IAEA WORKING GROUP PAPER
ON
SHORTCOMINGS IN SAFETY MANAGEMENT
SYMPTOMS, CAUSES AND RECOVERY

ABSTRACT

Strong economic performance in the nuclear business must be driven by excellence in nuclear operation and uncompromising safety. If this balance is not maintained then the ability of the utility to manage this technology safely will justifiably be challenged by the public and the nuclear safety regulator. Experience has shown that once nuclear installation performance has deteriorated to a level at which there are serious regulatory concerns about the adequacy of nuclear safety, then the magnitude and difficulty of the effort required to recover performance are such that continued viability of the organisation comes into question. Thus from both the perspective of individual utilities and the nuclear industry as a whole, it is extremely important to be able to detect shortcomings and deterioration in safety management performance before it becomes a serious concern, and to put effective corrective actions in place to restore and maintain performance at high levels. Following this theme and stimulated by the Canadian Government, senior representatives of utilities and regulators from Canada, United States, Sweden and Agency staff discussed common factors from recent cases involving safety management problems and subsequent recovery processes with a view to determining the need for further work to help prevent such difficulties in the future. From the working group discussion it was concluded that in most cases considered, the utility senior executives from, in some cases the Board of Directors and Chief Executive Officer, to senior nuclear site executives, did not have the nuclear business acumen or provide the leadership necessary for the management of a successful nuclear programme. Nuclear business acumen is the insight, knowledge and ability to manage the unique interaction between the technology, economics, human factors and safety in a changing nuclear generation environment. Senior utility management failed to recognize, within their suite of performance indicators, the symptoms and significance of shortcomings and degradation in the safety management processes and safety culture and hence failed to take effective corrective actions at an early stage. Key performance issues such as critical oversight, self assessment processes and effective corrective action programmes were not fully appreciated by senior management even after performance deficiencies were identified by the regulator and other external agencies. The seeming inability of the regulator to influence this senior management level, especially at the early stages of safety performance degradation was a major contributing factor in the continuation of the performance decline to the point that regulatory intervention became a necessity. Recovery processes commonly used a new utility senior management team to kick-start the change process and corresponding regulatory resource increases focused on monitoring the recovery. A comprehensive recovery plan and an interactive relationship with the regulator were deemed essential for a successful recovery. A review of the developing safety culture was a factor considered necessary to ensure sustainability. Public involvement in the regulatory monitoring process helped restore their confidence in the regulator, utility and plant management. The group recommended IAEA continue work to develop guidance for senior corporate management and regulators in this area.

BACKGROUND

In recent years, both the electrical utility industry as a whole, and the nuclear component of it, more specifically, have been buffeted by change. For the foreseeable future economic, political, industrial, technological and organizational change are likely to make change a continuous reality for the industry. The effectiveness of management in handling change can vary considerably from utility to utility. At the extremes, the way that change is managed and nuclear safety and operational performance are integrated can help lead a plant to operational excellence, or destroy what was once an effective organization.

The importance of management and organizational factors for the safe operation of nuclear installations attracted much international attention after the Chernobyl accident, especially after the concept of safety culture was introduced in the 'Summary report on the post-accident meeting on the Chernobyl Accident' in 1986 and the following report on 'Safety Culture' (1,2). The Convention on Nuclear Safety also adheres to the contracting parties' desire 'to promote an effective nuclear safety culture' (3).

Despite increased apparent awareness world-wide of the major role played by safety management and safety culture in the safety performance of nuclear installations many nuclear organizations have in recent years experienced serious declines in these aspects. This has in turn led to extensive and costly improvement programs and intensified regulatory supervision.

One of the major challenges for the future is for both the nuclear industry and regulators to achieve a more proactive approach to safety management so that problems are detected and acted upon at an early stage in order to prevent significant degradation (proactive prevention). An important step in this effort is to carefully review the lessons learned from some of the recently reported problems and recoveries in safety management and safety culture.

PURPOSE AND MAKE-UP OF WORKING GROUP

Stimulated by the Canadian Government, a two day working group meeting was convened in Vienna to review Ontario Hydro's (OH) recent performance degradation in comparison with similar situations elsewhere. The mandate of the meeting was to put together collective experiences on the causes, symptoms and correction, of shortcomings and degradation of Safety Management processes. Many of the symptoms and causes are already well documented, hence the idea was not to duplicate this list but to try and get an understanding of what common factors lie behind these causes and also determine common aspects of successful recovery processes. The product of the meeting was to be this discussion paper destined for presentation at the IAEA, Aug/September 1998, International Conference on Topical Issues in Nuclear, Radiation and Radioactive Waste Safety. Further work to be performed by the Agency in this area would be determined by member state reactions to the working group recommendations.

The working group members were Mr. Brian Mac. Tavish (Ontario Hydro Nuclear V.P. Regulatory affairs) representing the Ontario utility and Mr. Jim Harvie (Director General of Reactor Regulation at the Atomic Energy Control Board of Canada) representing the Canadian regulator. North East Utilities (Millstone facility) was selected as a similar situation on the North American continent for comparison purposes. Mr. William Travers (United States Nuclear Regulatory Commission Special Project Office Director for Millstone) represented the regulator and Mr. Marty Bowling (North East Utilities Millstone Plant Vice President and Recovery Manager) the Utility. Unfortunately Mr. Bowling could not attend the meeting however his input was obtained via a conference call several days after the meeting. Other experience was provided from Sweden by Mr. Gosta Carlsson (Unit Manager Oskarshamn Unit 1) representing the Swedish utility Group and Ms. Kerstin Dahlgren (meeting scientific secretary) formerly of the Swedish regulator (SKI) and now on staff at the agency as Safety Culture Specialist, Operational Safety Section. Other agency staff present were Mr. Ken Talbot (Section Head, Operational Safety Section of Nuclear Installation Safety) Chair, Mr Jamshed Hashmi (Unit Head, Operational Safety Section) Tom Mazour (Nuclear Power Engineering, Specialist), Mr. Harold Eichenholz (Operational Safety Section Specialist).

SUMMARY OF SAFETY MANAGEMENT CASES CONSIDERED

In Canada, Ontario Hydro (OH) shut down seven of their nineteen units in 1997 because of long standing management, process and equipment problems (e g 4). The decision followed an assessment initiated by new senior nuclear management engaged by OH (5). The assessment showed that all

operating stations needed immediate management attention in order to improve or maintain performance. It was concluded that a totally new approach to the culture, structure and management of Ontario Hydro Nuclear (OHN) would be required. They acknowledged the fact that OHN was highly successful during the design and construction phase, but that they failed to make a 'smooth transition' to focusing on operating and maintaining the operating units.

Like many other emerging nuclear programmes, OH's shortcomings in safety management probably existed from the beginning. Staff, having gone through the commissioning phase were extremely familiar with plant and equipment and hence compliance to procedures was not given the emphasis it has under today's standards. Production tended to be put ahead of safety with resultant non conservative decision making and a lack of suitable climate for the development of a good safety culture.

This situation created problems as the plants got older and as the original experienced staff were replaced. Corporate management and the regulator tolerated these low standards even though the outside nuclear community was, on the whole, making rapid strides to improve their safety performance. Although internal and external reports and peer reviews including corporate evaluations had revealed significant operational problems for many years, ineffective response from senior Ontario Hydro management allowed these conditions to continue. Several attempts to resolve these issues by the introduction of various programmes were unsuccessful. Little analysis was performed on why such efforts were unsuccessful before another change of management direction took place often driven by other corporate needs. The absence of effective corporate monitoring of nuclear safety indicators within the suite of corporate performance indicators, coupled with a lack of effective corporate oversight of the management aspects of the nuclear programme were contributing factors. An insular and complacent attitude, a failure to maintain a constant long term vision of how its nuclear assets should be managed and a failure to establish critical oversight and self assessment with a questioning attitude at all levels of the organization from the Board of Directors down were regarded as primary causes of the consequent decline in performance.

The regulator, the Atomic Energy Control Board (AECB), had also been critical of the utility's performance for many years and had required improvements in a number of areas in order for the utility to maintain 'the future licensability of the stations'(6). They had demanded to see evidence of corrective programmes at work but had witnessed a series of unsuccessful attempts with little senior management analysis of why they had failed before the next programme was initiated. They acknowledged that some short term improvements were made, but due to shortage of resources and the failure of Ontario Hydro senior and corporate management to recognize the potential future significance of the issues, by 1994 it was evident that sustained progress was not being achieved. These observations were conveyed to the President and Board of Directors of Ontario Hydro to little effect.

In the USA, the Northeast Nuclear Energy Company holding the license for the Millstone Station was in 1996 ordered by the USNRC, prior to restart (all units were at the time shutdown by the utility) of any Millstone units, to implement independent third-party oversight to verify the adequacy of the licensee efforts to establish adequate design bases and design controls (7). This independent corrective action verification programme was intended to provide additional assurance to the NRC that the licensee had identified and corrected existing problems in the design and configuration control processes. Additionally, the NRC was concerned about the failure of licensee management processes and procedures to effectively handle safety issues raised by its employees who brought safety and other concerns to the attention of management. These concerns resulted in a second order by the NRC in 1996 directing the licensee to develop a comprehensive plan for reviewing and dispositioning safety related issues raised by its employees, and to retain an independent third-party to oversee implementation of its comprehensive plan.

An article in Time Magazine highlighted the difficulties encountered by employees who tried to raise safety concerns to the attention of Millstone management as well as to the NRC .

Employee safety concerns had been prevalent for many years prior to the order by NRC to maintain all three units in a shutdown state. The NRC had from 1988 through the systematic assessment of licensees performance (SALP) noted safety management performance problems. The utility had in their own self-assessments in response to NRC concerns confirmed that there were a wide variety of problems at the Millstone plants. Problems included ineffective leadership, lack of a safety-minded culture, and inadequate resources provided by the corporate management. Although the plant launched a performance enhancement program to address these findings, the NRC continued to receive allegations by employees at a rate that increased every year. The allegations were related to continuing safety performance problems and failure of NU management to respond to employee concerns in a timely and safety conscious manner. These deficiencies resulted in several enforcement actions by the NRC during the period from 1985 to 1995.

The primary cause of problems at Millstone appeared to be a breakdown and failure of management leadership from the CEO to senior site executives who were not aware of the serious state of key performance issues. An effective corrective action programme and crucial self evaluation processes were not fully appreciated by senior management even after they were identified by outside and regulatory agencies. Contributing to this was very poor management communication from the top to the bottom of the organization and a consequent lack of trust between management, employees and the regulator (8).

Millstone was not the first utility to be shut down because of safety management problems. In 1987 the NRC issued an order to Philadelphia Electric Company suspending power operation at the Peach Bottom Atomic Power Station. The order concerned issues of operator sleeping, inattention to duties, failure to adhere to procedures, and management inaction or inadequate action. In the plant's own assessment of primary causes (9) they concluded that some of the same cultural characteristics which produced operational excellence in the early years became contributing influences to the primary causes resulting in its shutdown.

In the mid eighties the Tennessee Valley Authority (TVA) decided to shutdown their five reactors after having had an increase in safety related problems, which also was reflected in a series of low performance ratings by the NRC. In the review performed by an advisory committee (10) it was, however, pointed out that 'neither TVA nor the NRC initially recognized the serious and pervasive nature of TVA's nuclear problems'. TVA's management problems were considered to be deeply rooted in its peculiar form of governance 'amplified by the corporation's virtual freedom from accountability and the harmful effects of the Federal pay ceiling'.

At a Commission Meeting in 1994 the USNRC discussed the issues and performance related to the conduct of utility self-assessments. A particular case discussed was the Cooper Nuclear Power Station. This station had undergone a classic performance decline in safety management that resulted in significant weaknesses developing in the areas of management and leadership, programme effectiveness and equipment performance and conditions.

During the discussion between the Commissioners and NRC staff, the following points were made: there is evidence (i.e. SALPs) that there are problems and yet it took years to finally come to a point where significant regulator actions were necessary; it is seen with utilities, time and time again, when all the indications of problems are evident that they are not taken seriously enough or early enough, to head off their further growth. At this meeting, Commissioner Rogers reflecting on the question of self-identification of problems, discussed Thomas Murley's (a noted past senior NRC manager and currently an acknowledged expert in the area of nuclear safety) 'classical scenario' pertaining to plants that had had very good initial performance that started to slip (see also, 11). This degradation continued for an extended period before the regulator got the utility's attention, thereby

requiring them to take extensive measures to straighten themselves out. This scenario involves three distinct phases, namely: a period of denial, or even arrogance, where the utility believes there is no problem, and the regulator has it wrong; recognition that there is a problem and then a conclusion that the problem has to be dealt with seriously and turned around; the difficult recovery process as the utility climbs out of the hole.

Regarding the 'denial' phase, it appears from the cases discussed in this paper, that, denial takes many different forms. In the OHN case, it appears to reflect a lack of acumen on a senior corporate management level (two independent corporate peer reviews were conducted in the early 90s on Ontario Hydro and several significant shortcomings identified. Little effective action resulted;) In the case of Millstone, the regulator had identified in a report (Millstone Independent Review Group Regarding Millstone Station and NRC Handling of Employee Concerns and Allegations) that an unhealthy work environment existed, which did not tolerate dissenting views and did not welcome or promote a questioning attitude (7).

The challenge in these two cases would have been to ensure that the utility's senior management and/or responsible corporate boards had an awareness, willingness and capability to address the safety management issues as part of balancing the needs of the technology with economics, human factors and safety.

In Sweden, five reactors were shutdown in 1992 due to design basis deficiencies discovered in connection with an incident at one plant. During the shutdown the Oskarshamn Unit 1 reactor performed an expanded in-service inspection program. Results showed flaws at several locations and a decision was eventually taken by the plant to renovate the whole interior part of the reactor. Subsequently there were more discoveries of weaknesses in design and QA which delayed the project for another two years. The final request for restart of the plant to the regulator contained an 'unusual event report' entitled 'Deviation from reported safety level'. This type of report required the regulator to approve restart. No single deficiency was regarded as reportable as an unusual event, but collectively the identified deficiencies deviated from the assumed safety level to the extent that it had to be reported. The plant considered the main cause for this deviation to be failure in the management and organization of the plant and therefore submitted two reports of improvement measures taken - one concerning the technical improvements made and the other the measures taken to improve management and organization (12,13). The regulator acknowledged the plant's ability to analyse and describe the relationship between how the plant had been managed and the technical quality of the plant (14).

From the regulatory perspective the Swedish regulator (SKI) has for some time placed significant emphasis on the human performance aspects of regulation and especially on the management influence on that performance. Their monitoring of MTO related events (MTO is the interplay between man, technology and organization) has enabled hem to challenge plant management to correct primary causes of recurrent human performance problems.

At Barsebäck Kraft AB (BKAB), the regulator noticed through its yearly follow-up of MTO-related events a recurrence of events with similar causes during the period 1990-93. This was presented to the plant by the regulator with requests for immediate corrective actions. The plant referred to an ongoing review of management and organization and a foreseeable reorganization that would take care of the problems. A major reorganization was introduced, the human performance effects of which had not been properly analyzed and hence created a further increase of MTO-related events. The regulator was immediately aware of the situation and the plant was put under 'special supervision'. A major improvement effort was introduced, which was carefully monitored by the regulator(15). The plant was considered proper for 'normal supervision' in 1997. In this example the regulator was unable to prevent the unanalyzed organization change but at least had the capability to monitor subsequent performance and take appropriate effective corrective action.

Although regulatory strategies may vary between countries there were some common obstacles encountered. The difficulty identifying criteria for when regulatory action should be taken for gradual degradation in the performance of safety management was common. Performance of an in-depth investigation into a subject which would trigger further investigations should the condition warrant, was one regulators approach.

Regulators as well as utilities initially had a strong focus on technical issues and have been handling safety issues related to management and human performance more in a reactive way i .e. in response to failures identified through various types of events. Except in the case of Sweden, little regulatory effort had been placed on management and organizational capability to handle the unique interaction between technology, economics, human factors and safety in a changing environment. Furthermore, regulators in general have not paid as much attention to the impact of organizational changes on safety as they have on technical plant modifications. More strict regulatory requirements on submitting an analysis of potential safety consequences of organizational changes as well as careful regulatory review of these changes may have prevented some of the problems experienced by the utilities.

In the Canadian and US experiences it was apparent that the regulator during the initial phases of identified weaknesses in safety management processes lacked capability to effectively influence top management to make necessary improvements. Repeated changes in management approach and introduction of new, often unsuccessful, programmes without due analysis was accepted by the regulator rather than treated as a major indicator of problems with the safety management processes. In several of the cases considered the regulator was not sufficiently persistent in tackling the senior level of the organization and failed to convince the corporate level of the severity of the situation.

COMMON SYMPTOMS AND CAUSES OF SAFETY MANAGEMENT PROBLEMS

Factors common to all plant situations described above were that during their early operation they belonged in the league of the best performing plants as measured by the means available at the time. They had however failed to adequately manage the transition from the design and construction stage into an era where the focus needed to be excellence in operation and maintenance of the plant. Common obstacles to a smooth transition were inadequate corporate support, poor leadership and managerial skills focused more on technical competence than people skills, a lack of recognition of the need to develop a good safety culture, 'insularity' with lack of learning from the experience of others and/or benchmarking themselves against others, lack of resources, reorganizations and/or downsizing including the loss of experienced staff and 'corporate memory', increased backlogs in maintenance and updating of procedures, a low status for the QA departments as well as poor follow-up of QA findings etc. In addition, there was a relatively high threshold to impending safety management and cultural problems before action was taken among utilities as well as regulators (except for the second Swedish example).

A common feature in these causes is the fact that senior Corporate/utility management failed to appreciate or recognize these symptoms or their significance and failed to take effective corrective action at an early stage despite overtures from regulators and others. A lack of the appropriate questioning attitude by senior management up to the Board of Directors and the absence of an effective 'corporate oversight' to bring attention to the significance of the issues were contributing factors. The absence of a strong senior management reaction to safety lapses by the plant or declining safety performance lead to the acceptance of standards which were less than the industry norm. In conclusion it can be said that in most cases considered, the utility senior executives from, in some cases the Board of Directors and CEO, to senior site executives, did not have the nuclear business acumen or provide the leadership necessary for the management of a successful nuclear programme. Nuclear business acumen is the insight, knowledge and ability to manage the unique interaction between the technology, economics, human factor and safety in a changing nuclear generation environment.

A particular challenge to the regulator in these situations is difficulty in developing clear criteria for when regulatory action becomes necessary in the case of gradually declining safety culture and associated management performance. Regulatory capability to monitor organizational and human performance and the managerial capability being applied to safety management was often lacking and/or ineffective. The seeming inability of some regulators to influence at the senior level up to the Board of Director level especially when detecting gradual degradation in safety management was also a major contributing factor in the continuation of the performance decline to the point that regulatory intervention became a necessity.

THE RECOVERY PROCESSES

An essential first element in the recovery process is the development by the utility of a comprehensive plan that delineates the issues and resolves the causes.

Ontario Hydro Nuclear developed the Nuclear Asset Optimization Plan (NAOP), in response to the findings of their Independent Integrated Performance Assessment. Ontario Hydro determined they had insufficient human resources to simultaneously implement changes that needed to be made to satisfy regulatory requirements; respond to other issues (e.g., major equipment improvements programs needed for long term plant viability); and continue to safely operate all its nuclear units. As such, the recovery plan focused on newer units while placing the 7 older in a temporary lay-up status. The major elements of the longer term recovery plan focused on improvements in management processes such as corrective actions, work management and oversight, design basis/configuration management and material condition and human resource/cultural issues.

For the Millstone the key issues were organizational and process, the utility developed a programme titled 'Improving Station Performance.' The ISP involves performance concerns in the areas of leadership, communications (employee concerns), the corrective action program, procedural adherence and procedure upgrades, work planning and control, and operational enhancements. Effective QA oversight and self assessment programmes were re-established and extensive leadership training was provided at all levels of management and supervision. The principle elements of the utility's planning for restart included: organizational readiness; operational readiness; system readiness; and regulatory readiness. Also, the utility developed a Configuration Management Plan (CMP), which was the principal program to resolve design-bases weaknesses. The CMP objective was to document and meet the units' licensing and design-bases requirements.

In Sweden the utility developed improvement plans involving the developed goals and strategies that assures a long-term perspective; special efforts to increase the level of competence of the plant personnel; improve assessments performed by the Quality organization, and other planned improvement measures, including internal safety review and corporate safety culture improvements.

There was general agreement that a successful recovery process involves a change of the management team to actually drive the recovery changes and provide sustaining capability. A number of common reasons were identified including; loss of corporate trust in their ability to effect change; loss of credibility with the national regulator and/or workforce; a new work culture was needed to bring about the change and carry out the recovery process and finally they were probably suffering 'burn-out' due to the exhaustive but fruitless efforts taken by them to improve safety management performance. However, a number of caveats were identified by the working group involving the change-out of the recovery management team. Change should not be performed for the sake of change, but only after proper analysis is performed that supports the need for change. Consideration of alternatives to changing the recovery management team, namely, addressing the issue of whether the existing recovery management team could effect the recovery if given the same resources that senior management is now willing to place at the disposal of a new recovery team. It was generally felt, however, that hard decisions to change management need to be made especially assessing

whether a management team that has expended significant energy on attempting to keep performance from declining has sufficient energy remaining to lead the full recovery operation.

Due to the significance of decline in safety performance evident in each plant's case, the regulators ultimately had to work together with utility management in a highly interactive recovery process. They themselves had to develop new and different regulatory approaches to cope with this situation. These were necessary to deal with the complex issues and the lack of confidence in utility assurances that they would effectively deal with the issues. This latter point was the result of the regulators, in both the Millstone and OHN cases, indicating that they were disappointed in their own efforts to initially convince senior utility corporate management of the need to address safety performance concerns. While it was agreed that ultimately, the utility is responsible for the safety performance of the plant(s) that they operate, the regulator (at least for the Millstone and OHN cases) can be seen to have contributed to the degree of decline by an apparent inability at an early stage to obtain senior utility officials attention on their utilities shortcomings in the area of safety management. Ultimately the regulator needed to resort to the use of extraordinary means to facilitate needed changes. However it was agreed that the new regulatory process developed during the recovery phase will enhance performance of both the regulator and utility to deal more effectively in addressing future safety management and safety cultural performance.

For the Millstone case the NRC, in addition to using its established processes for problem plants, crafted very specific 'Orders' requiring utility action to resolve deficiencies in safety management performance. One involved the requirement for an independent third-party oversight of the utilities implementation of resolution of its' employee' safety concerns issues. The other involved the establishment of an independent third party oversight of corrective actions for design and plant operation deficiencies. Both the requirements established by the Orders needed to be satisfied as a condition of restart of the plants. A dedicated organization was established under new management to oversee from a regulatory point of view the progress being made by the utility. Considerable additional resources were required for this effort as well as the development of new processes to handle the integration of effort between utility and regulator.

In the Ontario Hydro case, which is in the early recovery phase, the AECB response to a lack of progress in utility safety performance improvements resulted in the issuance of reduced term license renewals (6-9 month periods as compared to the traditional 2-yrs) in order for the AECB Board members to regularly review progress. In this case the utility informed the regulator that a shortage of resources in the regulatory organization could threaten the success of the recovery and volunteered to fund additional resources for the regulator to ensure there were adequate regulatory resources to deal with the recovery.

Similar to the Millstone - NRC experience, the AECB required the utility to conduct, via an independent party, an assessment of the safety culture of the operating organization. The difference in the Ontario Hydro case is that 12 units remain in operation while the recovery changes are instituted. This requires particular diligence on the part of the utility and regulator to ensure the results of changes are in the positive direction at all times thus further emphasizing the need for close monitoring of results.

At Oskarshamn, SKI followed closely plant management progress and encouraged the conduct of further investigations to assess the significance of a number of unplanned conditions. In this case the plant impressed the regulator in its assessment of the link between poor safety management and material condition. The regulator then followed closely the results from the correctional plans.

In the case of Barseback the regulator reacted to the problems with human factor performance and also that the corrective organizational change was in fact worsening the situation. The regulator demonstrated initiative by crafting a form of a watch list status by placing the plant under 'Special

Supervision.' Subsequently, the regulator conducted a special field investigation to ensure that the utility was sincere in it's efforts to resolve the performance concerns.

After every significant failure of safety management which becomes obvious to the public there is a need to re-establish public trust in the regulator, in the utility and plant management. The regular regulatory review processes and the technical reviews with station staff were made available to public scrutiny at Millstone. Both the regulator and the utility also held regular public meetings to explain the current situation and describe progress along the recovery route.

The participants agreed that the utility must demonstrate sustainability of the safety related changes and identified that an assessment must be performed at an early stage as to whether a recovery plan is going to be successful. This is why the regulator requires both a utility plan and evidence that successful implementation of plan elements for improving performance are occurring. An item of commonality supporting this issue was the need to carefully monitor the change in safety culture as changes were taking place. This was deemed necessary in order to ensure the safety management changes were driving the culture in the right direction i.e. towards a learning organisation and away from a command control type.

COMMON ASPECTS OF THE RECOVERY PROCESS.

Review of the recovery processes adapted by the Utilities revealed several common approaches.

Two utilities had experienced problems stimulating a dynamic recovery process and used a change of senior management creating a new recovery management team to kick-start the change. A new management culture needed to be developed within the organisation at the commencement of recovery in order to drive the recovery process as well as to re-establish credibility with the national regulator, the work force and corporate office.

Development of a comprehensive plan to fix the causes of the problems and ensure long term sustainability was an essential component of all recoveries. In depth analysis of the situation was necessary in order to identify the causes. In two cases this was performed by the utility and the regulator played a major role in the other.

Recovery plans could be grouped into: 'Fixing the processes' - safety management issues such as quality assurance and self assessments, corrective action and operations and maintenance programs for sustaining performance. Improving the competence of plant personnel or 'fixing the people' was a prominent feature of another group of plans using enhanced training and developmental programmes for all levels of staff, supervision and management. Organizational changes were tackled by all with mixed results. A common lesson was to ensure complete analysis of the effect of the change prior to its enactment; Design basis, configuration management and material condition related programmes (fix the plant) were another group which had some reliance on improved processes and people to be in place before they could be successfully executed.

As the recovery change process takes place a safety culture is developed across the organization which is different from the previously established culture. Review of the effectiveness of this cultural change in improving safety was demanded by all three regulators to ensure the utility had 'fixed the Culture' Where the regulator did not have the in-house expertise in this area independent external contractors were used.

Due to the extreme pressures placed on the utility and regulator during recovery the regulator has to rapidly develop new processes to effectively deal with the complex technical, human and public confidence issues. This takes considerable resources and new skills to manage. The regulator therefore has to look at invoking similar management and process changes as the utility to enable successful and sustaining response to the situation.

The regulatory relationship with the utility changes as the recovery process develops. In some cases the initial adversarial role moved to one of mutual of trust in a highly co-ordinated, interactive working relationship, while maintaining a businesslike regulator/utility interface.. All parties agreed the mutual development of such a relationship between regulator and utility was essential for a successful recovery.

Public participation in the regulatory monitoring process was key in the Millstone case to restoring public confidence in the regulatory process, the utility and plant management.

RECCOMMENDATIONS FOR IAEA ACTIONS

Strong economic performance in the nuclear business must be driven by excellence in nuclear operation and uncompromising safety. If this balance is not maintained then the ability of the utility to manage this technology safely will justifiably be challenged by the nuclear safety regulator and the public. Experience has shown that once nuclear installation performance has deteriorated to a level at which there are regulatory concerns about the adequacy of nuclear safety, then the magnitude and difficulty of the effort required to recover performance are such that continued viability of the organisation comes into question. Thus from both the perspective of individual utilities and the nuclear industry as a whole, it is extremely important to be able to detect shortcomings and deterioration in safety management performance before it becomes a serious concern, and to put effective corrective actions in place to restore and maintain performance at high levels.

Given the above, the Working Group felt the following actions could be taken by the IAEA to assist senior management of nuclear installations in Member States in the early detection and correction of deteriorating safety performance before it jeopardizes the viability of the asset.

1) The IAEA should develop guidelines describing the processes that could be utilised by senior corporate management of nuclear facilities for early recognition of shortcomings and degradation of the safety management ingredient of their management processes. These guidelines should include information on how to develop and maintain the acumen required for successful corrective actions to be taken before the viability of the asset is jeopardized.

2) The IAEA should develop both qualitative and quantitative performance indicators for senior utility management to enable them to discern and react to shortcomings and early deterioration in the performance of safety management within the suite of other business performance parameters. (The new INSAG paper on Safety Management covers some of this, ref 16.)

3) The IAEA should develop guidance for regulatory bodies on how to detect shortcomings and early signs of degradation in the management of safety and how to most effectively use this information to assist utilities in early response to such conditions. Guidance should also be developed on how the regulator can most effectively monitor for signs of successful recovery.

4) The IAEA should either augment their existing operational safety services or develop a new service which would assess the effectiveness of management processes used by senior management particularly the safety management ingredient. This may involve the development of a set of performance objectives and criteria to enable senior management to perform self assessment of their own processes. (The INSAG paper on Safety Management will help in this area.)

5) The IAEA, with the help of an expanded Working Group, should prepare documentation on lessons learned in the early recognition of and recovery from degraded performance particularly in the recovery processes. Case studies should be performed of utilities that have undergone problems and recovered as well as those exhibiting excellent long term performance, to capture their experience in amalgamating good nuclear safety management practises within their corporate

management role. The results of this work will help with the development of the guides noted in 1) above.

6) The IAEA should organise workshops for senior utility management and regulators on the above.

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