EUROPEAN COMMISSION

nuclear safety and the environment

Regulatory Assessment of the Effects of Economic Deregulation of the Nuclear Industry

Nuclear Regulators' Working Group (NRWG)
Task Force Report

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The views expressed in this report are those of the authors and do not necessarily reflect those of the European Commission

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1 EXECUTIVE SUMMARY

The European Commission's Nuclear Regulators' Working Group (NRWG) appointed a **Task Force (TF)** to develop a common view among European regulators on the assessment of typical safety consequences resulting from economic pressure on operators as a result of deregulation of electricity markets. Although the report seems to imply that there are only negative aspects of deregulation, this is not the case. As the focus of the TF has been potential safety consequences we have not dealt with potential positive effects of deregulation.

To provide a general background to the analyses of the safety consequences , the TF undertook **a survey** of the current situation within the EU and candidate countries on aspects of economic deregulation of the countries' nuclear industry and the experiences so far of regulating these issues. Answers were submitted in of July 2001. 13 NRWG members with nuclear power plants took part in the survey.

1.1 Summary of the Survey Results

The survey clearly indicated that the issue of economic deregulation of electricity supply and distribution industry with its potential consequences for nuclear safety was highly topical, but with no consistent policy emerging. As a result, existing nuclear power generation companies in a country were either privately owned, government owned or a mixture of public and private ownership. Similarly, the degree of deregulation of the electricity market also varied between countries from being fully deregulated to being totally state controlled. Likewise there was not a common policy on the construction of new nuclear power stations.

The survey indicated a number of issues that had arisen in more than one country. One common example of an effect attributed to deregulation was pressure to increase the availability of plants for electricity production. As a result several operators were seeking to reduce refuelling outage time and investigating the greater use on-line maintenance where this was practicable. In some instances there was evidence of increased resistance from operators to consider plant back fits and other safety improvements that did not have a direct effect on production efficiency.

Organisational change and the use of new management tools were observed in many countries. There were also several reports of reduction in the comparative level of competent staff in the operator, vendor and technical support organisations. Similarly, there was a concern related to the potential future loss of corporate knowledge arising from reductions in staffing levels in operator organisations. Consequently, the countries considered the preservation of the design basis knowledge as an important challenge. Issues also arose from the increased use of contractors for safety related work. In this respect the majority of the countries recognise the impact of the corporate staffing policy on the level of contractor usage.

Countries' regulatory systems for addressing the three issues of nuclear safety, the electricity market and electricity grid operation, were found to vary widely. However, a common feature was that different regulatory bodies regulated each of the three issues separately. In most cases the market regulator could make decisions without reference to and consultation with the safety regulator. However, in some countries

precautions had been taken so that the market regulator could not impose requirements with potentially negative effects on nuclear safety.

Deregulation had increased the merger activity within countries' energy sectors and some mergers had also resulted in changes in nuclear power plant ownership. Regulators also reported that some indications of adverse effects on staff levels, excessive use of contractors and outsourcing had been seen. This was more prominent in those countries where the electricity market had been deregulated the longest. As a response some regulators found it necessary to adapt, changing one or more of the following actions: inspection programmes; major safety audits; enforcement actions; or introduced licence conditions to regulate organisational change.

In many non-EU countries, where electricity markets were deregulated, nuclear power plant operators claimed that nuclear power productions suffered from a "regulatory burden" in the form of unduly conservative design criteria, and operation and maintenance requirements. This had not become a strong common theme in EU countries, although in a few countries suggestions had been made to put more emphasis on risk-informed regulation.

1.2 Typical consequences, generic safety issues and regulatory approach

Although the situation varies between the different countries the questionnaire gave evidence of many different changes taking place as a result of economic pressure on operators. Experience indicates that this is putting regulators in new and maybe unfamiliar situations.

The generic safety issue associated with a **change in ownership and permit to operate** arises from the new owner or licensee's potential lack of resources, be they financial, organisational or concern technical knowledge. It is crucial that the legislation regarding ownership and permit to operate cover all these aspects. The regulator should also be allowed to make decisions or give advice to the deciding body regarding changes in ownership and new licensees. **Outsourcing** presents similar generic safety issues, but here the focus of interest is centred at the licensee's ability to keep and develop enough competence within its organisation to maintain full control over safety in the short and long-term perspective. The issue of **downsizing** is also associated with concerns regarding resources and competence: fewer resources dedicated to safety-related activities and reduction of technical knowledge. Another concern is that psychological and safety culture side effects may occur.

In order to effectively regulate changes in ownership and permit to operate, outsourcing and downsizing the regulatory body should have the appropriate legislation to allow flexible regulation in an area where the situation changes rapidly, and where the need for legislation may not have been previously noticed. These consequences also put new demands on regulatory competence (for example, organisation, finance, and human factors that traditionally may not have been necessary for the regulators to consider in any great detail).

Although the TF did not discussed the issue of what actions a regulator should take if a licensee goes **bankrupt**, it must be recognised that it is important that legislation

can deal with such an event in an open market. The financial capacity of the owner/licensee and its capacity to exercise control of the finance and safety of operations are crucial questions here. The long-term perspective of nuclear waste must also be considered.

The effort for cost reduction and increased efficiency also has affected technical areas. **Changed operational and maintenance strategy** are examples where if they are not properly analysed such changes might have unexpected effects on plant safety. This accentuates the role of the Safety Analysis Report and whether the existing analyses cover the new strategy. One effect may be the requirement to increase attention to root cause analysis of equipment failures and plant incidents.

Delay of backfitting programmes is another effect of cost reduction that may have consequences on technical safety as well as safety culture. The regulator is faced with a heavier burden of defining necessary safety improvements and may need to reconsider its regulatory strategy. In some cases utilities are reconsidering traditional maintenance and inspection procedures, which have been based on deterministic approaches and target all components that are significant to safety. Instead, they are considering concentrating effort on components that seem more likely to need attention. This is an example of a tendency to move **away from deterministic design and assessment** towards probabilistically based arguments. The major safety challenge associated with removing deterministic design criteria is that it is necessary to understand the safety reasons for the deterministic requirements and ensuring that such safety reasons have been addressed in the new criteria. This means that the regulator must develop a clear policy towards the use of PSA in the development of existing nuclear power plant systems and operating and maintenance procedures and programmes. The regulator must also ensure that it has the necessary expertise available to assess safety cases justifying change in this respect. Regulators have also experienced an increase in applications for **exceptions from tec specs and LCO**.

1.3 Recommendations for the future

Although deregulation is not the only reason why nuclear operators have intensified their efforts to reduce costs and become more efficient, it is clear that the industry is changing and that regulators must be prepared for new situations.

The TF has identified that the effort for cost reduction and increased efficiency has affected financial, organisational and technical areas as well as the relationship between regulators and licensees. The TF believes that there will be a number of innovative ways in which the licensees will try to rationalise and cut its on costs. As a result, the regulator must be prepared to address new issues as they appear before the issues adversely affect safety.

As the situation varies to such an extent between the countries, prioritising between deregulation and other safety issues must follow from the assessment of the national situation.

The TF suggests regulators take a proactive view and think in terms of legislation and approaches that will account for several situations even if they have not yet been encountered: try to cover all organisational change important to safety rather than to specify each example.

The TF suggests regulators should continue sharing experiences in this area. We suggest that NRWG organise a workshop during 2003. Also, collaboration and sharing information with other relevant organisations and groups should be considered.

2 INTRODUCTION

The European Commission's Nuclear Regulators Working Group (NRWG) appointed a Task Force **(TF)** to develop a common view among European regulators on the assessment of typical safety consequences resulting from economic pressure on operators as a result of economic deregulation of electricity markets. Although the report seems to imply that there are only negative aspects of deregulation, this is not the case. As the focus of the TF has been potential safety consequences we have not dealt with potential positive effects of deregulation.

The TF came to the view that the overall effect of deregulation on the nuclear power industry could be described in terms of fluctuations in the price of electricity and thus income for the power industry. These fluctuations are not easy for power station operators to forecast which in turn has led to an increase in uncertainty. This effect has forced nuclear power station operators to focus on financial issues and in particular cost reduction. It has also encouraged them to make changes to their present operating structure in order to find more efficient and lower cost solutions. The pressure to reduce nuclear generation costs may also mean a reduction or delay in planned investments in plants unless these are considered good value in terms of providing positive financial returns on investments. Depending on national regulations and regulatory practice, licensees will submit such changes to the regulatory body for approval or the regulator will identify them in other ways. Anyhow, the regulatory body will have to assess the effects of changes from a safety point of view. In order to do this, clear legal safety requirements on the operator and clear acceptance criteria from the regulator are needed.

The TF has tried to identify the important generic safety aspects of some typical changes to the nuclear power industry resulting from economic deregulation and the consequential pressure to reduce costs. In addition the TF has discussed reasonable acceptance criteria for deciding the acceptability of changes from a safety perspective.

To provide a general background to the analyses of the safety cases, the TF undertook a survey of the current situation within the EU and enlargement countries with regard to aspects of economic deregulation of the countries' nuclear industry and the experiences so far of regulating these issues. A summary of the results of the survey is included in Section 3 of this report.

The TF distributed the questionnaire at the end of May 2001 to the nuclear regulator in all countries represented on the EC's Nuclear Regulators Working Group. Answers were to be submitted by the middle of July 2001. 13 NRWG members with nuclear power plants took part in the survey.

Some of the questions were difficult to answer in such a short time, as they required several experts' opinion and industry input as well. Some of the questions asked for evidence of effects, for example of increased competitive pressures to reduce operating and/or maintenance costs. Most countries gave negative answers to these questions. It is, however, difficult to interpret the answers as there may be cases of

indications of adverse change but the regulators may not feel they have sufficient proof or evidence of safety erosion to act.

In some cases the situation in a country changed after the questionnaire was answered. In a few cases known to the TF members the changes have been included as footnotes in this report.

Bearing all this in mind, the TF considers that this report contains valuable experience from the countries that have answered the questionnaire. Other consequences may appear in the future.

Members of the TF were: Lucian Biro, National Commission for Nuclear Activities Control (NCNAC), Peter Dickenson, Health & Safety Executive, Mr Philippe Goedertier, Association Vinçotte Nuclear (AVN), José Antonio Gómez, Commission européenne, Timo Karjunen, Radiation and Nuclear Safety Authority (STUK), Jozef Kubanyi, Slovak Nuclear Regulatory Authority (UJD SR), Annika Ovegård, Swedish Nuclear Power Inspectorate (SKI) and Teresa Sanz, Consejo de Seguridad Nuclear (CSN).

3 THE SITUATION WITHIN PARTICIPANT EUROPEAN COUNTRIES

As reflected in the answers to the questionnaire.

3.1 National Situation

3.1.1 Nuclear Industry Size

Country	Number of NPPs[1]	NPP net power [MWe]	Nuclear share in electricity production approx. [%]	Notes
Belgium	7	5 850	57	
Bulgaria	6	3 532	45	
Finland	4	2 656	28	
France	58	62 950	75	
Germany	19	16 900	33	
Lithuania	2	2 370	74	
Romania	1	706	11	
Slovakia	6	2 424	56	
Slovenia	1	670	37	
Spain	9	7 749	30	
Switzerland	5	3 077	40	
Sweden	11	9 819	47	
UK	33	12 600	20	Can be up to 26%

3.1.2 Policy on the construction of new nuclear power stations

National policy on the construction of new nuclear power stations in the countries fell into one of three positions:

1. Belgium, France, Germany, Slovenia, Sweden, and Switzerland did not have plans to construct new stations, or their governments had decided to postpone indefinitely the authorisation to construct them.

2. Slovakia, Spain, and the UK again did not have plans to construct new stations. However, new stations could be built if private companies wanted to build them and could privately fund the building costs and meet the regulatory requirements.

[1] Nuclear Power Plant; as a matter of fact, this is number of reactor units

3. Bulgaria, Finland, Lithuania and Romania had plans to build new nuclear power stations. Bulgaria had a plan, based on an updated National Energy Strategy, to erect a 950 MW nuclear power station to replace the capacity of Kozloduy Units 3 and 4. Lithuania was considering whether or not to build, by 2009, new nuclear energy capacity to replace its RBMK-type reactor units. Romania's national policy was to complete the commissioning of Cernavoda Unit 2 as a short-term and medium-term priority. In the long-term, the government was considering the possibility of continuing construction works of at least Cernavoda Unit 3. Finland has plans to construct a new station. [1]

3.1.3 Ownership of nuclear power stations

Ownership of nuclear power stations within the countries included in the report have been divided into four groups:

1. The first group contained countries where nuclear power stations were government owned and in all these countries there was only one nuclear operator: Bulgaria (Kozloduy NPP plc.), France (EDF), Lithuania (Ignalina NPP), Romania (SNN), Slovakia (SE a.s.) and Slovenia (NPP Krsko). However, privatisation of the Slovak nuclear power plants was being prepared.

2. The second group covered two countries, Belgium and Spain, where the nuclear power stations were privately owned. In Belgium there was a single nuclear operator (Electrabel) whose shares were owned by another company and by members of the public. The shares were traded on a stock market. In Spain there were five nuclear operators (Iberdrola, Union Fenosa, Almaraz-Trillo, Asco-Vandellos and Nuclenor) owned by electric companies. The shares of the electric companies were traded on a stock market.

3. In the third group there were three countries (Finland, Sweden, and the UK) with mixed ownership of nuclear power stations, with some owned by government and others owned by private companies ***or*** municipal entities. Finland had two operators. One was Fortum Power and Heat Oy, owned by Fortum with 25 % of its stock traded on the stock market. The second one was Teollisuuden Voima Oy, whose shares were not publicly traded. Sweden had four nuclear operators. Barseback Kraft AB operator was owned by another operator, Ringhals AB company. The other operators, OKG Aktiebolag and Forsmarks Kraftgrupp AB were owned by several companies. The shares of some of the owner companies were traded on the stock market. In the UK there were three operators. Two of them, British Energy Generation Ltd. and British Energy Generation (UK) Ltd. were owned by British Energy plc. Another operator, Magnox Electric plc was owned by BNFL, which in turn was wholly government owned. The shares of British Energy were traded on the stock market.

[1] The parliament has made a decision of principle and the utility (Teollisuuden Voima Oy) will apply for a construction licence.

4. The fourth group covered two countries, Germany and Switzerland. Their nuclear power stations had a mixed private ownership (by public limited companies) and public ownership (in Germany by some town councils and boroughs and, in case of Switzerland, by cantons and other public entities). In Germany operational management was executed either directly by the plant owners or by operating companies[3] that were subsidiaries of the (majority) owners. In some cases, other power utilities were shareholders. The proportion of shares owned by public institutions was low. The shares of some nuclear power plant owners were traded on the stock market. In Switzerland there were four operators: Nordostschweizerische Kraftwerke AG; Bernische Kraftwerke AG; Kernkraftwerk Gosgen-Daniken AG; and Kernkraftwerk Leibstadt AG. The shares of the owners, which can also be other companies, were not publicly traded on a stock market.

Any restrictions on the ownership may be an important issue for deregulation. Only four of the relevant countries provided information on restrictions. A change in ownership in Belgium and Spain would require a new authorisation to operate the nuclear power station. In the UK, the owner had to be a corporate body and had to be deemed to be suitable to be a licensee by the regulator (this was the position in Slovakia as well). In Lithuania law, nuclear power stations "shall be owned by the State".

As far as an ownership transfer from the government to the private sector was concerned, the situation in some countries was worth mentioning. Finland was going to sell 25 % of its government-owned stocks in Fortum, but the time schedule was not known. In Slovakia, the transfer of stock into private ownership had recently been considered and an effort had been made to accelerate the process of transferring ownership into the private sector, however, so far no time-scale had been declared. In Switzerland, the process of transferring regionally and publicly owned utility companies into privatised companies continued. Trend towards corporate merges could be observed in Germany, Spain, Sweden and Switzerland.

3.1.4 Economic deregulation of electricity supply and distribution industry

The major regulatory concern arising from the economic deregulation of electricity supply and distribution industry was how to control the potential consequences for nuclear safety. In terms of deregulation, the participated countries could be divided into two groups as follows.

The first group contained countries that had already deregulated part or all of its electricity supply and distribution industry: Belgium, Finland, France, Germany, Slovenia, Spain, Sweden, and the UK.

- In Belgium the electricity market was deregulated for large industrial customers and the process of total deregulation should be completed in 2003.

[3] Neither the number of operators nor their particular identification was available to the authors when preparing this report

- Finland had deregulated all its electricity supply. However, since distribution was partially separated from supply and was not deregulated, an energy market authority monitored it.

- France had deregulated the electricity market for very large customers.

- Slovenia's internal market had been opened and its electricity market for external producers should become open in 2003.

- Germany, Spain, Sweden, and the UK had already deregulated their electricity markets.

The second group comprised countries that were going to deregulate in the near future: Bulgaria (2002), Lithuania (2001)[2], Romania (2003-2004), Slovakia (2002 or 2003), and Switzerland (2002 or 2003).

3.1.5 Trading arrangements

Trading arrangements were seen as being a consequence of the above ownership characteristics and the position of the electricity industry in terms of deregulation. Hence, countries with a deregulated electricity industry trading arrangements allowed market regulation whereas countries with a government regulated industry and public ownership of the electricity production trading arrangements had different ways of fixing prices by public institutions.

As with other information used to prepare this report, the details of trading arrangements in each of the countries in the study can be found in appendix [] to this report.

In Finland, Germany, Spain, Sweden and the United Kingdom electricity prices were established in a competitive wholesale market, which was regulated differently in each of them. The remaining countries established the prices of electricity by agreements between the producers and government or public institutions. The agreements differed from country to country.

Regarding the government power to modify the electricity prices, again there were different approaches in different countries:

1. Modification power through taxes (Finland, Germany and Sweden).

2. Direct setting or modification of prices by the government or public institutions (Belgium, Bulgaria, France, Lithuania, Romania, Slovakia and Slovenia).

3. Modification of prices in special circumstances (Spain and Switzerland).

4. Government without power to modify the electricity prices (the United Kingdom).

[2] 2001 is the year in which the questionnaire was answered

The price of electricity had decreased in those countries with a deregulated electricity industry after deregulation (Finland, Germany, Spain, Sweden and United Kingdom), mainly for large consumers, but recently there had been a trend for the average price to increase.

In countries without a deregulated industry prices had not changed significantly, except in Switzerland, where there was a downward trend of prices for large customers.

3.1.6 Grid Structure

The high voltage distribution grid had different ownership structures from country to country. In some cases it was publicly owned (Bulgaria, France, Lithuania, Romania, Slovakia, Slovenia and Sweden) and the owner was the government or public companies. In other cases the grid was privately owned (Belgium, Finland, Germany, Spain and United Kingdom). In Finland the distribution grid is owned by a dedicated company, which has both public and private companies as shareholders.

In all cases there could be just one or several owners. Where there were several owners of a national grid this was either at the national, regional or local level within the countries.

Grid stability everywhere was the responsibility of the grid operators and owners, who were obliged to meet the technical requirements and constraints. The nuclear operator in Spain did not monitor grid stability and its effects on nuclear plant operations. In some other countries the operators had analysed the effects of grid instability on plant performance (Bulgaria and Finland).

The remaining countries monitored grid stability and its effects on nuclear plant operations without further explanation about how they did it.

Some countries did not provide information about the stability and reliability of their grid system. However, regardless of having a deregulated industry or not, all of them indicated that the performance of their grid was good and where there has been deregulation, it has not had an effect on the grid performance so far. In the United Kingdom, the grid performance had improved.

3.1.7 Financial aspects for safe operation, decommissioning and radioactive waste and spent fuel management

Countries had different ways of covering the costs of decommissioning, radioactive waste management and spent fuel management. The methods were by:

1. Provisions made in the accounts of the operator companies (Belgium).

2. Establishment of funds independent of the State budget but government controlled (Bulgaria, Finland, France, Germany, Lithuania, Slovakia, Slovenia, Sweden and Switzerland). The funds were financed by the nuclear power stations according to the amount of electricity they produced.

3. Establishment of a public company in charge of decommissioning, radioactive waste management and spent fuel management, funded with a percentage of the electricity price (Spain).

4. Setting up a segregated fund for the privately owned generating companies to cover decommissioning costs that was independently audited (the United Kingdom).

Countries used different approaches to judge a potential operator's financial ability. For example:

1. Use of well-known operators and reliable companies. Their financial situation had not been evaluated on the basis of specific requirements (Belgium and Spain).

2. Assessment of financial aspects when the operating licences were granted (Finland, Romania, Sweden and the United Kingdom).

All countries were able to intervene when safety of a plant is seriously at stake, but only Germany indicate that this could happen on the grounds also of financial problems of a nuclear company. The other countries indicated that lack of safety only would justify their regulative actions regarding an operating plant.

3.1.8 Public awareness

In most of the countries (Belgium, Finland, Romania, Slovakia, Slovenia, Spain, Switzerland and Sweden) the deregulation or potential deregulation had not initiated a renewed public interest in nuclear safety and the regulatory system.

Only the United Kingdom reported a general public heightening of awareness in its deregulated industries. Before privatisation of part of the nuclear industry there had been public and media debates.

3.1.9 Conclusions

1. Countries with the largest or significant nuclear industry size in terms of nuclear share in electricity production (Belgium, France, Germany, Slovenia, Switzerland, and Sweden) had no plans for constructing any new nuclear power stations. Similarly, other countries with a significant nuclear share (Slovakia, Spain, and the UK) were not planning the construction of new stations, but in principle, they could be built if private companies wanted to build them and were able to fund them. Bulgaria, Finland and Romania intended to construct some new nuclear power stations. Lithuania was considering whether or not to build new nuclear energy capacity.

2. With regard to ownership of nuclear power stations, in most of the countries they were either privately owned (Belgium, Spain) or there was a mixture of government/public entities and private ownership (Finland, Germany, Sweden, Switzerland, and the UK). It should be mentioned that several companies could be the owners. Except for Switzerland, the shares of the private owners of nuclear power stations were traded on a stock market. A change in ownership would require a new authorisation to operate the nuclear power station in Belgium, Spain, Sweden and the UK. In other countries (Bulgaria, France, Lithuania, Slovakia, and Slovenia), nuclear power stations were in government ownership. Nevertheless, privatisation of the Slovak nuclear power plants was being prepared.

3. In countries with deregulated electricity industry trading arrangements were based on a wholesale market, but, except for the United Kingdom, the government had some power to modify the electricity prices.

4. Deregulation had not had any apparent impact on grid stability and reliability. Recent experience in Sweden indicates that stability margins had decreased and to compensate for this the grid regulator had had to buy or lease additional production capacity.

5. Independently from the degree of deregulation in each country, the cost of decommissioning and waste and spent fuel management was addressed either by establishing special funds financed by the plants, or by creating companies to deal with the subject, financed by means of the electricity price.

6. The operators' finances were assessed mainly when the operating licences were being granted.

7. In general, there was not a heightened public awareness of the safety regulatory system after deregulation.

8. The conducted survey clearly indicated that the issue of economic deregulation of electricity supply and distribution industry with its potential consequences for nuclear safety was highly topical at present.

3.2 Industry Issues

3.2.1 Recruitment of senior utility executives and plant managers and their awareness for nuclear safety / Regulatory requirements

Most countries reported that new senior utility executives, in particular plant managers, had extensive experience in the nuclear industry or that there have been no new recruitment. Only Sweden and the UK reported the recruitment of senior utility executives or plant managers who were new to the nuclear industry.

In Finland and Sweden, plant managers must have participated in a training programme organised by the utility, which included courses on nuclear safety in relation to their responsibilities. In Finland the regulator also gave some courses.

In Sweden, plant managers were made aware of their responsibilities through individual training programmes at the plants and through meetings with the regulator's management. There are also regulatory requirements regarding competence.

In most countries staff were required to have minimum education and qualifications by the regulator, especially for utility plant manager posts. For higher-level posts, the regulators imposed no detailed requirements.

3.2.2 Changes in staffing levels over the last five years

In Bulgaria and Romania, the corporate structure and staffing levels changed significantly as a result of restructuring of the energy sector and the creation of independent organisations for the operation of NPPs. These changes resulted in an increased responsibility for the nuclear operators and forced them to create additional management levels and structural units. Other countries, such as Belgium, Spain, Sweden and the UK, reported reductions in site staffing levels. The remaining countries reported no changes.

The majority of the countries reported no changes in control room staffing levels.

In Belgium, Spain, Sweden and the UK, the number of staff providing technical support had been reduced. In Sweden, however, this reduction of external resources had been compensated by an increase in the number of technical staff working for the utility. Slovenia also reported an increase in technical staff. The other countries reported no significant changes.

Belgium, Finland and Switzerland did not monitor the number of staff working for suppliers and consultants. Romania, Slovenia and Sweden had noticed a trend towards reduction of staff working for suppliers and or consultants. On the other hand, in Bulgaria the number of staff working for suppliers and consultants had increased. In the UK and in Germany the utilities tended to rely to a greater extent on contractors. France, Slovakia and Spain observed no significant changes.

3.2.3 Impact of deregulation on plant capacity factors

For most of the countries profitability was an important objective for NPPs. As a result there had always been pressure to optimise and, where possible, to increase plant capacity factors.

In some countries, however, deregulation caused utilities to look even closer at all opportunities to increase availability of the NPPs. This was the case in Germany, Romania, Slovenia, Spain and the UK. Germany noted that plant capacity factors could only be achieved by improvements to operational management and an adequate emphasis on improving nuclear safety.

3.2.4 Impact of deregulation on work processes, outage planning, overall management of day-to-day operations, maintenance policies and training

In France, Germany, Slovakia, Slovenia and Sweden, deregulation of the electricity market had not resulted in changes to work processes. However, new management tools had been introduced in some other countries: a management process to increase efficiency in Romania; a self-assessment procedure in Spain; quality assurance and process management systems in Switzerland; and computerised management systems in the UK. Belgium, Bulgaria and Finland had implemented new organisational structures. Important objectives of these new organisations were to optimise the available manpower and to standardise work procedures.

France, Lithuania, Slovakia and Switzerland did not provide information on changes to outage times. However, Sweden was making a continuous effort to reduce outage time. This was achieved by improving preparation, planning and organisation of the outage activities and / or by selecting more suitable or appropriate contractors.

Except for those countries where the utilities changed their organisational structure (Belgium and Bulgaria), only a small number of participating countries experienced modifications to the overall management of the day-to-day operations. In Romania, a Management Configuration Control System was being considered for final implementation. In the UK, some night shift maintenance had been moved to day shifts.

In Romania, Slovenia, Spain and the UK deregulation resulted in an augmented use of on-line maintenance. In the other countries (Belgium, Bulgaria, Finland, Germany and Sweden) deregulation had had no impact on the amount of on-line maintenance that was being carried out. Also in the UK the privatised operators were looking to change shift patterns by investigating the use of 12-hour shifts. This change will have to be acceptable to the regulator. Further information on this topic is given later in the report.

In Belgium, Bulgaria, Finland, Germany and Sweden no significant changes to the training programmes had occurred. In Romania, a review and update of the training programmes and an improvement to the plant specific simulator was performed. Slovenia has installed a plant specific simulator and the number and duration of the training sessions had been increased. Spain established minimum requirements for training of staff performing safety related activities and in Sweden and the UK, a tendency existed to move from centralised to decentralised training.

3.2.5 Evidence of de-coupling between business managers with authority for economic decisions and plant managers with respect to nuclear safety responsibilities

None of the participating countries reported having experienced evidence of de-coupling of business managers with authority for economic decisions and plant

managers having responsibilities for nuclear safety. Although only Switzerland mentioned explicitly an increased emphasis on economic considerations at all management levels, this tendency probably also existed in other countries (e.g. Belgium).

3.2.6 Indications of changes in nuclear technology infrastructure

The majority of the countries reported the first indications of the deregulation effects on nuclear technology infrastructure. These indications were represented by changes to the competent staff in operator, vendor and technical support organisations. In general the infrastructure changes led to the loss of competent staff, primary at the level of senior personnel and management staff. In some countries these indications were not yet significant, but major changes were expected in a few years, when a relatively large fraction of staff would have retired. There were some examples of countries, for example, France and Slovakia, which had no concerns with respect to a lack of staff in the near future. However, the tendency could be observed that all suppliers and manufacturers were scaling down their capacities.

The majority of countries recognised that fewer competent people were interested in joining the nuclear industry. The major concern was that year by year fewer junior engineers and technicians were entering the profession. In countries undergoing economic transition, society liberalisation had lead to increased pressure from highly qualified staff leaving the organisation for developed countries. However this was not yet a dominant tendency and actions were envisaged to prevent this effect increasing. As far as the regulator was concerned there were still continuing problems in keeping qualified staff and hiring new staff because the salaries were lower than in the nuclear industry. For both industry and regulator there were important difficulties in maintaining the best-qualified university graduates inside their organisation and not to go to the national private sector or abroad.

The majority of countries reported no changes in the design basis knowledge of the operator. However, concern was expressed regarding the loss of corporate knowledge. Countries consider the preservation of the design basis knowledge was an important challenge. In this context, countries had started to take appropriate measures to prevent the reduction of the operator design basis knowledge.

Countries were taking different approaches as follows:

- setting up a Knowledge Management project;
- maintaining operator knowledge by continuous activities within the nuclear power plant modernisation programmes;
- transferring periodic safety review activities from contractors to the utilities;
- developing specific programmes to maintain the utilities capabilities for nuclear power plant configuration control; and
- staff training.

The changes to safety research sponsored by operators on safety related topics were strong dependent on the national policy in the nuclear sector and by the policy at the operators' corporate level. In the case of the countries with nuclear power plant undergoing modernisation programmes, the operators had taken measures to diversify finance sources and means to cover their needs for safety research in the field of nuclear safety. In the case of countries where the centralised economy mechanisms were not fully replaced by new ones there were co-ordinated research programmes on basic medium and long-term aspects with government co-ordination, in which both the research institutes and operators were directly involved. There was also an increased flow of direct contracts between the operator and the research institutes to solve urgent current operating issues. In some countries the resources were gradually decreasing and were increasingly used in applied research or the pressure to reduce safety research was observed. There were a few countries with no specific changes to their safety research that was sponsored by operators on nuclear safety related topics.

Only three countries, Finland, Slovakia and Spain, reported no changes in the nuclear competence of their universities. The other countries reported that in general, there was less interest in studying nuclear engineering, which had resulted in fewer nuclear engineering courses. Also declining numbers of students wanting to study nuclear disciplines had resulted in a reduction in teaching capacities. The reduction in the number of universities with nuclear competence was not only due to deregulation. The national policy on nuclear power had a strong impact on maintaining the nuclear competence at universities. In the case of some countries the universities manage the changes using various mechanisms based on their own internal programmes or having PHARE support from programmes likes TEMPUS, SENECA etc. Also, their interface with the operator had increased from joint activities on plant staff training and by early orientation of graduates to plant problems. However, in general, with only a fewer students choosing to study nuclear engineering many universities had found it necessary to close their nuclear courses. The potential problem had been recognised in some countries and actions were being taken by Governments, regulators, industry and universities to address it.

3.2.7 Changes resulting in the use of contractors for safety related work that was previously undertaken in-house or vice versa

The majority of the countries recognised the impact of the corporate level policy on the magnitude of the contractors – utilities relations. Some utilities intended to significantly reduce their staffing levels, which would inevitably result in greater use of contractors. However, in one case the operator had developed its own knowledge and capabilities and assured resources for performing some of the safety related work in-house that had previously been undertaken by contractors. This change in policy was not directly related to deregulation. In other cases the operator was doing more construction and advanced types of work, while simpler tasks were increasingly subcontracted. Also, in order to counteract the decreased capacities of manufacturers and vendors, attempts were made by the utilities to build up their own specific know-how. In the countries in economy transition, there were important problems to be solved in this interface due to the fact that the market rules were not yet fully operable in their economies. In this case, approaches had to be continuously adapted to the countries' transition market economy, and this included deregulation aspects.

3.2.8 Evidence of keeping reactors on line when electricity prices are high in a way that may affect nuclear safety judgements

The majority countries reported no evidence of keeping reactors on line when electricity prices were high in a way that may affect nuclear safety judgement. Only in a one case was there evidence of such practices, but this is something that is not easy to detect. At the time it was possible for the grid operator to talk to operators in the power station control room. The UK has now arrangements with the nuclear power station operators to ensure that there are no direct communications from grid operator to the operators in the control room. However, the control room staff does communicate with the operator's Head Quarters if they can foresee a need to vary output.

3.2.9 Evidence of increased competitive pressures to reduce nuclear generation costs (operating and/or maintenance costs)

Some countries were under no increased competitive pressure to reduce operating costs. On the other hand, there were some countries where the corporate policy was to reduce the cost to increase profitability. Also, the national economy environment imposed a need for a reduction in the operating costs and maintenance costs. Another source of pressure to reduce operating costs was from staffing levels and fuel cycle costs. Operating cost reduction seemed to be being achieved on a case-by-case basis in many cases rather than by the use of a clear-cut strategy on the part of the operators. However, some companies had a declared objective of reducing costs by 20% by 2002.

3.2.10 Evidence of resistance from operators to consider plant back fits and other plant safety improvements, including investments to improve plant availability

In general, the resistance from operators to consider plant back fits and other plant safety improvements, including investments to improve plant availability was low. However, licensees were less willing to spend money on improvements if the benefit to safety was seen by them to be small in comparison to cost. There was less resistance if the investment was for improving plant availability. In some countries

there was no such opposition. In other countries the operators' opposition occurred sometimes, depending on the issues.

3.2.11 Conclusions

1. Only a few countries reported the recruitment of senior utility executives or plant managers who were new to the nuclear industry. In these countries, the individuals concerned were made aware of their responsibilities through training programmes. In most of the countries regulators required minimum education and qualification requirements for nuclear power plant personnel, especially for plant managers. For higher-level non-operational posts, often the regulator imposed no prior qualification requirements.

2. Profitability was an important objective for nuclear power plant and hence there had always been pressure to optimise and, where possible, to increase plant capacity factors. In some countries, deregulation had caused utilities to look closer at all opportunities to increase the availability of their nuclear power plants.

3. In some countries, the utilities had implemented new organisational structures. Other countries reported the introduction of new management tools. In the majority of countries, there existed a continuous effort to reduce outage time. Deregulation resulted in an augmented use of on-line maintenance in many countries. In most of the countries, no significant changes to the training programmes had occurred.

4. None of the countries reported evidence of de-coupling of business managers with authority for economic decisions and plant managers with responsibility for nuclear safety.

5. The majority of the countries reported indications of deregulation affecting the nuclear technology infrastructure. These indications were represented by reduction in the comparative level of competent staff in the operator, vendor and technical support organisations.

6. The majority of the countries recognised that fewer people were interested in a career with the nuclear industry. The major concern was that year by year fewer junior engineers and technicians were entering the nuclear power industry.

7. The majority of countries had not seen changes in the design basis knowledge of the operator. But a concern was present related to the potential future loss of corporate knowledge. The countries considered the preservation of the design basis knowledge as an important challenge.

8. The changes to the level of safety research sponsored by operators on safety related topics were strongly dependent on the national policy in the nuclear sector and by policy at the corporate level.

9. The reduction of the universities nuclear competence was not only due to deregulation. National policy on nuclear power had a strong impact on

maintaining the nuclear competence at universities. The potential problem needed to be recognised and actions were needed from governments, regulator, industry and universities to address it.

10. Related to the changes resulting in the use of contractors for safety related work, the majority of the countries recognise the impact of the corporate level staffing policy on the magnitude of the contractors – utilities relationship.

11. The majority of countries reported no evidence of keeping reactors on line when electricity prices were high in a way that may affect nuclear safety judgement. Only in a one case was such evidence apparent and the nuclear power plant was being monitored.

12. There were countries with no increased competitive pressure to reduce operating costs. On the other hand, there were some countries where the corporate policy was to reduce the cost as an instrument to increase profitability. Also, the national economy environment could impose pressure to reduce operating costs and maintenance costs.

13. In general, resistance was low from operators to consider plant back fits and other plant safety improvements, including investments to improve plant availability. In some countries there was no opposition to such safety improvements. In other countries operator opposition occurred sometimes, depending on the issues.

3.3 Regulatory Issues

3.3.1 National system for regulating nuclear safety, electricity market, grid operation etc

The regulatory systems concerning nuclear safety, the electricity market and the grid operation varied widely between the countries. However, a common feature was that different regulatory bodies regulated nuclear safety, the electricity market and the grid operation.

Of those countries that had deregulated their electricity market, only the UK Government seemed to have consulted the Nuclear Safety Regulator during the process of deregulation. The Health and Safety Executive (HSE), the nuclear safety regulator, advised the Government on licensing aspects of restructuring the industry and was satisfied that the proposed new structures of the industry and time scales were commensurate with maintaining high standards of safety. HSE recognised the potential effect of the changes on safety and advised the licensees that applications for replacement licences for all the nuclear power station sites (16 in all) would be necessary. Licensees prepared Safety Management Prospectuses describing proposed corporate approaches to ensuring safety and made arrangements for carrying out the changes. HSE assessed these and other information and found them to be an adequate basis for restructuring. Using these arrangements the licensees split their Magnox reactor, Advanced Gas-cooled Reactor and Pressurised Water Reactor operations into divisions over several months and operated the new divisions as shadow companies. This enabled HSE to inspect the implementation of the changes before licensing.

Granting new nuclear site licences was not a simple paper exercise but could only be considered after assessment and inspection of all the significant safety implications of the proposed changes. HSE's Chief Inspector of Nuclear Installations' accepted that the licence applicants had adequate resources, experience and arrangements to become licensees and that the changes, which had been made as minimal as practicable, would not degrade safety. Sixteen new licences were granted.

In all the countries except in the UK and France, the market regulator appeared able to make decisions without reference to and consultation with the safety regulator. In France the Safety Regulator's decision prevails over the Market Regulators decision, and in some other countries the Market Regulator could not make decisions where safety was concerned. So far no electricity market regulator had made decisions affecting nuclear safety, but the potential did seem to exist.

The countries had not seen any evidence that operators had tried to play one regulator's requirement off against another regulator's requirements in connection with deregulation. However one country had experienced this kind of behaviour in another context, and other countries did not rule out the potential for this situation appearing.

3.3.2 The regulators' experience of effects of economic deregulation

Belgium, Switzerland, Sweden and UK had experienced an effect on communication and working methods between the nuclear regulator and the nuclear power station operators, either directly or indirectly. Other countries had not experienced this and/or did not expect any such effects. Some regulators had adapted their inspection programme and/or undertaken major safety audits, considered the need for more enforcement action and introduced licence conditions to regulate organisational change.

Several countries had experienced upgrading of plant capacity and plans for life extension. This was generally performed for economic reasons. However this, in turn, was not always a direct consequence of deregulation. Slovenia, Spain, Switzerland, Sweden and the UK had experienced pressure from operators to switch from deterministic to risk-informed regulation. In Finland this was also an issue although it was not a direct consequence of deregulation. In Belgium the question was expected to become an issue in the near future. In the other countries this issue had not been raised.

Load fluctuation did not seem to be a common feature arising from deregulation. Some countries had seen this at some plants. However in Germany this was due to the increase in generation of electrical power by regenerative sources i.e. wind rather than deregulation.

The way regulators addressed the licensees' staff competence and training varied widely from country to country. In most cases regulators set the level either by issuing guides or approving training programmes prepared by the licensee. Typically the regulators had a view on the level of technical staff required within operating organisations. The view was sometimes expressed in criteria for training, qualification and certifications of staff. In some cases the licensee must justify to the regulator its staff adequacy both in terms of numbers and competence. The licensee defined the

level of technical staff within operation organisation. In some countries people working in certain positions must be licensed. The nature of positions that can be filled only by licensed people varied; in some countries such positions were only operating staff, while in some others also management and key technical experts must be licensed.

The methods regulators used to obtain information on the level of technical safety expertise in vendors and contractors again varied widely. In some countries the regulator did not get any information, while in some others the regulator periodically audits contractors and technical support organisations of the main vendors. In addition, the licensee may have to include relevant information in their licensing documentation. In many countries it is the responsibility of the licensee to ascertain that the technical expertise of its organisation was not reduced to a safety critical level. The licensee was in turn required to have proper processes to make this judgement. In other countries the regulator assessed this at inspections, reviews etc of the licensee, vendor or contractor.

Spain and UK reported pressure from the operators to reduce the regulator's research funds, but this was not as yet a common trend. In Romania, Slovakia and Slovenia the government have limited funds in a way that meant they were being reduced.

In some countries there was some evidence that in isolated instances operators were giving priority to economics over safety. These included reports of senior plant managers being under great pressure and stress. Also, there had been cases where staff had been required to do excessive overtime, in particular, management during outages. However, this evidence was not common and regulators did not consider that it had resulted in reduced quality of work or safety level. In particular, no evidence had been found to imply that maintenance would be reduced or safety problem reporting would be suppressed. Similarly, the capability of operation staff to manage plant effectively and safely was not eroded, although in individual cases parts of technical competence and resources within the operating organisation had been lost. It was noted that UK and Sweden, countries that had come a long way in deregulation and where competition in the electricity market was pronounced were concerned about these potential effects although it was not possible to find evidence of deterioration at present.

Regulators' used different means to collect evidence of economics taking priority. This evidence had been gathered from routine inspections, safety audits and reports prepared by the operating organisations. Also, in some cases, staff surveys had been made. In Belgium, UK and Sweden management and organisational changes were submitted to the regulator for review and approval. All countries were able to take some form of regulatory action to stop safety taking second place to economics, which varied from addressing technical matters case by case to ultimately withdrawing the licence of an operator.

3.3.3 The regulators' authority to regulate changes in ownership, financial, organisational and business matters

In the countries where corporate mergers had occurred or were anticipated, the regulators by various means tried to assure that they could regulate change of ownership and other organisational changes. Even in Romania and Slovenia where

there were no plans for privatisation of nuclear power plans the regulator had means to control a change of owner.

Some methods employed to monitor the effects of ownership changes were through the licensing process and by inspections and reviews of organisational changes.

In Bulgaria, France, Romania, Slovenia and Switzerland, the law prevented foreign companies purchasing the country's nuclear power plant. In the other countries, however, a foreign company may buy a nuclear power plant. This had already happened in a few instances. In some countries the operator of a plant also had to be the licensee. This meant that a change in ownership did not necessarily mean an automatic transfer of the licence. In other countries the owner was the licensee and when another company buys a major part of the shares of a nuclear power company the need to transfer the licence arose. In some countries the government could veto such a transfer.

In Germany, Romania and Slovenia the regulator had the authority to regulate the operator's financial matters, but not in the other countries, at least, not directly. However this was often a matter that was considered when the licence was granted. Funding to cover decommissioning costs was in many countries handled on a national level or the regulator had authority by other means.

In all countries that answered this question the regulator had the authority to regulate organisational issues such as safety management. This did not necessarily mean that the regulator could interfere directly with the operator's management, but that the regulator could enforce the safety requirements and decide whether the organisation was able to perform all the safety functions required.

Few regulators were able to directly regulate business management of the licensees, but most regulators perceived that they indirectly had an impact on business management: if the operation of a plant was not considered safe the licence or operations could be suspended. To review business management some regulators either had financial/economic competence in house or were able to seek advice from government and consultants. Other regulators regulate these questions indirectly by ensuring licence holders met their liabilities with respect to nuclear safety, while in others state this was the operators' responsibility.

3.3.4 Regulators' actions to adapt to the changing situation

Germany, Romania, Sweden, UK, Switzerland and Slovenia had found that existing regulations were not adequate in certain situations that had arisen. This resulted in changes in the regulations. UK had made substantial changes. These included the introduction of a new licence condition that required the licensee to demonstrate that planned modification to the organisation did not have negative impact on safety.

In countries where the nuclear power plants were owned by government, modifications of legislation or regulative documents were expected to take place in such areas as the licensing process and funding of national research.

In Finland, France, Romania, Switzerland, Sweden and UK operators had requested reductions in what they saw as unnecessary regulatory burden. In some cases this was expressed in a tendency to challenge the need for new regulations. It was not always

clear whether these requests were a result of increased competition in a deregulated environment. The specific areas that operators targeted for reductions varied from country to country.

Most regulators believed that the new competitive environment demanded more regulatory effectiveness and efficiency. The effectiveness may change, as the regulator may have to become more concerned with control of the licensees' actions and accuracy in reporting. On the other hand, the licensee would be more interested in meeting the regulatory requirements in order to maintain high level of safety and reliability, as any unforeseen outage could have much more serious effects on the licensees' economic performance.

The areas where regulators needed or may need new skills and competencies as a response to electricity market deregulation included the evaluation of organisational aspects and management of change and safety. Some regulators pointed out that enforcement practices might require revision, as it was foreseen that the licensees may challenge regulatory decisions more readily. Also inspection programmes may need modification.

3.3.5 Conclusions

3.3.5.1 Regulatory systems

Countries' regulatory systems to cover the three issues of nuclear safety, the electricity market and electricity grid operation were found to vary widely, however, a common feature was that different regulatory bodies regulated each of the issues. Even so, there were differences in the way collaboration between different authorities was organised. In most cases the market regulator could make decisions without reference to and consultation with the safety regulator. However, in some countries precautions had been taken so that the market regulator could not impose requirements with potentially negative effect on nuclear safety. These precautions included a duty to consult the nuclear safety regulator first and ensuring that safety regulator's decision prevailed over the market regulator's decision.

3.3.5.2 Regulation of organisational changes

Deregulation had increased the merger activity within countries' energy sectors and some mergers had also resulted in changes in nuclear power plant ownership. In the countries where corporate mergers had occurred or were anticipated the regulators by various means tried to assure that they could regulate the resultant change of ownership, licensee or organisational structure. Usually when another company bought a licence-holding company, or a large part of it, the need to transfer the licence arose.

3.3.5.3 Regulation of management and resources

Market deregulation in any area tended to lead to increased demand for economic efficiency, and in many cases this had lead to staff cuts, increased use of contract workers and outsourcing. This had occurred also in the nuclear energy sector, particularly in the non-European countries, where electricity markets were deregulated earlier than in Europe. Here the electricity market deregulation had not had a drastic effect, although some indications of similar trend were noted, in

particular in those countries where the electricity market had been deregulated the longest. These indications included:

- notions that senior plant managers were placing increasing priority on economics and were under great pressure and stress

- cases where part of technical competence and resources within the operating organisation had been lost

- cases when work required excessive overtime, in particular by management during outages

As a response some regulators found it necessary to adapt their inspection programmes or undertook major safety audits; considered the need for more enforcement action; and introduced licence conditions to regulate organisational change. For example, in one instance a new licence condition was introduced, by which the licensee must justify to the regulator the staff adequacy both in numbers and competence and that the planned modification of the organisation would not have a negative impact on safety.

3.3.5.4 Safety requirements

In many non-EU countries, where electricity markets were deregulated, nuclear power plant operators claimed that nuclear power productions suffered from a "regulatory burden" in the form of unduly conservative design criteria, and operation and maintenance requirements. This had not become a strong common theme in EU countries, although in a few countries suggestions had been made to put more emphasis on risk-informed regulation.

4 TYPICAL CONSEQUENCES RESULTING FROM PRESSURE TO REDUCE COSTS IN THE NUCLEAR INDUSTRY

The TF has not discussed the issue of what actions a regulator should take if a licensee goes bankrupt as this issue is legally complex and will be addressed in different ways in different countries.

4.1 Change in ownership and operating permits

In a deregulated market we can expect changes in ownership. Typically a privatisation and deregulation will lead to an increase in nuclear companies/operators, followed by a concentration in ownership. As indicated in previous sections this has been the case in several EU countries.

The question of change in operating permit may also arise. In some countries the licence to operate is always linked to ownership. In those cases there may also exist a separate licence to carry out operation. In other countries ownership is separated from license to operate. In those cases there may also be restrictions on ownership, for example that the owner must not be foreign. The questions of change in ownership, licences and permits may arise regardless of whether the licence and ownership are linked or not.

4.1.1 Discussion of the generic safety aspects associated with change in ownership and operating permit

The generic safety aspects associated with change in ownership or licence to operate arise from the new owner or licensee's capability to take responsibility for safety. Resources could be financial, organisational or concern technical knowledge. All stages of a plant's life must be considered: safe operation, to maintain the plant in shutdown mode if necessary and decommissioning of the plant. Resources must take into account emergency situations as well as normal operation. In order to be able to take full control over safety of a nuclear installation it is necessary to have the documents of a safety case. When ownership or license to operate changes it is important to assure that the company that has the responsibility for safety can control such documentation.

It must also be recognised that changes in ownership or licence to operate have the potential to introduce an inadequate distribution of responsibilities between operator and owner. If the distribution of responsibilities is not clear, this could potentially lead to neither company dealing with important safety issues. Examples could be investments, research and development, modernisation and modification of equipment, including independent safety review. Another example is distribution of responsibility regarding investigation and analysis of incidents and corrective actions following.

4.1.2 Discussion of regulatory approaches

It is important that the legislation regarding ownership and permit to operate allows the safety regulator to make the decisions regarding new licences, or allows the regulator to give advice regarding new licensees to the deciding body.

Possible regulatory approaches could be either to assess the new licensee's abilities for safe operation or to give credit to the company for being well known. Many countries used the second approach (with some modifications) at the time when the first licenses of nowadays-operating plants were issued. Recent experiences show that the situation today has changed in a manner that makes this approach less reliable: Today a company with a "good name" may be no more than a label, with all its actual resources split up in other companies and business partners. On the other hand, if the safety regulator approves detailed descriptions of an organisation with specification of technical staff etc, this must not affect the operator's primary responsibility for safety.

The TF would like to recommend that regulators assess the potential licensees' capability to take full responsibility for safety. One way of doing this could be through having applicants include a description of a base line organisation. The description should include financial and organisational factors as well as staffing and take all stages in a plant's life into account.

One country has elaborated this approach into a licence condition. The new licence condition enables the regulator to require the licensee to submit a safety case for changes that could have a significant effect on safety if they were inadequately conceived or executed. The regulator can, if necessary, prevent the change from taking place until satisfied that the safety implications are understood and that there will be no lowering of safety standards.

The licensee and the owner need not necessarily be the same entity. In effect this means that the owner can change without the need to re-licence a nuclear power station. However, if the licensee, the body responsible for operating the power station safely, changed the regulator would have to ensure that the new licensee could meet its obligations under the nuclear site licence to operate the site safely before it would be allowed to do so. The licensee and the operator should not be separate bodies if a separation of licence and permit to operate opens up the possibility of unclear distribution of responsibility for safety. The licensee must take full responsibility for safety even when another company has a permit to run the plant. This means that the licensee must be able to actively assure that safety is maintained to a very high level. The licensee must have the capacity (legal and otherwise) to make investments, modernisation and upgrades in the plant for safety reasons and must also be able to make other decisions regarding the technical and organisational operation of the plant. Consequently the licensee must demonstrate that it is able to take proactive as well as reactive action and that it has the legal, organisational and financial capacity to do so.

One regulator has stated a minimum level for the distribution of responsibility between the licensee and the operator. As a consequence, the licensee must:

- State goals and objectives for how the operator is to maintain safety at the plant

- Assure that the operator has the resources and the competence necessary to be able to maintain and develop safety

- Assure that the operator applies uses adequate quality assurance (according to the regulator's regulations)

- Regularly controls that the operator manages the operation in accordance to all safety regulations and requirements from the regulator as well as from the licensee

- On a regular basis follows incident reports and safety reviews of the operator to make sure that appropriate action is taken

- If necessary is able to direct the operator to take appropriate action, or to himself take such action.

Transferring a licence is generally not allowed without a new application.

4.2 Outsourcing of activities important to safety

In order to rationalise, companies may outsource what they do not consider to be their core business. This means selling, or by other means getting rid of, parts of the company's operations. Recent examples of outsourcing in Europe include maintenance, engineering services, computer services, training of operating staff and archive functions. There is even an example where a company wanted to outsource the full operation of a nuclear plant. (This can also be regarded as an example of the operator not being the same company as the owner.)

4.2.1 Discussion of the generic safety aspects associated with outsourcing of activities important to safety

Generic safety aspects associated with outsourcing concern the licensee's ability to keep and develop enough competence within its organisation to be able to maintain full control over safety in the short and long perspective. One difficulty that may arise is that a contractor any moment may decide to dedicate their staff to other more profitable business, leaving the plant without necessary competence. To prevent this care must be taken in the drafting of any contract with the contractor. These must state for instance what competence the contractor is to provide. It should also be noted that competence once lost might be difficult to retrieve when parts of a company have been sold out and staff is scattered.

When an activity is outsourced, the main safety challenge is how to maintain the control of the outsourced functions from the safety point of view. This requires the means apply appropriate quality assurance when undertaking the task and using an organisation and staff with the necessary education and training to be able to do the job necessary. In addition, the operator must make sure that the work has been done to the required quality by applying its own checks.

In order to maintain the ability to take full responsibility for safety it is necessary to keep competencies in core business as well as other vital and strategic parts of the company's business. Here the concept of being an "intelligent customer" is introduced. This means developing and keeping the necessary in-house competence in order to order, assess and follow up outsourced work done by contractors. One approach that has been taken is the regulator holding detailed discussions with the licensees to ensure they maintain an "intelligent customer" capability. Areas where in-house competence must be maintained include the technical ability to understand the safety case, plant thermohydraulics, core fuel configurations and probabilistic safety assessments (PSA). This may mean that it is necessary not only to keep enough competence in the nuclear organisation, but also to develop new competencies.

An example of the need to develop competencies is the development and use of computer software for use in safety applications, where it may be necessary to hire specialists. However, in order to do so successfully in-house staff must keep in touch with state of the art programming solutions and their potential problems. Another example is PSA studies. In the nuclear industry PSA technology has been widely applied. The application of PSA methodology may become even more widely used if the pressure to use risk informed regulatory strategies (see section 4.6) becomes more wide spread. It is important that the licensee has in-house staff that is able to act as an intelligent customer. The same principles apply to using contractors when preparing and performing design assessments, plant modifications, maintenance etc.

One of the challenges presented by outsourcing is how to define the functions of an operating organisation that could not be outsourced without serious safety implications. Some of these may be easy to recognise as core functions, for example staffing the control room. There are also other competencies that are strategic and which should be kept in-house, at least to a certain level. Having the competence to understand what is happening at the plant is the key issue. Decision-making that could significantly affect safety cannot be outsourced since the licensee has primary responsibility for safety and cannot delegate this responsibility. The types of tasks that must be performed by the licensee's in-house staff would typically include:

- Management of the organisational units significant to safety
- Tasks that require specific training and qualifications or an official licence (for example shift personnel)
- Adequate supervision and control of all the activities carried out by personnel that do not belong to the plant
- Negotiating, with adequate technical knowledge, the basis for awarding contracts
- Planning, co-ordinating and reviewing all the hired activities

Companies that would like to consider only the safe operations "production of electricity" as their core business will require careful assessment by the regulator to ensure that safety is not being compromised.

The operator must also be able to evaluate the contractor's ability to provide the service needed. Different problems are encountered depending on the nature of

activities or functions that have been outsourced. Routine work may be easier to control, whereas work that requires expert knowledge may present more of a challenge. To be an intelligent customer may mean knowing enough of what is being bought from a consultant. The consultant in turn must also know enough about the parent organisation and technology to be able to fit expert solutions to the organisation's particular circumstances, being able to cope not only in normal conditions but also if an emergency or an accident should occur.

4.2.2 Discussion of regulatory approach

It is important for the regulator to be able to intervene in the outsourcing process if safety is at risk of being compromised. As the process is not always reversible it is important that the regulator can take a proactive approach in these matters and/or intervene early in the process. In addition the regulator needs to monitor the effects of outsourcing on safety. There are several possible regulatory approaches, most of which can be combined.

The challenge for the regulator is how to recognise what are the core functions of an operating organisation, which could not be outsourced without serious safety implications. Experience from non-nuclear businesses indicates that strategic competencies are important to consider in this respect.

One strategy, which makes it possible for the regulator to act early, is by making the licensee submit proposals to the regulator before outsourcing work that may be important to safety. In the proposal the licensee should clearly demonstrate to the regulator that a proposal to outsource does not jeopardise safety by stating:

- What activities important to safety are involved
- Minimum staffing required to carry out safety tasks
- Qualification or experience required to undertake the work
- The balance between activities performed in-house and those performed by contractors
- How the licensee will monitor the quality of the work being undertaken

This approach has the advantage of leaving the responsibility for safety with the licensee. The regulator will need to satisfy itself that if the work is outsourced the licensee will properly control it.

Another possible approach is to regulate the minimum technical staff necessary to maintain the safety of the power station by getting the operator to justify to the regulator the existing staff levels against the need to maintain safety, including their qualifications.

In order to control the quality of contractors and consultants a system of authorisation is sometimes used. If this is done the assessment of the contractors and consultants should include a demonstration of the financial, technical, material and organisational preconditions, including a quality system. Proof of specialist qualifications should also be included in the assessment. Holders of an authorisation for outsourced work should be subject to regulatory control on the same basis as the licensee. In some countries permanent outsourcing requires a Government Permit.

In order to monitor the effects of outsourcing on safety the regulator may also use several approaches, including its normal range of regulatory activities. These may include inspections and audits of the licensee's process for conducting outsourcing and ability to plan, supervise and follow up activities performed by contractors. It may also include inspection and review of activities and functions that are performed by contractors and attending inspections and audits conducted by the operator or a third party on a contractor. Follow up on incident reports, failures and trends may also be an important part of this strategy. The regulator could also encourage or require licensees to have regular peer reviews performed.

Another possible regulatory approach is to focus on the process the licensee applies to management of outsourcing. The regulator should make sure that the licensee's process includes

- A clear policy, which sets the boundaries of outsourcing, and states what will not be outsourced.
- What actions are to be taken to retain the licensee's competence and capability to assess the quality of work that is being outsourced
- That the same standards be applied to contractors as to the licensees' own staff
- A plan for how supervisory and management powers are to be retained.

Depending on the national regulatory system a regulator might consider a prescriptive approach. This gives control to the regulator, but has the tendency to restrict positive development if specific solutions are prescribed. It also puts pressure on the regulator, with heavy demands on in house competence and resources if the approach is to be effective. This strategy also has the potential disadvantage of moving the responsibility for safety from the licensee towards the regulator.

4.3 Downsizing of activities important to safety

Downsizing and slimming of organisation that is, cutting down on staff numbers is another common feature when companies try to rationalise. The idea being to have just enough staff to handle a certain activity. However, if exercised too vigorously this is contrary to the common ideas associated with good safety culture of keeping a staffing level that can handle difficult situations, as well as routine situations. Downsizing can take place in large or small steps. In either case, the result is that the operating organisation loses resources and competence without any guarantee to re-establish them when needed. This has implication not only for a certain activity of importance to safety, but also for a whole nuclear facility's capability and capacity to

handle situations that might arise in the future. In time the over all competence of the nuclear business in a country might become affected.

Experience from other types of business indicates that an exaggerated level of downsizing can seriously impair an organisation's ability to keep a long-term vision. It can also diminish its ability to handle unforeseen or complicated situations, for example a long lasting emergency situation, and put a halt to development. The concept of "lean production" seams to have been interpreted by many managers as if the workforce and not the organisation ought to be slimmed. Organisations have in many cases been heavily downsized with the result of negative consequences like under manning and stress. Under manning creates reactive actions. Developmental work is neglected when there is a strong time pressure and the organisational learning vanishes. Sub-optimising enforces a special kind of behaviour, as individuals perceive the situation as highly dependent on their own activities. Highly stressed individuals may become forgetful and have problems with insomnia. All this will increase the potential for mistakes.

4.3.1 Discussion of the generic safety aspects associated with downsizing

Generic safety aspects associated with downsizing can occur both within the operating organisation or its subcontractors. There are several concerns associated with downsizing. If less resources are

- Less resources dedicated to safety related activities
- Reduction of the technical knowledge of the organisation
- Psychological and safety culture side effects

Some of the possible adverse effects of downsizing (for example increased backlogs of work waiting to be done) may be apparent in the short term, but other effects are delayed. The effects of failure to take action now that would prevent issues arising in the future would not be evident until later. Examples of this would be less time spent on training and insufficient quality or absence of evaluations of safety related activities. Also with less resources dedicated to safety related activities there can be decreasing quality of work or restrictions on the number of safety related activities being undertaken. Downsizing can also result in loss of motivation, loss of long-term perspective and increased level of mistakes.

4.3.2 Discussion of regulatory approach to downsizing

It is difficult to keep track of the added effect of several minor changes over a longer period of time. The approach to require licensees to review organisational change and submit particularly important organisational changes will be adequate if downsizing is taking place in bigger steps, but it does not cover the accumulated effects of small changes. The licensee may not even regard these as organisational change.

Basically the safety challenges for the regulator are to define the limit for the minimum resources needed to ensure plant safety and how to keep track of the several minor changes before they have a significant effect on maintaining safety levels. This "cliff-edge effect" presents a specific problem as it is difficult to keep track of many,

apparently insignificant, small changes that may take part stepwise, “salami slices”, in different parts of the organisation. This becomes an even bigger problem when the licensees go through organisational change at a continuously increasing pace. This means it becomes very difficult for an outsider (the regulator) to keep track of the number of people actually working with a specific activity – within the licensee’s organisation or at a contractor or both.

One approach to the problem is requiring the licensee to describe its base line organisation, and then require the licensee to submit organisational change to the regulator (as mentioned above). The licensee is also required to justify proposed changes, demonstrating no adverse affects on safety and the regulator judges the adequacy of such changes by assessment and inspection. The regulator approving the licensees’ arrangements achieves regulatory control. Once approved the arrangements cannot be changed without the regulator’s agreement. In addition, the licensees must keep a change register for inspection by the regulator. Complex changes have to be divided into stages requiring the regulator’s agreement to move from stage to stage. The regulator also has the power to direct a licensee to cease a change. Licensees provide the regulator with a baseline, which substantiates the right size, structure and experience that the company needs. The existing organisation is not accepted as a baseline without thorough justification. Hence, the production of a complete and fully rigorous baseline can take some time. It covers the operators’ sites and headquarters support, contractors’ support, staffing and organisational changes, and the test to be used to establish the safety impact if the change does not work. Each change is classified by its potential safety impact to facilitate appropriate licensee processes and to facilitate regulatory intervention. Planning and making the change requires the licensee to set out the roles and responsibilities of those making the change, assessment and review of the implications of the change and ensures that proper planning records and change registers are kept. Quality Assurance arrangements must be used to produce transparency through procedures, records, audits and reviews.

Another approach is to require the licensee to state its minimum staff needed to face the safety activities that must be carried out in the plants and to report to the safety regulator each time the organisation reaches the minimum level. If a baseline, or minimum, level were not defined - it would be necessary to find other ways of keeping track of the added effect of smaller changes over time.

Other possible, but more reactive, strategies are to promote periodic self-assessments of management of safety and organisational questions, including staffing and competence. The use of safety indicators could also be used.

4.4 Changed operational strategy

The licensees’ operational strategies depend on several factors, including the cost and return on production, outage time, closure of the plant and depending on marked balance, price of produced electricity and the price of compensatory production.

In times of decreased or varying revenues from production, owners may be less interested in staying constantly connected to the grid as the price of electricity may not make this strategy profitable at all times. On the other hand, when prices are high

and/or alternative sources scarce any unplanned outage can be very costly to the utility in terms of loss of income. Consequently companies are looking to develop changes in their operational strategies. Such new strategies must be carefully assessed for their potential impact on safety before they are implemented.

In some countries operators have been observed to reduce nuclear power production in order to affect the market prices of the electricity they produce. In addition, reactors have been run at a low-level load for various periods of time. In some cases reactors have been submitted to fairly rapid changes in load in order to respond to the changing demand for electricity. This means more frequent fluctuations in load, with associated strains on the plant structures, systems and components. Such changes in operation need to be demonstrated as being satisfactory in the safety case for the plant before the changes takes place.

Where the strategy has been to maximising grid connection times, this has been observed to affect the maintenance strategies used by the operator, changing them from preventive towards more corrective maintenance. Plants may also increase the tendency to continue operation with equipment until the next shut down period if this is allowed in the Technical specifications. Change from maintenance during outages to on line maintenance during operation where this is feasible is another trend connected with a wish to stay on line as long as possible.

Operators will also try to minimise the time taken to complete the shutdowns. There is also a clear interest shown by some operators to extend the intervals between inspections and testing of mechanical components, and to extend the time between shutdowns.

In one country, a licensee has proposed a major change in the shift pattern for one of its nuclear power stations involving a change from a three-shift day to a two-shift day. This was performed with potential cost cutting as prime motivator. The regulator is assessing the proposed change, which has both safety benefits and some problems associated with it. The advantages are that it is forward rotating (from days to nights followed by a rest period) and it minimises the shift changes, particularly important during normal day hours to allow day teams, for example maintenance staff, to return completed tasks to the same shift team that initiated them. The principal concern is that it is based on 12-hour shifts, which, though consistent with some international practices, take workers closer to the length of working period that fatigue is known to be a concern. An extended trial was agreed with the regulator, together with rules to minimise excessive hours and to control rest periods and with the direct monitoring of potential fatigue effects on the workers concerned. The trial concluded that the particular arrangements that were introduced during the trial period, together with clear and tightly controlled operating constraints and monitoring arrangements, did not result in any observable degradation in operations staff performance at the site.

4.4.1 Discussion of the generic safety aspects associated with changed operational strategy

Several safety challenges are associated with changes in operational and maintenance strategy. Basically, methods of operation that are new and have not been properly

analysed might have unexpected effects on plant safety. Some examples and their possible consequences are mentioned in the following sections.

The potential safety challenge associated with fluctuations in load concern the additional strains on the plant structures, systems and components that may not have been taken into account in the Safety Analysis Report or the Safety Case which is the basis for the operating permit. Many of the plants have been constructed for continuous use and it was assumed that fluctuation in electricity demand was to be met by other electricity producers. Additional pressure cycles and material fatigue may turn out to be an issue, and the need for revision of the Safety Case for the regulator to assess may arise.

With a change in maintenance strategy towards less preventive and more corrective actions the risk for components actually malfunctioning during operation would increase, thus affecting safety. The trend to extend inspection intervals may also increase the risk of breaks and malfunction during reactor operation. Extending inspection intervals also increases the amount of work needed in preparing for outages as more inspections and testing will be required at the outages. This in turn could result in a potential for increased risk of mistakes being introduced due to the greater complexity of the planning required and the need to co-ordinate and perform the extra work during outages. If in addition there is pressure to shorten outages time this will accentuate the problem. In order to reduce work to be undertaken during an outage, operators are looking to undertake maintenance while the reactor is operating where this is feasible. All such changes will need to be demonstrated as being safe before the changes are implemented.

4.4.2 Discussion of regulatory approach

It should be noted that changes in operation might include a series of small changes that may have an accumulated adverse effect on the overall level of safety of the power station. This issue has been discussed earlier in the document and similar regulatory strategies should be applied to regulate licensees' operational strategies.

As is normal practice, the regulator will require all major changes to operational practices at the power stations to be assessed for their safety implications and a safety case made to justify the changes before they are brought into practice. The deterministic analysis might need to be reconsidered and changes should also be assessed with PSA. In order to check on the success of the changes, the use of safety indicators is one approach that could be used. In TECDOC-1141 the IAEA describes recommendations for the operators, which are aimed at developing the framework of operational safety performance indicators (PI). In the TECDOC there is suggested that there are three important aspects of plant operational safety to be addressed – NPP in normal operation, NPP in emergency operation, and the attitude of NPP personnel towards safety. The IAEA is producing another document with a model of an upgraded performance indicator system based on this framework which is going to be released this year.

The regulator could also use safety indicators as an objective tool to review changes in the level of nuclear safety. In doing so some of the activities, which the regulatory body might like to focus on, are

- selection of the set of indicators used by nuclear operators useful to the regulator
- identification of goals, thresholds and performance bands
- development of the guidelines for the use of PIs in relation to other regulatory activities and practices

The regulator will require licensees to keep operation in line with what is assumed in the Safety Case. When the licensee consider changing its operational strategy this should be cleared by the regulator before this is put into operation, particularly if this includes altering the safety case.

A change in maintenance strategy should rest on thorough analysis of safety implication, and the same would go as far as inspection intervals are concerned. The licensee should clearly demonstrate this to the regulator.

The regulator must assure itself that the operator carries out root cause analyses of equipment failures and plant incidents to ensure that if there are trends associated with incidents lessons are learnt from them and corrective measures implemented.

4.5 Delay of backfitting programmes

While many utilities have reacted to the changing electricity market by starting modernisation and upgrading programmes to guarantee a continuation of efficient operation, there are also signs of an opposite trend. The unpredictability of the nuclear power companies' income and increased interest in economising has lead to an uncertainty whether large programmes will result in return in investment. As a result there has been delays and reconsideration of already decided large investment programmes for the older plants. Sometimes only the safety work required by the regulator receives any priority. As a result the regulator will be the one stating the safety level and that goes contrary to the principle that the licensee should own the Safety Case.

4.5.1 Discussion of the generic safety aspects associated with delay of backfitting programmes

If the pace of modernisation and backfitting is considerably reduced or delayed a situation may develop where technical plant safety is in danger of being slowly reduced instead of continuously enhanced. This is a long-term consequence connected with an increased risk of for example equipment failure.

Backfitting programmes may have been put together for productivity as well as safety reasons. Sometimes it has not been clearly documented if a component of a programme is aimed at either or both types of goals. When whole backfitting programmes are split up into pieces the action taken may not be sufficient to fulfil a certain safety goal and the safety implications of changes in backfitting programmes might not be obvious. It may even be necessary to make a new safety analysis to be

able to make clear what parts of a program that is necessary from a safety point of view.

Another important generic safety aspect associated with delay of backfitting programmes concerns safety culture. Reluctance to undertake backfitting will risk getting the message across to the employees of the licensee that safety is not as important as it used to be or that the plant has no future.

Reducing backfitting programs have secondary effects as they may accentuate the common view that there is no future in the nuclear business. This in turn may make the acquiring of new staff more difficult.

4.5.2 Discussion of regulatory approach

The greatest challenge is how to encourage the industry to continue their modernisation and backfitting programmes to improve safety. In order to make this successful the regulator must have a clear view of the technical safety status of the plant, and on what it requires to be backfitted. This means that the regulatory body gets a heavier burden to define necessary safety improvements and may need to reconsider its regulatory strategy.

One strategy is to get this information by yearly and periodic safety reviews. These can take account of Probabilistic Safety Assessments (PSA) in combination with deterministic safety analyses to highlight what changes need be implemented.

Another approach might be is to state a new safety level that is to be applied to all plants in the country. In many countries this is not possible due to legal problems. This may require the issuing new regulations to define “modern” safety requirements for existing plants.

4.6 Deterministic or probabilistic requirements

Market deregulation has resulted in utilities reviewing the way that they maintain and inspect the condition of their power stations with a view to reducing costs. In some cases this is being addressed by reconsidering traditional maintenance and inspection procedures, which have been based on deterministic approaches. Such approaches target all components that are considered to be significant to safety, rather than concentrating on components that are more likely to need attention.

The objective in changing the approach to maintenance and inspection is to maintain similar or enhanced safety levels, but with less resource spent. One potential source of savings is seen to be by not automatically changing components after a fixed service life that are still serviceable or reducing inspects of components that are very unlikely to have developed faults during use. To be able to do this effectively the operator must be able to accurately predict the safety consequences of the change. To achieve this utilities use Probabilistic Safety Assessment (PSA) tools to try to target the resources where most needed. This is done by probabilistically evaluating systems and their Technical Specifications, maintenance schedules and inspection programmes to highlight where attention and resources are best focused.

As a consequence the utilities may try to eliminate deterministic requirements and replace them with ones that are based on probabilistic arguments. One major example of this is the use of so-called risk-informed strategies for in-service inspections to indicate which systems and components need to be inspected to ensure they remain safe and which systems are unlikely to have degraded and hence need not be inspected so regularly.

An important aspect connected with such an analyses is the importance of adopting the risk-informed approach as a whole and not only in a limited area where reliefs are in sight. Such cherry picking may undermine the safety concept of a plant. For example, if a plant want to change the test interval of an auxiliary feed water system they should include all systems that could fulfil that function in the analysis.

4.6.1 Discussion of the generic safety issues

In order to move away from deterministic design and assessment the operating envelope of the plant must be clearly understood and very well documented and the probabilistic arguments built on complete, comprehensive and dependable PSAs of a sufficiently high quality.

The relatively high safety level, in probabilistic terms, of existing nuclear power plants is associated with a relatively low core damage frequency, which is calculated taking into account both the expected frequencies of different initiating events and the expected plant response. As the most severe initiating events have typically very low probabilities, the systems that are designed to manage and mitigate such events can have relatively low reliability without major impact on the overall core damage frequency. This can make "optimisation" tempting, which can lead to making modifications that reduce the reliability or efficiency of emergency safety systems, which have little or no apparent impact on the overall safety level. One way that this could be achieved is by using the highly reliable first safety barriers (the fuel and the primary circuit) to compensate for reductions in the reliability of the last barriers (the emergency systems and the containment).

More generally, PSA does not support a good balance between the different levels in the defence-in-depth, and a good balance between different physical safety barriers. Other qualities that may get lost are robustness, simplicity and transparency when relying too much on the PSA result.

The major safety challenge associated with removing deterministic design criteria is that it is necessary to understand the safety reasons for the deterministic requirements and ensuring that such safety reasons have been addressed in the new criteria. It should always be demonstrated that a well balances defence-in-depth design is maintained.

4.6.2 Discussion of regulatory approach

Nuclear safety regulators are increasingly being asked to review modification proposals supported with probabilistic safety analyses. Regulators must therefore have or develop a clear policy towards the use of PSA in the development of existing nuclear power plant systems and operating and maintenance procedures and programmes. When drafting the policy, it should be noted that a systematic PSA

could be an efficient tool both in diagnosing and analysing the adequacy and coverage of the existing safety analyses, when sufficient resources are put into its development and review. However, when the resources are not sufficient and the effort is more motivated by "optimisation" of the plant design, operation and maintenance from a risk perspective, the outcome may in fact be detrimental to safety, as safety barrier independence and effectiveness can be eroded with unbalanced changes in accident prevention. In order to prevent this development, the regulator should clearly state that the main safety barriers should be kept as independent from each other as technically feasible. The PSA studies, together with deterministic safety analyses, can be used to demonstrate that such independence exists and that it is not eroded by any planned changes in plant design, operation or maintenance.

Many of the safety cases that result from a desire to change deterministic approaches into probabilistic ones will require expert assessment if their implications are to be fully understood. The regulator must ensure that safety cases justifying change, have been prepared by suitably experienced personnel and that the regulator itself has the necessary expertise available to assess them.

4.7 Exceptions from technical specifications

In order to maximise electric energy production or decrease production cost some licensees have made frequent requests for exceptions from or changes in Technical Specifications (tec specs) or Limiting Conditions of Operation (LCO). This situation may occur in various circumstances. In a major backfitting or modernisation the process is usually divided into several implementation stages. It is possible that each step will need specific temporary changes of LCO. Modernisation of a system or component based on design change might lead to a permanent change of LCO. Sometimes the need for a certain type of maintenance work has not been anticipated at the time when LCO was developed and exceptions are necessary. Many more examples can be found.

4.7.1 Discussion of the generic safety aspect

This type of exceptions from tec specs and LCO has the potential to decrease the safety level of the plant, temporarily or permanently. Careful analysis of the situation is required to avoid this. When analysing a modernisation of a system or component based on a design change, it is necessary to reassess the new state in terms of maintaining the given (prescribed) safety level as well as its impact on the existing LCO. The design change in many cases results in a permanent change of LCO. It is also important to analyse the safety impact for each implementation stage of a modernisation program including its effect on LCO during transitional states of the process.

4.7.2 Discussion of regulatory approach

One of the challenges for the regulator concerns keeping track of all the, sometimes small and temporary, changes that might occur simultaneously and their possible combined effects on the safety level. The licensee should be required to perform the

necessary analyses when applying for changes in tec specs and LCO. Licensees should also be required to take LCO into account when planning their modernisation and backfitting projects.

4.8 Licensees' change of attitude towards regulatory body

The answers of the questionnaire indicate that there has been a change in communication and working methods between the nuclear regulator and the licensees. Where previously the regulator did not have to make a formal request to make the licensee comply, the situation today is sometimes not so straightforward. There are also examples of licensees disregarding or not paying proper attention to regulatory comments and requirements.

4.8.1 Discussion of the generic safety issue connected with this issue

This could be a sign of serious degradation of safety culture and the licensee's ability to maintain safety could be questioned.

4.8.2 Discussion of regulatory approach

Any sign that a licensee is deliberately trying to evade regulatory control must be taken very seriously. The principal question should be made an issue for top management at the regulator and the licensee. The regulator would also have to consider intensifying control of licensee compliance to regulation.

5 DISCUSSION – THE SITUATION TODAY

Although the situation varies between the different countries that answered the questionnaire, it is possible to learn from the experience of other countries. The situation today gives evidence of many different changes taking place as a result of economic pressure on operators. Experience indicates that this is putting regulators in new and maybe unfamiliar situations.

The generic safety issue associated with a **change in ownership and permit to operate** arises from the new owner or licensee's potential lack of resources, be they financial, organisational or concern technical knowledge. It is crucial that the legislation regarding ownership and permit to operate cover all these aspects. The regulator should also be allowed to make decisions or give advice to the deciding body regarding changes in ownership and new licensees. **Outsourcing** presents similar generic safety issues, but here the focus of interest is centred at the licensee's ability to keep and develop enough competence within its organisation to maintain full control over safety in the short and long perspective. The issue of **downsizing** is also associated with concerns regarding resources and competence: fewer resources dedicated to safety-related activities and reduction of technical knowledge. Another concern is that psychological and safety culture side effects may occur.

In order to effectively regulate the three areas of change in ownership and permit to operate, outsourcing and downsizing the regulatory body must have the appropriate

legislation in an area where the situation has changed rapidly, and where the need for legislation may not have been previously noticed. These consequences also puts demand on competence within in areas of knowledge – organisation, finances, human factors etc that may not traditionally have been the strongest areas within the regulators.

Although the TF has not discussed the issue of what actions a regulator should take if a licensee goes **bankrupt**, it must be recognised that it is important that legislation prevents such an extreme event. The financial capacity of the owner/licensee and its capacity to exercise control of the finance and safety of operations are crucial questions here. The long-term perspective of nuclear waste must also be considered.

The effort for cost reduction and increased efficiency also has affected technical areas. **Changed operational and maintenance strategy** are examples where the generic safety aspects concern that methods that are new and have not been properly analysed might have unexpected effects on plant safety. This accentuates the role of the Safety Assessment Report and whether the analyses cover the new strategy and may require increased attention to root cause analysis of equipment failures and plant incidents. **Delay of backfitting programs** is another effect of cost reduction that may have consequences on technical safety as well as safety culture. The regulator is faced with a heavier burden of defining necessary safety improvements and may need to reconsider its regulatory strategy. In some cases utilities are reconsidering traditional maintenance and inspection procedures which have been based on deterministic approaches and target all components that are significant to safety, rather than concentrating on components that are more likely to need attention. This is an example of a tendency to move **away from deterministic design and assessment** towards probabilistically based arguments. The major safety challenge associated with removing deterministic design criteria is that it is necessary to understand the safety reasons for the deterministic requirements and ensuring that such safety reasons have been addressed in the new criteria. This means that the regulator must develop a clear policy towards the use of PSA in the development of existing nuclear power plant systems and operating and maintenance procedures and programmes. The regulator must also ensure that it has the necessary expertise available to assess safety cases justifying change in this respect. Regulators have also experienced an increase in applications for **exceptions from tec specs and LCO**.

The consequences of economic pressure on operators mentioned in the section above, mean that it may be necessary to reconsider old truths: are Safety Assessment Reports still applicable in the light of changes that have been performed or are planned? Will new analyses have to be performed? How can we be sure that safety is not jeopardised by the added effect of these changes? This also puts pressure on the regulator to make sure that legislation covers these issues, on regulatory strategy and on the resources and competence available to the regulator.

In addition, several regulators have experienced that **the relationship between the licensees and the regulator** is changing, putting an additional strain on the regulator.

6 CONCLUDING REMARKS – THE NEXT STEP

Deregulation has directly and indirectly created new issues that were previously not addressed by the regulator. It is directly causing new legal situations regarding for example ownership and licences to operate. Other effects are connected with the economic pressure that may be caused by deregulation. Although deregulation is not the only reason why nuclear operators have intensified their efforts to reduce costs and become more efficient it is clear, that the industry is changing and that regulators must prepare for this new situation.

This TF has identified that the effort for cost reduction and increased efficiency has affected financial, organisational and technical areas as well as the relationship between regulators and licensees. We have not seen the end of these effects, and it is not possible to fully anticipate what form they will take in the future. The TF believe that we will se a number of innovative ways in which the licensees will try to rationalise and cut down on costs. This means that the regulator must be prepared to address subjects as they appear.

As the situation varies to such an extent between the countries the TF would not like to give outright advice regarding prioritising between deregulation and other safety issues. This must follow from the assessment of the national situation. We hope that this report will be of help in this assessment and we do advice regulators to give thorough consideration to the subject matter.

The TF would also like to give some further advice: Although subjects must be addressed as they appear it is possible to make preparations for the future. Acquiring and advancing regulatory knowledge and resources working with human factors and organisational as well as financial issues is one measure to take.

Regulators are also advised to make sure there are legislation and regulation to cover these issues. The TF suggests regulators take a proactive view on these questions, and think in terms of legislation and approaches that will account for several situations even if they have not yet been encountered: try to cover all organisational change important to safety rather than to specify each example.

The TF suggests regulators should continue sharing experiences in this area. We suggest that NRWG organises a workshop during 2003. Collaboration with other organisations and groups should be considered.

The TF have discussed other manifestations of organisational change than these that have received their own sections in this report. Among those are other aspects of managing resources, succession management, change in organisational structure and turning towards process oriented management. The ability to analyse the situation, apply a safe and effective organisational solution and prepare for, introduce, implement and follow up effects of organisational change is also a matter of importance to safety. Other groups, (for instance OECD/CSNI “Special Experts’ group on Human and Organisational Factors”) are working with the issue of management of change and regulatory approach. Regulators are advised to take part in and follow the work of these groups.

7 LIST OF ABBREVIATIONS

IAEA	International Atomic Energy Agency
LCO	Limiting Conditions of Operation
CSNI	Committee on the Safety of Nuclear Installations
NPP	Nuclear Power Plant
PHARE	EC assistance programme to the countries of Central and Eastern Europe
PSA	Probabilistic Safety Assessment
RBMK	Russian designed boiling water reactor with graphite moderator