a daily basis is probably the most important indicator of a solid safety culture. Therefore, IAEA demands that safety should not only be the business of the managers or the safety officers. Safety issues have to be identified and acted on by all employees

as part of their normal working routine. It must be the goal of an organization to have an easy to use, but nonetheless confidential reporting system open to all the persons working in the utility. Also Dekker (2007, pp. 39-46) elaborated on the importance of reporting to minimize risk and enhance protection.

All the above-mentioned elements are ingredients building a good foundation for a safe organization, but they do not form the safety culture. They are observable elements and form, according Schein (1992), the artifact level. Artifacts are relatively easy to observe, but observation does not automatically disclose their deeper meaning. The knowledge of espoused values, following Schein, will help to understand the underlying thoughts and perceptions. However, this is only possible if the basic assumptions have become clear.

Elements characterizing the level of artifacts are for example a systematic approach to safety, proven by a high quality of a safety management system with a clear setting of safety priorities and tools. Another element is the commitment of the top management to safety. This commitment has to be demonstrated in managers' behavior, in their attitude to safety including the allocation of appropriate financial and work power resources. The strategic importance of safety must be apparent in the organizations goals and action plans, as mentioned in IAEA's document (2002). Long-term goals demonstrate that an organization is actively preparing for the future. In addition, the relationship with the regulator is on the level of artifact, characterized by the grade of openness in communication and mutual trust.

IAEA (2002) points out further that characteristics of the espoused value level can be found in the setting of high priority to safety, but actions and behavior can be contradictious to this espoused level in practice. The constant improvement of the safety performance reflected in a wide application of self-assessment is another espoused value, like an open communication,

which can set ground for an effective performance of the employees. Organizational learning is regarded as an organizational philosophy in which the approach to a problem is recognized as an opportunity to learn.

An important aspect of the basic assumption level for IAEA (2002) is characterized by the view of mistakes. They can be regarded as basis for punishment or opportunities for learning. The choice does not only depend on the organizational culture but also on the social culture. Organizations can influence but not change the view of mistakes among their employees.

Properties of safety culture on the regulator's side

International level

The Nuclear Energy Agency (NEA), consisting of the Organisation for Economic Co-Operation and Development member countries (OECD), published 1999 a report: The Role of the Nuclear Regulator in promoting Safety Culture. The early safety culture definition published by IAEA (1991) was adopted. According to this report it has become clear, that safety culture is not only an issue for the operators but also for the regulatory body. The Committee on Nuclear Regulatory Activities (CNRA) of the OECD established a task group focusing additionally on the dual role of the regulators. First, he has to promote safety culture as described by IAEA through its own example and through encouragement given to operators, and second he has to control the safety culture of the operators through audits or other methods. However, the NEA document (1999, vol.1, p. 11) states also clearly, that the regulator must keep in mind, that the responsibility for a safe operation of the nuclear power plant is on the operator's side. The review of this document shows that the attributes of a good regulatory safety culture are identical to the ones of the operators. It is even recognized by the regulators that there is no measuring

instrument to quantify safety culture. What can be done is evaluating the outward operational manifestation of safety culture, but not the safety culture itself. An open horizontal communication between operator and regulator is proposed, not to put the operator on the defensive but to encourage enhancement.

In the NEA report (1999, vol.2, pp. 32) the view of the Swiss regulator how safety culture should be promoted was integrated as follows:

> In the field of safety culture, the regulatory body finances a research project. It will be used for analyzing minor incidents which could have resulted in more severe accidents. Based on document reviews and interviews, scenarios are created where people will be asked what they would have done in a given situation. Furthermore, managers will be asked how their people would have reacted to certain incidents. This method will be conducted as self-assessments in the plants. One key factor is confidentiality and anonymity. Such a method will fail if individuals believe that they will be identified.

This sensitive approach can be set in parallel to the efforts done in airline industry where confidentiality and anonymity are key factors to enhance safety. Ek, Akselsson, Arvidsson and Johansson (2007), came to a comparable conclusion: Safety culture is better developed in an air traffic control setting with a mature approach to report incidents in an open dialogue and in a blame free context, which allows a better procedure for analyzing limitations and by that creating the opportunity to implement improvements

As a reaction to the NEA report: The Role of the Nuclear Regulator in promoting and evaluating Safety Culture (1999a), the Committee on Nuclear Regulatory Activities (CNRA) explored possible regulatory responses. Their publication: Regulatory Response Strategies for Safety

Culture Problems (NEA, 2000) tried to give answers. One of the problems is the difficulty to measure quantitatively the safety culture, a second the unavailability of resources or the preference to focus on inspections and assessments of observable safety performance indicators. The process described in this document makes it clear, that the regulator and the operator need the same basic definition of safety culture; otherwise, an enhancement is much more difficult. Choudhry, Fang and Mohamed (2007), listed 27 definitions of safety culture existing in the academic literature focusing on research undertaken from 1998 onwards. Most of the definitions are relatively similar. All of them tend to reflect, that safety culture is something an organization 'is' rather than 'has'.

In the second part of last decade (1995-2000), a series of events across the nuclear industry reinforced the acknowledgement of the importance of robust safety management. Growing deregulation in the market of electric energy, changes in ownership, outsourcing and not only ageing plants but also an ageing workforce affected the management and organization of nuclear installations. Those challenges had also a growing influence on the regulator's side. It was in this context, that the Special Experts' Group on Human and Organisational Factors (SEGHOF) was requested by the CNRA to examine the role and influence of safety culture and safety management. Workshops and surveys resulted in the state-of-the-art report on systematic approaches to safety management (NEA, 2006). The general definition of a Safety Management System as offered by IAEA (1999, p. 2) was accepted: "The safety management system comprises those arrangements made by the organization for the management of safety in order to promote a strong safety culture and achieve good safety performance."

The three-level model (Schein, 1992) was again used to show the relationship between the concepts of management system and safety culture. The report noticed the connection between the regulator and the operator, showing that the possible influence of the regulatory body on the

level of artifacts is substantial. The level of espoused values is only partly accessible and the regulator has very limited access to the basic assumptions. In order to achieve an effective progress in the relationship between the regulator and the operator, it is advisable to establish a common understanding to the scopes and bounds of regulatory interests at an early stage and to the approaches used to manifest that interest (NEA, 2006). In the concluding remarks regarding regulatory approaches the report repeated, that any regulatory activity must rest on the principle, that the operators are responsible for the safe operation of the plants and that the regulator should support this responsibility. Especially in the area of safety culture, the regulator should provide some space for self-regulation in order to encourage the operator to develop its own solutions and tools. Both, the regulator as well as the operator, need to make sure they have incorporated the needed knowledge and skills in their approaches. As the regulators set the requirements, there is clearly a need for a continuing exchange of experience. Elaborating on potential further work, the report (NEA, 2006) closes with the remark that improvements to safety management systems should involve the regulators as well as the industry, with the support of research teams and international groups. Experience about regulatory oversight and the approaches of operators in the area of safety culture should be shared internationally.

In the current decade, the nuclear industry faces again new challenges. Beside the known areas of deregulation, changes in ownership and aging problems, plants have to be phased out and new ones are built. If these processes are not properly planned and implemented, they have the potential to make a negative impact on safety culture. The regulatory bodies do not only have a growing interest in these issues, some are also actively working to develop and implement approaches to gather information about operator's safety culture (NEA, 2006). The Committee on the Safety of Nuclear Installations worked out a report about methods and approaches for the regulators to maintain oversight of the licensee's safety culture (NEA, 2008). The main conclusions were that the IAEA safety culture characteristics could be used as a starting point,

but that the regulators have to 'operationalise' the evaluation criteria. Gathering data at the level of artifacts and espoused values according Schein (1992) is possible, but to probe underlying assumptions is rather difficult. The regulator should look at attitudes, values, assumptions, perceptions and behavior in addition to systems and processes, as they influence the implementation of formal systems. Inspections should periodically focus on safety culture. This can help to improve the profile of safety culture within the industry. If the regulator targets his intervention at the senior management level, he acknowledges by that the strong influence of leadership on safety culture.

The need for periodic gathering of safety culture information, some proactive and some reactive, was also highlighted. Safety culture reviews have to be incorporated into new built and significant plant modification programs. As in new built projects, the operator is just one of many organizations involved, and regarding the international dimension and complexity of the supply chain the regulators are confronted with additional complexities. To mitigate those challenges, international groups should develop guidance on safety culture. It was agreed that increased emphasis should be given to multi-disciplinary regulatory teams, improved capture of safety culture during routine inspections and reinforcing safety culture through interaction with licensee senior management. Regulators should also reflect on how they can use operator events as learning opportunities for their own organization (NEA, 2008).

As this review shows, the international bodies created a wide frame, setting ground for the local regulator to specify his view on safety culture.

Safety culture by the Swiss regulator

Ryser and Frischknecht (2003), employed by ENSI, were dealing with safety culture and safety related issues. They focused on the question if safety culture is a regulatory issue and came to the conclusion, referring also to Durbin, Melber and Blom (2002) and Camargo, Choi, Gutierrez, Ryser and Taylor (2002), that the regulator's activities have an influence on the operator's safety culture, independent of the regulatory strategy adopted by the regulator. The fact, that the impact of the regulator, depending on the type of regulatory strategy, can be very different, is also described by Camargo et al. (2002), Durbin et al. (2002), and the Swiss Federal Nuclear Safety Commission (KSA, 2002). As the regulators' activities have detrimental effects on the safety culture of the licensees, the basic principles determining the attitude of the regulator have to be defined. During the third IAEA Consultant's meeting, four principles were defined (Camargo et al., 2002). First, the responsibility principle, making clear, that nothing the regulator does should endanger the fact that the responsibility for safety always remains with the operating organization. Second the 'Don't make it worse principle' makes it clear, that no intervention of the regulator should have a negative impact on the safety culture of the operator. The third principle demands, that questions and other activities of the regulator should strengthen the self-reflection and by that foster the organizational learning principle. Finally, the regulator should always keep the regulatory balance as the fourth principle, staying aware that he is playing three different roles: the expert role, the authority role and the public role (Reimann and Norros, 2002).

Ryser et al. (2003, p.2) deduce from the two assumptions, a) that the safety culture of an organization affects its safety and b) that safety is the core business of the regulator and that safety culture must also be a regulatory issue. However, as no unequivocal criteria exists specifying the 'right' safety culture, the regulator cannot regulate safety culture directly. The

authors give several reasons for this position and point out, that an objective assessment of safety culture is not possible. The safety culture indicators can only describe, but not define a safety culture. They therefore do not recommend statements on the part of the regulator concerning safety culture in general.

Because attempts of the regulator to regulate safety culture could influence the organizations own efforts towards higher safety standards, they propose that this should be avoided, as these interventions even pose the risk that the operator drifts back on the stage of minimum regulatory compliance.

The oversight activities according Ryser and Frischknecht should be based on an open and frank dialogue and need mutual trust. Nevertheless, there remains a distance between the operator and the regulator and for the latter it is nearly impossible to assess the non-observable aspects of a safety culture and the basic assumptions of the member of the organization. The Swiss regulator, following the theory of Schein (1992), can primarily judge observations on the level of artifacts; sometimes he might be able to perceive espoused values.

As self-assessment and self-regulation of the licensees are much more fruitful than assessments and regulations of the regulator, initiatives in this direction have to be strengthened. Non-voluntary implementation of safety culture programs on the operator side might be seen as a sign of the operator not having reached a high level of commitment. In this case the regulator might request the operator to develop safety culture related programs rather than prescribing how to implement safety culture. In addition, as safety culture is developed by a group or organization over a time period and based on its history of success (Schein, 2002), the regulator can influence the operators culture by influencing the history of success. The use of positive reinforcement is a tool to produce positive experience to strengthen a safety culture.

The Swiss regulator additionally edited further a guideline (HSK, 2002) containing the expectations regarding safety culture. This guideline is mainly based on IAEA (1999) and is a reflection of Switzerland's ratification of the Convention on Nuclear Safety. This guideline is not in contradiction to above described attitude. The definition of the goal of guidelines reads:

> The Guidelines developed by the Swiss nuclear safety authorities explain how the authorities intend to carry out their statutory mandate. In this way, the criteria the authorities use to assess applications and implement the regulatory process are communicated to the vendors and operators of nuclear power plants (HSK, 2002, p.1).

The operators have to consider the described expectations, but have the freedom to proceed differently as long as they can prove that the safety requirements are met.

As Ryser et al. point out (2003, p.3) the guidelines, containing only general principles, cannot be taken as an usable instrument by the regulators inspectors in their oversight duties, but can be used as an instrument for the inspectors in their oversight process. Together with the Institute of Work Psychology at the Swiss Federal Institute of Technology in Zürich (ETHZ), a handbook for internal use has been developed to give the inspectors of the human and organizational section a tool for the assessment and evaluation of the operator's safety management system. Beside the handbook and the guideline, the regulator developed a catalogue of questions about several aspects of the work processes. The main goal of this structured questionnaire is the collection of a large amount of data about work preparation, documentation and execution, about safety rules, housekeeping etc. in order to detect and follow trends over a longer period. As the authors mention, no direct conclusion and statements about safety culture can be drawn due to the fact, that judgments in the respective list are subjective. Nevertheless having its limitation in

mind, this tool, seen as a part of the regulators effort, delivers observable artifacts relating to safety culture.

The above review reveals that the Swiss regulator uses the same sources as the operators to define and describe safety culture. However, the regulator is aware that he is restricted to set the frame in which the operator is free to specify the realization.

Annex B

Safety culture and the issue of power

Even if there is no clear definition of safety culture, the respective concept links up with attitudes and values which are shared by the members of an organization. But Organizations can only be characterized in rare cases by comprehensive consensus and harmony. Far more differences, conflicts and fights for rare resources influence the life of an organization substantially. Antonsen (2009) shared his vision in a respective article. He based his thoughts on publications from Lukes (1974, 2005) who divided the topic power in three complementary dimensions. The first dimension defines power as the ability of an individual to realize his will in a specific situation. This sort of power is sufficient to alter actions of other persons or groups and it has different backgrounds:

- Power by hierarchical position
- Power by expertise and better information
- Power by control of resources and reward systems
- Power by force and sanction
- Power by alliance and network
- Power by charisma, energy and rhetoric skill

The second dimension of power is not directly visible. This covered sort of power is expressed e.g. that some topics do not appear on the agenda, that specific persons are not invited to meetings or are not contacted during a decision process. Those two groups are not exclusive but complementary to one another.

The third dimension refers to power used to form opinions influencing social life. The dominating part influence the dominated one in such a way that goals, values and attitudes are adopted.

The study of Antonsen (2009) clearly shows, when analyzing a safety culture, power has to be included. This conclusion is crucial while studying the relationship of a regulator and the operators. The decisive authority is with the regulator as he represents on one side the government and on the other side the public. Operators, responsible for the safety of their plants, and accountable to their owners, are forced to fulfill the requirements of the regulator and the demands of the shareholders.


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