

## **Topical Issues Paper No. 2**

### **INFLUENCE OF EXTERNAL FACTORS ON SAFETY**

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# 1. RATIONALE

In recent years a number of worldwide trends have emerged which affect the operating environment of nuclear power plants (NPPs), both externally in the sense of their political and economic business climate, and internally in the sense of their budgets, staffing levels and business practices. It is very clear that the 'span', or breadth, of issues being faced by the owners, operators and regulators of NPPs today, and the speed at which these issues are changing, is much greater than ever before. Included for consideration are:

- Plants under construction or plants for which previously halted construction was resumed;
- Plants operating in a deregulated electricity market;
- Plants being refurbished and restarted;
- Plants undergoing life extension programmes;
- Plants facing closure for political reasons;
- Plants being laid up or decommissioned;
- Plants experiencing changes in ownership or operating control even by non-nuclear organizations;
- Plants which need substantial design and material condition upgrades;
- Plants facing a significant decline in revenue or funding;
- Plants learning new management techniques;
- Plants engaged in new regimes of safety regulation;
- Plants with serious shortages of human experience and talent;
- Plants facing ageing issues (institutional, personnel and equipment).

What is particularly new is that many of these activities are now often going on simultaneously within a single utility. This means that the management attention span may be substantially stretched. In the USA, in particular, many of these issues have been present for several years. They began before economic deregulation of the electricity industry and their frequency and significance have generally increased in recent years as a result of deregulation.

It is of paramount importance that co-operation and learning be promoted extensively as the industry faces these multiple overlapping and potentially distracting challenges. The basic principles of safety management that have been established and upheld in the past are extremely relevant for the future, but they have to be applied to new circumstances, and in some cases by new players. This challenge is not simply directed at the management teams of the NPPs. Instead, governments, regulators, owners, operators and staff all have a role to play in ensuring that the major upheavals that are taking place are dealt with safely and successfully, while taking full advantage of the positive incentives and opportunities offered by these challenges.

## **2. STATUS OF TOPICAL ISSUE**

### **2.1. STATUS**

The single most important change is the move to make electricity (and therefore nuclear electricity) a simple commodity in a commodity market. This change is accompanying electricity marketplace deregulation or rationalization in a number of countries, with varying degrees of success.

The second (possibly related) change is to shift nuclear power from 'government protection' to 'stakeholder influence'. This trend is driving a number of early plant closures, either due to identified problems, or as a result of political decisions. Early closures create substantial problems for staff motivation and skill retention: decommissioning plans must be prepared, financial support obtained, licensing and waste management issues resolved and the public and local governments kept informed, all while safe operation is maintained.

Thirdly, there are issues that emerge from the maturing of the industry. These include technical issues such as equipment degradation, but also the issue of the supply of skilled, competent staff for the future. This is currently a significant threat on the horizon of the nuclear industry.

Finally, the previous trends are posing new challenges for nuclear safety regulators, and there is, therefore, growing activity in the area of matching the regulations to the issues and problems that are emerging.

### **2.2. RESPONSES**

The industry is responding to these trends by continuing its tradition of sharing information and experience, although this could be threatened under some competitive situations. Progress has been made in developing approaches to a number of these issues. In the following some examples are given.

#### **2.2.1. Deregulation**

There is significant experience in the UK, USA and a limited number of other European countries about the impact both positive and negative of deregulation of the electrical supply industry on power plant operations. A report on deregulation from the perspective of the regulatory community is being prepared by the Nuclear Energy Agency (currently in draft form) [1], and has been used to assist with this review.

### **2.2.2. Early closures**

The closure of nuclear generation facilities before the end of their design life due to cost or performance related decisions, or decisions of a purely political nature, are being experienced in many countries. A recent IAEA workshop, entitled “Managing the Early Termination of NPP Operations” [2], addressed this issue. Attended by participants from North America, and Eastern and Western Europe, the workshop concluded that there are no internationally accepted common approaches or guidelines to help the utility or regulator on what to do and how to plan under these circumstances. It was also concluded that the IAEA would be an ideal forum to develop this guidance.

### **2.2.3. The nuclear industry and workforce**

With the maturing of the technology, the lack of growth in the nuclear industry in many states and the demographics created by early expansion in the 1970s and 1980s, many experienced people are retiring from the workforce and little new talent is being attracted to take their place. Together with this, many plants are approaching the end of their design life and while many operators are engaged in life extension activities, others are intending to phase out their older plants without replacement.

The IAEA has sponsored exchanges on the problems associated with staffing, and the subject of knowledge retention is becoming an area of attention. Technical information exchange is also ongoing on issues of plant ageing [3] and decommissioning.

## **3. PROBLEMS IDENTIFIED, ISSUES TO BE RESOLVED**

### **3.1. DEREGULATION AND COMPETITION**

*Electricity is increasingly a competitive commodity business. Governments are deregulating the electricity supply industry, introducing competitive markets and selling or combining assets.*

#### **3.1.1. Background**

The trend towards deregulated and competitive marketplaces is spreading into the electricity sector. There have been successful transitions of the electricity markets and successful transfers of ownership of NPPs (private sales, leases or transfers of operating licenses), as well as strategic partnerships and alliances, but there have also been significant difficulties in some areas. A large number of the world’s NPPs are either experiencing, or know that they will experience, these changes in the next five years.

Some general observations about this trend are:

- It is altering the governance structure of NPPs in some countries or utilities and is bringing in new players: new regulators, new managers, new shareholders, new market-makers, etc. Many of these players have had no or minimal prior direct exposure to the operation of NPPs and the necessary over-riding focus on nuclear safety.
- It places increased attention on the financial performance of NPPs. This means that asset values (material condition), operating performance, reliability and costs are very heavily scrutinized and managed.
- It drives a move towards ‘plan the work and work the plan’ in almost every area (e.g. ensuring that outage performance is on scope, schedule and budget, that costs are managed to budget, and that planned capital investments to upgrade the plant are spent on time and on budget).
- It can alter some very longstanding features of the operating environment such as grid supply security to the NPPs, and the basic market framework (i.e. whether an NPP has a ‘right to supply’, and possibly forcing consideration of unit manoeuvring).
- It provides a valuable opportunity to make other linked or parallel changes that decision-makers wish to adopt.

Obviously not all NPPs are experiencing all the changes that deregulation and/or privatization can bring. However, the broad effects are widespread.

### **3.1.2. Problems and issues**

Many of the changes are taking place in the area of governance. Some nuclear plants are becoming just business assets in the portfolio of an organization. Frequent changes are occurring in the ownership of utilities and in the type of businesses that the utilities are operating. There are also frequent changes in the management of NPPs; in many cases the top level managers have little nuclear acumen, expertise or experience. There has been an increase in the practice of acquisition and disposal of assets by companies, both nationally and internationally. This in turn is leading in some countries to a new situation in which the owner and the operator of an NPP may not be the same. This type of separation can impact on licensing arrangements, which may have in-built assumptions that the owner is the operator. (The experience in the USA has been that although owners and operators are often not the same, they are typically affiliated companies.)

The overall trend is therefore one of introducing new owners, new management practices, and new geographical relationships. In these new configurations top management is business (financially) focused because financial performance and credibility are vital to shareholders and investors.

New marketplace (competition) regulation and practices have the goal of providing a ‘level playing field’ for access to the grid. They are not directed at nuclear safety. This is producing a direct impact on operations. Along with the potential threat to the ‘right to supply’, which could initiate forced shutdowns, there are potential impacts on the reliability of grid supplies to NPPs for safety support as the grid is operated in different modes for competition. There are substantial financial pressures and penalties to meet committed generation targets (e.g. outage dates, manoeuvring rates, etc.) and there can be other impacts such as decisions about longer-term maintenance investment. The cost reduction pressures are relentless and plant managers can easily become distracted from operational safety by these many new issues.

In response, utilities are reorganizing, downsizing and using more contracted services (some of which are closer than before to the ‘core’ functions of the plant). These contractors may be selected on the basis of the lowest bid and may have less qualified staff and experience than the traditional repeat or partnership contractor. There could be staff from many different organizations working on the site and the operator’s resources may have difficulty in effectively controlling the contractor’s work. Simultaneously, there is inevitable production pressure. This is not intrinsically bad — NPPs exist to produce power — but it has to be managed in ways that enhance human performance and plant condition rather than detract from it. In particular, management must strengthen conservative decision making practices to avoid degradation, and it must ensure that competition does not inhibit the free sharing of information between plants, and degrade safety through loss of good operating experience (OPEX) exchange.

As the stakeholders look ahead in this new environment, they have to examine consumer trends, social concerns and political perspectives because these will affect future investment (e.g. distributed generation, environmental impact perception, etc.). These trends and perspectives also affect investment in the existing plant, and at some stage may drive decisions on the part of plant owners to move out of the nuclear business. This situation can create uncertainty and distraction for plant staff from safe operation.

Maintenance of nuclear utility share prices and financial returns will become increasingly critical as nuclear comes to be regarded as purely a business asset. These business results can be drastically affected by adverse performance reports. There is, therefore, the potential for the business to become less transparent and less likely to make performance evaluations public, which can contribute to an erosion in public and regulatory confidence.

There are some indications that due to competition and shareholder sensitivities, the willingness to share safety and performance information may be decreasing. The challenge to the industry is to continue to be as open and transparent as in the past despite the changing business conditions.

### **3.1.3. Opportunities**

It is important to recognize, in the midst of all this change, that there is a substantial opportunity to confront realities and to change them for the better. Poor performing plants can be identified and upgraded or shutdown. People can be freshly motivated and better managed, and new ownership and new perspectives can give positive energy to a maturing industry. To achieve these benefits is a substantial and imperative management challenge which has, in some countries, been successful in producing substantive safety and economic benefits.

A particular opportunity is to enhance human performance. ‘Event-free operation’ (i.e. high standards of human performance and reliability of equipment) enhances asset value and production revenues, while reducing costs and improving public and regulatory confidence in the operation. Alongside this there is the possibility of introducing new reward systems. However, these must be properly geared to the desired behaviour for safe operation.

There is also a renewed emphasis on forward planning in all areas (e.g. outages, plant life assurance upgrades, staffing, budgeting, etc.). Management will, therefore, focus on forward planning and adherence to plan (‘Plan the work and work the plan’) in all areas, and this has real benefits to safety if plans are properly conceived, are of high quality and are implemented effectively.

Freeing utilities from the bounds of State control can unleash the opportunities for continuous improvement in the safe operation of nuclear facilities. The combination of attitudinal changes towards more innovation, greater management and organizational flexibility, and an increased array of tools for managing change can stimulate increasingly higher levels of safe, reliable and competitive performance.

## **3.2. POLITICAL AND ECONOMIC ENVIRONMENTS**

*Nuclear power is being shifted out of ‘government protection’ into ‘stakeholder influence’. The political and economic environment for NPPs is therefore shifting significantly in some States, to the extent that the operating environment of financial or other support is radically altered. For example, in some countries there is pressure to shutdown even safety upgraded plants as a precondition to joining the European Union and in others the pressure of minority groups within government coalitions is sufficient to force policy reversals regarding nuclear energy.*

### **3.2.1. Background**

In many countries nuclear power started life as a ‘protected’ business in the sense that governments provided substantial resources and also perhaps, protected markets and prices. Governments have also defended the industry against its critics and have been heavily involved in direct regulation (nuclear safety) and other regulation (e.g. environmental), all of which have affected the industry’s operating climate.

In some countries, therefore, the operation of NPPs has become a highly charged political issue, since stakeholders believe that the way to change the industry is through political activism to influence governments. This leads to situations where governments become reactive to political pressure. In other cases governments are changing their agendas and are starting to place other objectives ahead of the protection of the nuclear industry (e.g. opening the electricity market to competition or de-activation of the industry to address social or political concerns), and are, therefore, proactively promoting change in the operating environment.

Finally, in some countries there are programmes of growth, with NPPs under construction or being refurbished to extend their operating life.

### **3.2.2. Problems and issues**

In some countries there are politically driven demands or decisions for early plant closures. These create instability and uncertainty for operating staff, with a possible loss of focus on safety. These demands are challenging to manage as they raise issues of; staff motivation and maintaining a good safety culture, personnel management, decommissioning, finances, licensing, waste management and public relations all at the same time that the plant is trying to maintain high levels of safety.

There are other cases where the desire to achieve fully commercial rates of return on assets is driving substantial and rapid cost reductions. If these cannot be achieved, then the plants will also face closure, with the same range of issues mentioned above.

Substantial uncertainty, insecurity and distraction can be created in operating staff by the unstable or shifting external environment. In addition, NPP management can become 'helpless' in the face of imposed change, and consequently lose decisiveness, energy and authority in the internal management of the plant. Unsettled and distracted staff can threaten a proper safety focus either by becoming disillusioned and demotivated, or by becoming excessively focused on production which they may see as the key to their security. This in turn could inhibit the reporting of adverse conditions due to staff concern that the plants must appear to be performing well, and could threaten a good questioning attitude which is a component of a healthy safety culture. The need to maintain worker motivation under all circumstances, by creating confidence that there is a future in the business for everyone, becomes a significant issue under the threat of closure and financial difficulties.

Utility finances are unstable in some countries (e.g. payments are not being made for electricity production due to political/economic instability and the essential service nature of the product). In these cases there is extreme pressure on financial investment and impacts on staff through low wages or non-payment of wages. Similarly, regulators in many countries, often being under government pay rates, offer significantly lower salaries than utilities with subsequent difficulty in attracting and holding new talent.

Less acutely, but significant in the longer term, are issues surrounding the predictability of the economics of operating nuclear plants. Environmental perspectives and future changes to regulation are affecting the views that investors and shareholders have of the future of the industry.

Overall, the issues surrounding the operating environment of NPPs have broadened substantially, but within one general trend — they are being brought out of ‘government protection’ and into ‘stakeholder influence’. This is happening in different ways, at different rates and with different stakeholders involved. Sometimes the transition is carefully managed to avoid potentially damaging ‘transients’, but in other cases NPPs are being faced with radical changes, as they have to adapt to some new realities very quickly.

A clear priority in responding to major external change is open and frequent two way communication regarding these matters with employees, the regulator and the public. Simply knowing the directions and possible and probable outcomes can make a substantial difference to the human reaction to change.

### **3.2.3. Opportunities**

Another trend is to produce greater accountability to stakeholders, so where there are clear stakeholder roles and effective communication and management of change there can be positive outcomes for ensuring proper plant condition and human performance. The US nuclear industry has clearly demonstrated this potential over the last five years.

The premature closure of some plants has been used as a lever to bring into public, business and environmental focus the positive aspects of nuclear power generation. An industry opportunity exists here to capitalize on this aspect in public and political forums to illustrate the role nuclear power can play in the future energy supply mix considering the dearth of present practical and sensible alternatives.

The political and economic pressure in some countries, which is stifling the growth of the industry, may at the same time stimulate the life extension of some plants. This, coupled with the achievement of fully commercial rates of return from the safe operations of some NPPs, is causing businesses and governments to reconsider the use of nuclear energy for potential long term financial returns and stability of clean energy supply. This in turn is forcing an innovative look at the technology in order to develop an NPP design more acceptable to the public and business from both the safety and economic viewpoints.

The continued expansion of the industry in some countries is a constant reminder to the global energy sector of the viability of the technology and of its capability to design, build and operate safe plants in the future.

### 3.3. THE CHANGING INDUSTRY

*The nuclear generation industry is maturing, and this brings new challenges that have to be managed alongside the mainstream operations. Examples are:*

- *Securing qualified human resources for the future;*
- *Managing ageing plants;*
- *Upgrading plants for life extension;*
- *Decommissioning activities including on-site storage facilities.*

#### **3.3.1. Background**

The two general challenges posed by changes in the industry are caused by actual or potential mismatches of resources to needs. The first mismatch is that just as the management and operational issues are proliferating the pool of experienced human talent is simultaneously under threat of a decline. The second is that the nature of NPP technical problems is changing (condition monitoring, life extension, decommissioning, on-site storage requirements, etc.), while simultaneously the technical infrastructure (R&D, original equipment supplier expertise, etc.) is eroding through staff retirements, lack of an ongoing new construction programme in some countries, reduced demand from operating organizations and reduced funding from governments.

These two mismatches, or ‘paradoxes’, are complicating the management challenge of maintaining and enhancing safety through changing times. The problem with these paradoxes is that they are not always being actively controlled by corporate level decision makers, and indeed there are limits on their level of control of many of these factors. Yet, they can be very limiting or threatening to management at the plant level.

#### **3.3.2. Problems and issues**

Broadly speaking this trend is slow, insidious and hard to assess in terms of safety impact. Yet on the overall scale of issues facing NPP, it can sometimes be the most serious threat to safety because competent people and a sound technical condition of the plant are the two foundation stones for everything else.

Some utilities definitely face an ‘experience crisis’ due to adverse demographics. This has likely been driven by the fact that downsizing simultaneously often loses both the most experienced talent and the younger talent pool at the same time. At the same time there are problems attracting new entrants. The overall image of the industry, its largely bureaucratic organizational work practices (which under a competitive environment are showing signs of improvement) and uncertainty over its long term future can all conspire to make it relatively unattractive to younger people. In addition, in the face of a lack of interest from students, many universities and colleges are no longer teaching nuclear technology.

The loss of institutional memory ('why we do things...', etc.) due to staff reductions and retirements can have a serious impact on management's overall ability to sustain and enhance safety in changing times. It can be very difficult to spot a significant degradation in this area because it happens slowly, and because once memory or capability is lost, there is no one left to recognize that fact.

There may be insufficient resources available to examine the technical issues facing some utilities. Ageing plants can create technical situations that threaten the design basis. These can go unrecognized, or they can be costly to address, causing a challenge to the plant owners and managers. In some countries, national solutions to waste handling and spent fuel storage are not being addressed in a timely manner, thereby forcing the need for on-site storage considerations in excess of original design intentions.

There is additional work required to upgrade plants for life extension. Data must be collected and analysed to demonstrate that the plant safety systems will continue to meet their design intent under emergency conditions. Also, because of the demands of more refined analytical techniques, backfits may be required to mitigate newly discovered circumstances.

Decommissioning is a long and costly process for which there are few international guidelines yet developed. Utilities facing this circumstance, therefore, tend to produce their own unique programmes which can be expensive, labour intensive and potentially hazardous.

### **3.3.3. Opportunities**

The potential of many existing NPPs for significant life extension is certainly capturing the imagination and investment of the business community. The management and execution of this process is a potential rejuvenator throughout the nuclear community as it offers secure long term prospects.

There may be the opportunity to bring in significant numbers of new staff to learn new methods and behaviour and refresh the culture of the operating plants. The challenge is to be innovative in developing ways to attract the new staff.

New solutions to spent fuel storage and waste handling are also being sought.

Mergers and acquisitions amongst nuclear utilities may encourage economies of scale and thus, to some extent, mitigate the loss of experienced people. Thus, technical expertise in areas such as refuelling outage management, support engineering and other areas may be able to be spread over a broader base without adverse impacts in those companies with several units.

The use of new technologies, both in the technical area as well as in the human performance and management fields, is an opportunity to attract new innovative staff. The technology, though yet to be fully developed for decommissioning, has potential applications in other industries that deal with hazardous by-products.

Also, in some cases significant fresh investment is being made to upgrade the safety and reliability performance of NPPs in order to extend the lifetime of a plant when justified from an economic perspective.

### 3.4. REGULATORY ENVIRONMENTS

*As the operating environment of NPPs changes, the regulatory framework is either shifting in response, or failing to shift in response. In either case, there is an impact on both regulators and operators as the previously established 'match' between operations and regulation is being disturbed.*

#### **3.4.1. Background**

Nuclear regulators are being forced to understand and react to the shifts that are taking place in the operating environments of NPPs. This is broadening their areas of interest and insight. Where they consider it appropriate, they are changing the regulations and introducing new methods and practices for oversight and enforcement. Both operators and regulators are therefore adapting, or struggling to adapt, to new realities. These changes can be expected to produce parallel changes in their relationship, which then becomes a secondary but equally important factor in the overall management of the facility and its safety.

In general, the shifts in regulatory attention and workload can be characterized as follows:

- Governance of NPPs: Changes in ownership, operating control, competitive marketplaces, financial guarantees for decommissioning, etc.
- Safety management and performance in NPP operation: New management practices, altered operation and management (O&M) budgets, grid reliability in deregulated markets, use of contractors, lay-up or return to service of plants, etc.
- Specific changes introduced by, or directly impacting regulators: New legislation, adoption of new standards or methodologies of oversight such as performance and process based regulation and risk informed assessments, new approaches to enforcement and the consequential potential decisions on the requirements for back-fitting of safety upgrades, changes in funding for regulatory agencies, etc. Regulators do not always introduce these themselves. Sometimes they are imposed on them by the government.

- Concern over the issues raised as the nuclear power industry matures: Physical ageing of components, R&D expenditures, management, storage and disposal of high level radioactive wastes and spent fuel, the supply of sufficient human talent for the long term, the development and maintenance of good safety culture within the operating organization, etc.
- Management of the relationship between NPP owner/operators and the regulator.
- International issues such as the Convention on Nuclear Safety, common technical standards, and co-operation and public relations.

Regulators are especially sensitive in ensuring that their actions or capabilities have positive impacts on safety. However, their impact is rarely entirely controllable from within. It is the combination of the regulator/licensee relationship and framework that actually enhances or degrades safety.

### **3.4.2. Problems and issues**

Taken together, the effects of this trend represent a major conceptual, managerial and administrative challenge for regulators, who are experiencing pressure to address significant numbers of new or emergent issues simultaneously. This is placing substantial pressure on their resources. Regulatory staff may lack the knowledge or resource capability to monitor, anticipate and manage the wide range of new and emerging issues, and this could lead to a loss of focus on operational safety. In some countries all this is happening while government funding to nuclear regulators is under review or is being reduced. This may lead to a reduction in the ability of the regulatory body to detect degradation in safety management before it reaches the performance stage, and may also inhibit the regulators' ability to exert influence at the senior management level in detecting such shortfalls.

The overall programme of change is largely being driven by governments, markets and NPP owners. Regulators are, therefore, often being placed in a position of being reactive to change, and this can lead to a loss of clear vision and direction. In these circumstances, existing regulations may appear to be mismatched to the emerging operating environments, and yet it is not easy to decide how and when to create new regulations. The regulator may decide to intervene in NPP management practices with insufficient insight or experience to produce the desired positive results, or regulatory questioning could distract NPP management in an already overstretched situation.

In a more competitive world, good commercial performance means removing all unnecessary costs and operating more efficiently and effectively, and also safely. The regulator may feel the need to react to this drive by 'compensating; with greater and greater levels of oversight and intrusion. Paradoxically, this may also deflect the NPP from its prime focus (and from its ability to deliver improved performance safely) that its commercial performance actually suffers. That in turn may tend to degrade the safety performance that both the NPP and the regulator wish to see improve. The regulatory staff can also become unsettled and distracted due to internal organizational change and the impact of external pressures.

Another factor is that there is a trend towards regulatory agencies recovering their costs from the licensees, which, if ‘micro-managed’, very easily leads to a lot of debate between NPP owner/operators and the regulator, and further ties up resources.

The nature of the regulations may be changing as new areas (e.g. environmental impacts) are being addressed, new overall perspectives such as moving from prescriptive to performance and/or process based regulation are being introduced and new standards are set. Sometimes there are interface issues, for example environmental regulation is often the responsibility of other government agencies. These in turn can negatively affect the operator. In some countries, new initiatives involving risk informed approaches form the basis for licensing and inspection regimes, which were formerly deterministically based. Some regulators now impose specific requirements on the licensee to demonstrate that there are no detrimental effects on safety prior to making organizational changes.

There is also the risk of the regulators becoming isolated from utilities. Excessive legalism could appear in the relationship, and open communications could be negatively impacted.

### **3.4.3. Opportunities**

As the industry changes and evolves towards an economically driven business, as a result of the previously described changes, so comes the opportunity for the regulator to shift from prescriptive regulation and/or performance monitoring to include more process evaluation and risk informed approaches where risk evaluation and consideration is built into the decision making processes. This is supportive of the industry insofar that it would generally place a lower financial and operational burden on NPPs while ensuring that safety standards were maintained.

There is an opportunity to rethink and redesign the role of the regulator and the nature of the regulation (e.g. standards) as the industry changes. Also, in some countries there will be the opportunity to separate the control of the regulator from the control of the utility, which is, for example, a requirement of the Convention on Nuclear Safety and is mentioned in IAEA standards.

As a result of shareholder sensitivity to potential reports of declining performance and the consequent potential trend by the licensee to be more secretive with such reports, the regulator may have to develop measures of performance which are completely transparent to the public. These could take the form of red/green rankings or test reports similar to those used in the consumer industry. The USNRC practice of displaying plant safety performance indicators on the Internet is a good example of such a practice.

Coupled with this is a unique opportunity to improve public confidence in the nuclear industry as a whole. As changes evolve, the owner/operator and the regulator can manage the process with a high degree of transparency and public involvement, using much improved communication tools. This transparency can be transformed into a learning environment for public acceptance and trust of the industry as a business.

## **4. RECOMMENDATIONS FOR STRATEGIC ACTIONS/PRIORITIES FOR FUTURE WORK**

### **4.1. SUPPORT FOR SAFETY CULTURE PRINCIPLES**

In this time of substantial change and future challenge, it is important that the principles of effective safety management be reinforced. The concept of ‘safety culture’ has been emphasized in order to recognize that in matters of nuclear safety ‘everything matters’. A number of organizations operating NPPs have not, however, fully embraced the concepts of safety culture at a corporate policy level. However, this is an ideal time to move that process ahead, and the IAEA could take a leading role, along with other international organizations such as the World Association of Nuclear Operators (WANO) and the OECD Nuclear Energy Agency (OECD/NEA) in facilitating the process of understanding and building global commitment to safety culture principles.

### **4.2. INFRASTRUCTURE SUPPORT**

Under the Convention on Nuclear Safety, signatory States have a responsibility to support the infrastructure necessary for nuclear safety. This includes ensuring that adequate financial resources are available to support each nuclear installation throughout its life, and also includes ensuring that a sufficient number of qualified staff with appropriate education and training is available.

These obligations have largely been established through licensing requirements placed on licensees. However, as governments introduce new operating environments through such activities as market deregulation, early plant closures and economic restructuring, the ability of the licensee alone to meet these requirements can be compromised. This may call for a fresh look at how the entire industry is being steered by the combination of accountable stakeholders (governments, owners, operators and regulators).

In some countries, the technical R&D support for the nuclear power industry has been largely government funded. This support may be shifting due to changes in the industry, but new issues related to ageing, decommissioning and waste storage are still emerging and require attention.

The IAEA, along with other organizations such as the OECD/NEA, can take a role of facilitating broad spectrum reviews of the issues surrounding infrastructure support in a changing environment.

#### 4.3. STRONG LEADERSHIP

The greatest accountability for nuclear safety still falls on the plant management. There are many industry and IAEA programmes for exchange and for peer review of management and leadership practices. These need to be fully supported and strengthened as the industry moves ahead, and the openness and transparency of the industry to the public must be encouraged despite possible business pressures to do otherwise. Again, the IAEA is able to support the required exchanges and to facilitate the development of guidance documents.

#### 4.4. CO-OPERATION

There could be a tendency for the industry to fragment as it deals with differing challenges. However, it is still very much a business where a safety incident anywhere is an issue for everyone involved. Some plants are still in need of significant financial and other support from sources outside their direct control. There need to be mechanisms whereby this support can be requested and provided.

#### 4.5. EFFECTIVE REGULATION

The nature of regulation has a significant impact on real safety issues, and on management practices. The trends that have been discussed are having a significant impact on regulatory agencies, and there is a particular need for co-operation and exchange as they set new directions for the future. The IAEA, along with other organizations such as the OECD/NEA, should continue to provide forums for regulators to share their insights and experience.

#### 4.6. IMPORTANCE OF COMMUNICATION

It is crucial during times of change that communications between the industry and regulator be open and transparent and that processes be in place to ensure this occurs. Communication between utilities, the public and the media is to be encouraged to counter the public perception that they do not have a need to know about nuclear matters and safety.

#### 4.7. ROLE OF THE IAEA

The mission of the IAEA is to assist Member States in the safe operation of NPPs and in meeting the challenges of the new business environment. In co-operation with other international organizations such as WANO, OECD/NEA, etc. the IAEA can support the safety of NPPs by identifying the key issues confronting stakeholders, providing guidance on effective practices, providing forums for utilities, regulators and governments to consider their directions, providing support for safety in their decision making processes and sharing insights and experiences. Also, to provide safety related services such as operational safety reviews (OSART), international regulatory reviews (IRRT) and operating experience and safety culture enhancement support.

## 5. QUESTIONS TO THE CONFERENCE

- What are the most effective methods of maintaining safety during times of externally imposed change as is presently being experienced? The promotion of the concept of good management of safety and safety culture is being promoted by the Agency as one answer to sustain continuous improvements in safety and performance standards under such conditions. Is this approach in fact effective and sustainable? What are its vulnerabilities and how can they be removed?
- How can the nuclear industry attract new talent to effectively halt the loss of expertise as a result of retirements and downsizing? What is the role of the IAEA in this challenge?
- What is needed to assist the industry in establishing consistently safe, effective, efficient and cost effective decommissioning programmes? Would the IAEA's help be useful in this area and, if so, what kind of priority should it be given?
- Some regulators are changing their regulatory strategy from the prescriptive approach, through results based, and onto process oriented methods. This is, in part, dependent on the maturity of the regulator and the licensees, but such a trend would assist the nuclear industry in facing future challenges as it tends to be less intrusive and burdensome on the industry. Is this a direction suitable for all regulators to follow? And is the potential risk of licensees not fully understanding the nature of this new environment, and allowing safety margins to possibly decrease under competing pressures for increased production, acceptable?
- The IAEA and other organization services such as WANO rely heavily on the dissemination of technology and information between utilities in order to promote improved performance. What strategies should be adopted by the IAEA in order to ensure that this information exchange between nuclear utilities is not stifled by competitive pressures?
- Nuclear power presently supplies 16% of the world's electricity. Nuclear power plant safety and performance have improved dramatically in the last ten years, and in some countries excellent environmental and business results are also being achieved. The political decisions for the premature shutdown of some plants is, in some cases, highlighting the lack of viable alternative sources of power. How effectively is this being broadcast to the public, political and business community? Is there a role for the IAEA in this effort?

## REFERENCES

- [1] OECD NUCLEAR ENERGY AGENCY, Nuclear Regulatory Perspective on Deregulation of the Electrical Supply Industry, draft report, OECD, Paris.
- [2] INTERNATIONAL ATOMIC ENERGY AGENCY, Managing the Early Termination of Nuclear Power Plant Operation (Proc. Workshop Greifswald, 2000), IAEA, Vienna, 2000.
- [3] INTERNATIONAL ATOMIC ENERGY AGENCY, Nuclear Power Plant Ageing Management Programme, Safety Reports Series No. 15, IAEA, Vienna (1999).