THE 25TH JAIF ANNUAL CONFERENCE

第25回原産年次大会

APRIL 8～10, 1992

JAPAN ATOMIC INDUSTRIAL FORUM

日本原子力産業会議

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第２５回原産年次大会総括プログラム

平成４年４月８日(水)～１０日(金)
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	第１日 ４月８日(水)	第２日 ４月９日(木)	第３日 ４月１０日(金)
午前	開会セッション (9:30～12:00) 年次大会準備委員長基調 原産会長所信 原子力委員長所感 〈特別講演〉	セッション２ (9:00～12:00) 「安全とは何か－統一的見解を目指して」 〔パネル討論〕	セッション４ (9:00～12:00) 「わが国のリサイクル路線の国際的な位置づけ－わが国の責務と諸外国の見解」 〔パネル討論〕
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４月８日（水）

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議長：安　部　浩　平　　　　中部電力（株）社長
　大会のねらい
　　石　井　威　望　　　　年次大会準備委員長
　　　　　　　　　　　　　慶應義塾大学教授
　原産会長所信表明
　　向　坊　　　隆　　　　(社)日本原子力産業会議会長
　原子力委員長所感
　　谷　川　寛　三　　　　原子力委員会委員長、科学技術庁長官

＜特別講演＞
　「２１世紀の科学技術と人類」
　　Y．ベリホフ　　　　　ロシア科学アカデミー副総裁
　「ジオカタストロフィの警告するもの」
　　坂　田　俊　文　　　　東海大学教授・情報技術センター所長

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―新たな５０年における原子力の役割

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　「２１世紀初頭のフランス、欧州における原子力の将来」
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　「国際的な安全基準と条約」
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　「中国の原子力開発の現状と展望」
　　閔　耀　中　　　　　　中国核工業総公司総経理助理
　「米国の電力化－１９９０年代における原子力発電」
　　J．P．ペイン　　　　米国エネルギー啓発協議会(ＵＳＣＥＡ)理事長

議長：青　井　舒　一　　　　（株）東芝社長
　「原子力発電の回顧と今後のエネルギー見通し」
　　W．K．ディビス　　　コンサルタント、元米国エネルギー省副長官
　「わが国のエネルギー政策」
　　林　　　政　義　　　　原子力委員会委員
　　　　　　　　　　　　　新エネルギー・産業技術総合開発機構理事長
　「国際協力における原子力安全」
　　K．テプファー　　　　ドイツ環境自然保護原子炉安全大臣

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４月９日（木）

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山　本　貞　一　　　　通商産業省資源エネルギー庁長官

＜パネル討論＞
パネリスト：
Ａ．ビルクホーファー　　　ドイツ原子炉安全協会理事長
石　川　迪　夫　　　　北海道大学教授
金　　炳　九　　　　韓国原子力研究所副所長
佐々木　史　郎　　　　東京電力（株）常務取締役
Ｅ．Ｊ．バーニー　　　　英国原子力施設検査局次長
Ｙ．ヤネフ　　　　ブルガリア原子力委員会委員長

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渡　部　恒　三　　　　通商産業大臣
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西　澤　潤　一　　　　東北大学学長

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- 「原子力施設の解体技術開発（デコミッショニング）」
- 「放射線疫学調査ってなあに」

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議長：今　井　隆　吉　　　　元軍縮会議日本政府代表部特命全権大使
(社)日本原子力産業会議常任顧問

＜パネル討論＞
パネリスト：
Ｊ．カルバリョ　　　　ブラジル原子力委員会（ＣＮＥＮ）委員長
Ｈ．ドラフォルテル　　　　フランス原子力庁（ＣＥＡ）国際局長
Ｗ．ダークス　　　　国際原子力機関(ＩＡＥＡ)事務局次長
遠　藤　哲　也　　　　前在ウィーン国際機関日本政府代表部特命全権大使
Ｂ．ゴードン　　　　米国兵器管理・軍縮庁核不拡散政策局長
Ｖ．Ａ．シドレンコ　　　　ロシア原子力省第一次官
Ｒ．モハン　　　　インド防衛・分析研究所客員研究員

＜参加者との討論＞

４月１０日（金）

セッション４（９：００～１２：００）
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－わが国の責務と諸外国の見解

議長：村　田　　　浩　　　　　(社)日本原子力産業会議副会長

＜基調講演＞

「わが国における核燃料サイクル政策について」

石　田　寛　人　　　　　科学技術庁原子力局長

「核燃料リサイクリング－ＩＡＥＡの見解」

Ｗ．ダークス　　　　　国際原子力機関（ＩＡＥＡ）事務局次長

＜パネル討論＞

パネリスト：

Ｎ．チェンバレン	英国原子燃料公社（ＢＮＦＬ）社長
Ｗ．ダークス	国際原子力機関（ＩＡＥＡ）事務局次長
飯　田　孝　三	関西電力（株）副社長 電気事業連合会原子力開発対策会議委員長
Ｔ．ネ　フ	マサチューセッツ工科大学 国際研究センター主任研究員
鈴　木　篤　之	東京大学教授

＜参加者との討論＞

セッション５（１３：３０～１７：３０）
社会は原子力情報に何を求めているか

議長：大　浜　一　之　　　　　科学評論家

＜パネル討論＞

パネリスト：

石　橋　忠　雄	弁護士
長　見　萬里野	(財)日本消費者協会事務局長
篠　原　　　徹	通商産業省資源エネルギー庁 公益事業部原子力発電課長
武　部　俊　一	朝日新聞社論説委員
中　島　篤之助	中央大学教授
成　田　頼　明	横浜国立大学教授
桝　本　晃　章	東京電力（株）広報部長

コメンテーター

Ａ．Ｄ．ロッシン　　　　　米国原子力学会次期会長

＜参加者との討論＞

フェアウェル・レセプション(１７：３０～１８：４５)

於　ヨコハマグランドインターコンチネンタルホテル　３階大宴会場「ボールルーム」

開会セッション

大会のねらい
年次大会準備委員長、慶応義塾大学教授
石 井 威 望

原産会長所信表明
（社）日本原子力産業会議会長
向 坊 　隆

原子力委員長所感
原子力委員会委員長、科学技術庁長官
谷 川 寛 三

〈特別講演〉
２１世紀の科学技術と人類
ロシア科学アカデミー副総裁
E．ベリホフ

ジオカタストロフィの警告するもの
東海大学教授・技術情報センター所長
坂 田 俊 文

大会のねらい

年次大会準備委員長
慶應義塾大学教授
石　井　威　望

ご臨席の皆様、第２５回原産年次大会の開催にあたり、大会準備委員長としてご挨拶を申し上げる機会を得ましたことは、私の深く慶びとするところであり、また四半世紀を迎えた記念すべき今大会に、日本国内のみならず世界各国から多数の方々にご参加いただきましたことを、ここに厚くお礼申し上げます。

さて、只今議長からもご紹介がありましたように、今から５０年前、米国のシカゴ大学で天然ウラン黒鉛減速型原子炉であるシカゴ・パイル（ＣＰ）－１を使い、エンリコ・フェルミらが世界で初めて核分裂連鎖反応の制御に成功してから、今年１２月２日で半世紀を迎え、今年は原子力界にとって歴史的にも一つの節目の年にあたります。この原産年次大会も、その半分の四半世紀にあたる２５回目を数えることになり、今大会では、２１世紀に向けて中・長期的な展望のもとに、わが国と世界の原子力発電をとりまく社会環境や今日的課題を論議することとなりました。

今大会の基調テーマ「２１世紀への課題－社会の中の原子力」は、世界の発電量の６分の１を供給している原子力発電の今日の状況を踏まえ、単に石油代替エネルギーにとどまらず、地球環境保全、南北問題の解決という側面からも論じられるほどに、その開発規模が成長した原子力の今後の５０年における役割を皆様に展望していただき、また討議していただくことを意図しております。

わが国では、原子力エネルギーが準国産エネルギーの役割を担うべく、原子力発電設備容量の拡大を図るとともに、これと併せ核燃料サイクルの完結に向けて多大の努力が払われてまいりました。世界に目を転じれば、１９９０年代から２１世紀初頭に向けてのエネルギー、原子力分野における展望の中で、幾つかの地域において経済成長に応じた原子力

発電の新規開発の兆しの動きもみられます。

人類は今日ルネッサンス以来の最大級の技術革新の真っ只中にあります。たとえば、半導体集積回路の進歩を辿ってみても、恐らく２１世紀初頭までに今日のメモリー素子（ＩＣチップ）の集積度の１０００倍程度にはなるだろうと予想されます。つまり、情報分野でのハードウエアの性能向上は驚異的であります。これが、チップ革命とかＩＣ革命と呼ばれており、全産業への波及効果は想像を絶する程です。これによって分散型の巨大システムの構築が可能になり、そのシステムの中に含まれるコンピュータは、いわゆるダウンサイジングによってポータブル化された機器になり、爆発的に普及するものと予測されます。そのような社会の情報化は、かつてモータリゼーションが社会全体に決定的影響を及ぼしたように、人類に豊富な制御能力の保有を約束するでしょう。人類は、もはやそれ以前の情報貧困状態ではなくなり、コンピュータ・ネットワークを介して各個人の社会への働きかけが可能になり、全体の活性化が起こりましょう。

地球環境の問題も、このような新しい情報面での活力を前提にして、その解決のシナリオが考えられねばなりません。宇宙衛星から送信されてくる地球全体の写真を眺められるのも、その成果の一つです。地球といっても従来は抽象的存在でしたが、今やその有限性が具体的に実感できるようになりました。このように宇宙時代であると同時に、高度情報化が進んだ２１世紀の社会が、原子力に対応する場合、当然前提条件における変化を認識する必要があります。要するに、エネルギー需要の内容が変化してきており、とくに環境への配慮が一段と要求されるようになるわけです。

宇宙船「地球号」という言葉に象徴されるように、経済活動のインフラストラクチャーとして環境が組み込まれるようになりました。経済活動と環境保全とのバランスを実現するために、情報システム技術がフルに応用されています。もちろん、その中でエネルギーの利用効率の向上は極めて重要な目標になるわけであります。このような背景を考えますと、原子力自身が高度な技術の産物でありますが、さらに先端情報技術群の活用を推進する必要があります。

エネルギーの確保と環境保全の両立の方途を論じることになっている大会第一日目のセ

ッションでは、２１世紀の科学技術の動向、そして現在の地球環境問題に警鐘を鳴らすことになる二つの特別講演に続き、海外の代表から２１世紀初頭を見通したエネルギー供給方策が紹介されることになっております。フランスの代表からは自国の原子力発電拡大への力強い自信と欧州規模でのエネルギー・原子力分野の対応策が、また日本、中国の代表からは原子力発電の役割増への期待が、そして米国の代表からは原子力産業の復活や再活性化に向けた新たな決意が表明されるものと思います。さらには、原子力安全分野の諸問題について、米国およびドイツの行政府の最高責任者から国際協力の側面に焦点をあてた諸方策が提案されるものと期待しておりますが、この二つの講演は大会二日目の「安全とは何か」のパネル討論の論議にも大いに資するものになると考えます。

「原子力発電はエネルギー供給と、温室効果をもつガスの排出削減に貢献する」とした主要先進国首脳会議の経済宣言にみるまでもなく、原子力発電を今後も進めていくことは先進諸国間の合意事項になっていると思いますが、その開発の方向性では一致していると言えるものの、各国それぞれ必ずしも明確な開発目標を掲げた原子力開発のためのシナリオを設定するまでには至っておりません。この背景として、最近の国際情勢の先行きに不透明な部分が多いことを指摘することができると思います。米国、ロシア等の核軍縮進展に伴う東西冷戦構造の解消、旧ソ連・東欧圏の社会主義体制の崩壊のもとで、国際政治・経済の将来見通しは極めて流動的であり、このため南北問題、平和維持機構を含めた新しい世界秩序を再構築することが必要であります。

わが国では、湾岸戦争や環境問題論争をきっかけとして、エネルギー問題に対する国民の関心が高まってきております。しかし、環境保全に対する国民の危機意識の急速な高まりやエネルギー問題に対する理解の高まりが、必ずしも原子力促進へと結びつかないのが問題視されるところでもあります。このジレンマの最大の要因は原子力がもつ潜在的な危険性に対する国民の不安にあると思われます。世論調査を行いますと、「原子力発電は安全でない」とみている人たちの回答が全体の半数近くを占めると聞きます。

今大会の第二日目には、「安全とは何か－統一的見解を目指して」をテーマにパネル討論を行います。スリーマイル・アイランド（ＴＭＩ）、チェルノブイリの二つの原子力発

電所事故の経験を通し、安全問題は各国における原子力論争のトリガーとなりました。例えば、旧ソ連邦内では、チェルノブイリ事故影響の誤った情報が流布された結果、これが原子力に対する健全な理解促進のために妨げとなったようです。また政治体制が激変した後の東欧では、旧ソ連から輸入したソ連型旧型原子炉の安全性に対する懸念が表明され、原子力の安全確保の考え方に疑問が投げかけられるとともに、安全とは何かがあらためて問い直されることとなりました。とはいえ、論議の拠り所となる安全の概念そのものが極めて漠然としているため、この安全論議は空転しがちであるといわれています。このパネル討論では、「どこまで安全であれば十分安全といえるのか」の概念づくりを含め、安全に対する共通の認識を構築するための方策をさまざまな角度から検討し、独創的な提案を積極的にしていただければ幸いであります。

ところで、１９９０年代に入り、核不拡散問題の焦点は、旧ソ連の核物質管理と潜在的紛争当事国の核保有阻止に移りつつあります。核不拡散条約（ＮＰＴ）が１９９５年に期限切れになるのを前に、現在、国際原子力機関（ＩＡＥＡ）による特別査察を含めさまざまな核不拡散体制の維持・強化策が検討されつつあります。今大会では、ＩＡＥＡをはじめ、各国の専門家が参加して、新しい国際秩序の構築を念頭に置き、原子力平和利用の促進と国際核不拡散体制の新しい考え方を模索する国際パネル討論を行います。ここでも、この核不拡散問題と取り組むわが国の積極的な姿勢をはじめ、活発な議論の展開を期待したいと思います。

中・長期的課題として、地球環境を保全しながら、一定の経済成長率を達成していくことがよく指摘されますが、この課題を解くカギの一つは、やはり先進工業諸国において原子力発電を積極的に推進していくことにあると思います。その背景には、原子力開発を進めていく本質的な特徴の一つに化石燃料資源を温存していくことに貢献できるからとの考え方があります。このためわが国では、原子力発電所の燃料としてプルトニウムを利用し、ウラン資源をさらに有効利用する道を切り開いていこうとのシナリオが出されております。大会最終日には、「わが国のリサイクル路線の国際的な位置づけ」をテーマに、このプルトニウム利用問題をめぐる国際パネル討論を行います。今後、プルトニウムを平和目的の

原子力発電用に積極的に利用していくというわが国の野心的な計画は、国際コミュニティの理解と協力がなければ実行できるものではありません。わが国の再処理・リサイクル路線に対する諸外国の率直な見解を聞くことになるこの国際パネル討論は、わが国の原子力関係者が次のステップへ上る試金石として活発に行われる筈であり、その結果が注目されると思います。

また大会の最後を締め括る討論テーマは「社会は原子力情報に何を求めているか」であります。原子力に関する情報については、「公開されている」、「公開されていない」の二つの問いに分けると、世論調査では、「公開されていない」との回答が「公開されている」との回答を大きく上回ると聞いております。この問題はわが国特有の社会条件等、それぞれの立場での認識の違いなども絡んでくると思われます。このパネル討論では、いろいろの立場の各界の方々にご参加いただいておりますので、活発な討論が行われるものと期待しております。

以上、大会の準備委員長として、今大会のねらいにつきまして概略をご報告申し上げました。原産年次大会は2年前の京都大会以来、内外の参加者とスピーカーの討論にも十分な時間を割くことでプログラムを企画してきておりますので、時間の許す限りフロアの方にも討議に積極的にご参加いただければと思います。また大会の最終日は一般の方々を対象とした聴講者の方もご参加いただけることになっておりますので、より活発な討論が交わされるものと思われます。

最後に本年次大会における議長、スピーカーをご快諾いただきました大会関係者各位に厚くお礼を申し上げますとともに、本年次大会に参加された国内および海外からの皆様に感謝の意を表し、今大会が実りの多い大会として終わりますように心から念願をする次第でございます。どうもありがとうございました。

以　上

Conference Keynote

Takemochi Ishii
Chairman
Program Committee
Professor
Keio University

Ladies and Gentlemen:

It is a great pleasure for me, as chairman of the program committee for the 25th annual conference of the Japan Atomic Industrial Forum.

As Mr. Chairman of the Conference has said now, we are to mark on Dec. 24 the 50th anniversary of Enrico Fermi's first success in the world in controlling nuclear fission chain reaction at the University of Chicago, using the Chicago Pile (CP)-1, a natural uranium graphite moderation type nuclear reactor. In this sense, this year is a memorable year to the nuclear industry. The Japan Atomic Industrial Forum is going to mark the 25th anniversary of its birth, a turning point in its history. In this sense, it has been decided that this conference should discuss present tasks toward the 21st century concerning the social environment surrounding the nuclear industry in Japan and the world with a mid- and long-range outlook.

Concerning the keynote theme of this conference "Challenges to the 21st Century -- Nuclear Energy in Our Society, we would like to have you discuss a prospect for the role of nuclear power in the coming 50 years, not merely as an oil-alternative energy source, but from the standpoint of protecting the global environment and solving the south-north problem, in consideration of the fact that at present nuclear power generation accounts for one-sixth of the world's electric power generation.

Our country has endeavored to expand the capacity of nuclear power facilities and complete a nuclear cycle so that nuclear energy may play its role as a virtually domestic energy source. If we take a look at the world, we will see in certain areas and region, signs and moves to newly develop nuclear power facilities commensurate with their economic growth, in consideration of the energy situation from the 1990s and the 2000s and a prospect for achievements in the area of nuclear energy.

Mankind is now in the midst of the greatest technological innovations since the Renaissance. It is estimated that the integration of today's memory (IC) chips will be increased 1000 times by early in the 21st century. In order words, the performance improvement of hardware for information processing is really surprising. This is called the chip revolution or IC revolution, and is having far-flung effects on all industries. Such a large integration memory chip makes it possible to configure a large-scale distributed type computer system. Contained in such a system are down-sized portable computers, which are expected to spread at an explosive pace. This informationalization of society will promise a tremendous capacity of control to mankind just as the motorization had a decisive impact on society as a whole. Unlike in the period of paucity of information in the past, individuals will be able to make their activities felt in society through computer networks, and the society as a whole will be greatly reactivated.

A scenario for the solution of the problem of the global environment should be worked out on the premise of the new vitality of information systems. One of such achievements is that we are able to examine photographs of the earth as a whole which are transmitted from space satellites. The earth was once a more or less abstract existence, but now we are able to understand its finiteness with a keen feeling of reality. In consideration of the fact that our age is a space age, in order for us to respond to nuclear power in a highly information-oriented society in the 21st century, we should naturally take note of changes in preconditions. In other words, the content of energy demand is changing, and particularly consideration to the environment will be required to paid more and more.

As is symbolized by the words "Spaceship Earth," the environment has come to be taken into consideration as infrastructures for economic activities. In order to balance economic activities with the conservation of the environment, information systems technology is now being fully utilized. Needless to say, for this purpose, an effective utilization of energy is an important target. Taking this into consideration, while nuclear power itself is a product of high technology, it is necessary to further promote the utilization of advanced information technologies.

In the discussions on the first day of the conference in which ways and means of making energy assurance compatible with environmental conservation will be taken up for discussion, overseas delegates are scheduled to present their views on ways of energy supply up to the early 21st century, following two lectures on trends in science and technology in the 21st century, which will sound warnings about the problems of the global environment. A French delegate will express his strong confidence in the expansion of nuclear power generation in his own country and make explanations on Pan-European responses to energy and nuclear power. Japanese and Chinese delegates will express their views on the increased role of nuclear power generation, while a U.S. delegate will express the determination of the United States to revive and revitalize the nuclear industry. Furthermore in the area of problems related to nuclear safety, high ranking U.S, and German government leaders responsible for nuclear power are expected to make proposals with emphasis on international cooperation. The lectures by these two government leaders will contribute greatly to panel discussions on what is safety on the second day of this conference.

There is no need for us to refer to the Economic Declaration of the Summit Meeting of the Heads of Government of the principal developed countries of the world to stress that future development of nuclear power is a point of agreement among the developed countries of the world. While it is true that they are agreed on the direction of development of nuclear power, but it cannot be said that different countries of the world have their clear-cut development targets and have set their scenarios for nuclear development. As a background to this situation we may cite not a few uncertain factors in the recent international situation. After the collapse of the east-west cold war structure due to the progress of nuclear disarmament in the United States, Russia and other countries, and the demise of the socialist systems in the former Soviet Union and East European countries, we can obtain only an uncertain prospect for international politics and economy. In view of this, it is urgently needed to restructure a new international order, including the solution of the south-north problem and a mechanism for the maintenance of peace.

In Japan there is growing interest in the problems of energy after the Gulf War and in connection with active discussions on the environmental problem. However, the problem is that the rapidly increasing crisis-mindedness of the public and an increased understanding of the energy problem do not necessarily lead to the promotion of nuclear energy. The most important reason for this is public anxiety over the potential danger of nuclear power. According to a public opinion poll conducted in Japan, nearly half of the respondents said that nuclear power was not safe.

On the second day, panel discussions will be held on the theme "What is safety -- Toward a unified view. Two nuclear disasters at nuclear power plants, that is, the Three Mile Island Accident and the Chernobyl disaster, triggered active discussion on the problem of nuclear safety in many countries of the world. For instance, in the former Soviet Union, wrong information was spread on the effect of the Chernobyl disaster, and this wrong information appears to have hindered a correct understanding of nuclear power. In East Europe where old Soviet type nuclear reactors were introduced, anxiety is expressed about their safety, People there question the concept of safety assurance for nuclear power and are posing the question "What is safety." However, since the concept of safety on which discussions are based, is vague, it is said that discussions over this question will lead them nowhere. It is hoped that the participants in the panel discussions will discuss from various angles the measures for proposing a common concept of safety, including the concept of how far a nuclear plant should be safe in order to be a safe plant, and make original plans positively.

From the beginning of the 1990s, the focal point of the nuclear nonproliferation question is switching to the control of nuclear substances in the former Soviet Union and the prevention of possession of nuclear weapons by countries in potential dispute. Prior to the termination of the nuclear nonproliferation treaty in 1995, IAEA is studying measures to maintain and strengthen the nuclear nonproliferation regime, including special inspections of nuclear facilities by IAEA. At this conference, international panel discussions will be held with the participation of specialists from IAEA and various countries to evolve a new concept of peaceful utilization of nuclear energy and an international nuclear nonproliferation regime, keeping in mind the structuring of a new international order. Here, too, active discussions are expected to be held on our country's positive stance on the problem of nuclear nonproliferation and various other matters.

Achievement of a certain economic growth rate while protecting the global environment is posed as a mid- and long-range task. I think a major key to the solution of this task is for industrially developed countries to positively promote nuclear power generation. This is because one of the essential features of nuclear power development is to preserve fossil fuel resources. In view of this, in our country we follow a scenario of opening up a process of effectively utilizing uranium resources by utilizing plutonium as fuel for nuclear power plants. On the last day of this conference, international panel discussions are scheduled to be held on the problems of plutonium utilization under the discussion theme "On the international position of Japan's recycling policy line." Japan's ambitious plan to positively utilize plutonium for peaceful purposes cannot be realized without the understanding and cooperation of the international community. The international panel discussions in which frank views will be actively expressed by the participants on Japan's reprocessing and recycling policy line, will be a touchstone to the Japanese who are engaged in the development of nuclear energy, and will be fully used by them in their advance to the next step.

The discussion theme on the last day of this conference is "What does the public want to know about nuclear information?" Asked if nuclear information is disclosed or not, it is reported, those who replied that it is no disclosed far outnumbered others who said that it is disclosed. I think this problem is related to social conditions peculiar to Japan and different individual recognitions. At the panel discussions, which will bw participated in by people from various different circles, active discussions are expected to be held.

In the above, I have outlined the aims and purposes of this conference as chairman of the program committee for this conference. This conference is the second one open the floor to the participants since the Kyoto conference held two years ago. We have planned our program this year so that Japanese and foreign speakers are allowed as much time as possible to speak, and participants on the floor are encouraged to speak at this conference. On the last day of this conference, ordinary people are to participate in the discussions, and an active exchange of views in expected.

Lastly, I thank very much those who gladly accepted our request to act as chairman, attend this conference as speakers and act as officers of this conference, and express my deep gratitude to Japanese and foreigners participating here, and sincerely wish that this conference will be held successfully.

年次大会会長所信表明

平成４年４月８日
日本原子力産業会議
会長　向坊　隆

議長、御臨席の皆様、私は今年２月より圓城寺さんに替わりまして、日本原子力産業会議の会長を勤めさせていただいております向坊でございます。原産年次大会の開催に当たり、主催者を代表しまして、一言私の所信を述べさせていただきます。

わが国が原子力の平和利用の研究を開始してから、40年近くになろうとしております。原子力利用に対する関係者の情熱、努力の甲斐があって、わが国の原子力は健全な開発、運転ができるようになり、現在、42基、3,340万キロワットの原子力発電所が稼働中で、その発電量は全発電量の28%に至っております。

私どもは、何のために原子力の開発に情熱を注ぎ、努力してきたのでしょうか。単に自国のエネルギー供給のためだけに開発を行ってきたのでしょうか。私どもは常にそのことを振り返ってみることが必要であると思います。

わたしが考えますには、わが国の原子力開発は、自国のためばかりでなく、世界のため、人類のためという大きな命題が、その根底にあったと確信しています。唯一の原爆被爆国である日本として、それからわずか10年の後に、原子力平和利用の研究に踏み切ることができたのは、核エネルギーの軍事利用は絶対行わず、人類のため、わが国のために平和利用に限って利用するという原則を確立し、それを実践することにありました。このことが、わが国の国民合意の原点でありました。そしてそれは、達成されていると思います。また、その結果の一つとして、原子力の開発が、安全性に対する先取りした考え方の導入や、産業と社会とのあるべき姿を描くことができ、企業の倫理の高揚、近代化の促進にも大きな影響を与えたと考えています。

今、世界は、イデオロギーを超えて、世界平和と相互協力に基づく新秩序を構築しつつあるといえます。このような中における人類の今後の大きな課題は、核兵器の廃絶と、地球環境問題への対応であります。

核兵器の廃絶は、わが国の原子力関係者のみならず、国民全体の悲願であり、全人類の悲願でもあります。超大国の緊張が緩和され、核軍縮が大きく進展しようとする今は、人類の悲願が希望に転じる歴史的な時期であります。しかしその反面、一部の国での核兵器開発の動きは、人間の愚かさを露呈すると共に、世界の人々の悲願を踏みにじるものと言わざるを得ません。核エネルギーは人類を破滅させるためではなく、人類を末永く繁栄させるためにのみ使われるべきものであります。

核軍縮、核廃絶についての働きかけは、わが国の政府、並びに国民の運動として、早くから精力的に進められてきました。私ども原子力関係者としては初めて、1982年６月の第２回国連軍縮特別総会に、当時原産会長であった有澤廣巳先生が代表してメッセージをお

くり、核軍縮について提案を行いました。それは、核廃絶への象徴的な意志表示として、核兵器を解体し、取り出された核物質を今後原子力平和利用に参入しようとする国のために、核燃料のストックパイルとして提供するよう提案したことです。アメリカ合衆国並びに独立国家共同体では、核兵器の解体が現実になりつつありますが、進めるにあたっては、取り出された核物質を拡散させることなしに、平和利用に有効に活用できるよう配慮されることを希望いたします。

核軍縮ばかりでなく、核不拡散も今後の大きな問題であります。安全保障は核兵器を持つことによって達成されるものではないことは、二つの超大国の例にみるまでもないことであります。また持とうとしても、世界各国からの孤立化は必然であり、何よりも、核を持つことにより、自国民を危険に陥れることにもなります。

そのような愚かなことを繰り返さないためには、日本のような国が、機微な国とも積極的に情報交換、人的交流を図り、核兵器開発の愚かさを伝える努力をすることが重要なことであり、使命でもあると思います。

核軍縮、核不拡散のために、世界的秩序の制度である核拡散防止条約（ＮＰＴ）は堅持しなくてはなりません。一部で、不平等条約であるがために、その加盟に同意しない国々があります。確かに核拡散防止条約は不平等ではありますが、それは世界に現存する不平等の状況を反映しているに過ぎません。私はこの条約が、核軍縮、核拡散防止を進展させることにより、不平等を平等に変えていくものであると考えています。

核兵器を作らせない、あるいは削減させるためには、人間同士と同様に、国同士、国民同士のコミュニケーションを広げることが大切なことであります。繰り返すようですが、わが国は、従来にも増して、多くの国々と話し合う機会を作り、　コミュニケーションを行う努力が必要であります。

人類にとって平和を維持するためには、エネルギーの安定的な確保はなくてはならない重要な要素であります。世界の人口は2000年で現在の20％増しの65億人、2025年で57％増しの85億人と推定されています。人口の増加分だけでも、エネルギーの消費量は増加しますし、各国が発展のために努力すれば、エネルギーの需要はさらに増加します。わが国を含め、エネルギー多消費国は人類全体のこと、地球環境のことを考え、省エネルギーの努力を一層強力に進めるべきであります。

また、エネルギー供給につきましては、太陽エネルギーなど新エネルギーや核融合の研究開発が進展しておりますが、わが国はこの方面の技術開発をも積極的に進め、経済的にも利用できるようにすべきであります。

しかし今は、実用可能なあらゆるエネルギー源を、それぞれの欠点をカバーしつつ利用し、安定供給を図らなくてはならない時期であります。原子力は、いわゆる「地球に優しいエネルギー」の一つである優れたエネルギー源であります。安全確保を第一に、原子力平和利用の積極的な利用を行うことは、環境問題を緩和することからも、世界の技術先進国の義務であります。

先に述べましたように、わが国は原子力平和利用におきまして大きな成果を挙げるに至っておりますが、原子力エネルギーのトータルな供給システムは完成しておりません。それは、プルトニウムの利用や、高レベル放射性廃棄物の処分問題などが解決されていないためです。

この年次大会では、日本の原子力開発の姿勢、世界での原子力平和利用のあり方、さらにはそれら諸問題につきまして議論していただくためにプログラムを考えました。忌憚のないご批判、ご意見を賜り、今後の原子力推進に役立てたいと考えています。

最後になりましたが、年次大会の準備委員長、及び準備委員、各セッションの議長の方々、この大会のために御参集いただきました海外、国内の発表者の方々、並びに会場の皆様に、心よりお礼を申し上げ、私の所信とさせていただきます。

ご静聴、ありがとうございました。

以上

Address to Annual Conference

Takashi Mukaibo, JAIF Chairman

April 8, 1992

Chairman, ladies and gentlemen, welcome to JAIF's Annual Conference. As you have heard, my name is Takashi Mukaibo, and I am the new chairman of the Japan Atomic Industrial Forum, having taken over from Mr. Enjoji in February. I am deeply honored to deliver the opening address before you on behalf of the sponsors of the Conference.

Some forty years have passed since Japan began studying peaceful uses of nuclear energy. We owe much to the enthusiasm and efforts of all interests involved in this field for achieving the sound development and operation of our nuclear power plants. Japan now has 42 plants operating with a capacity of 33.4 million kilowatts. They account for 28 percent of all generated electricity in Japan.

Why is it that Japan has been so enthusiastic in its efforts to promote the development of nuclear energy? Is it simply for securing a stable energy supply? That, I think, is a question that we must always reflect on. From my viewpoint, the development of nuclear energy in Japan has been promoted mainly with a view to serving domestic needs as well as those of the rest of the world. Our decision to embark on the study of peaceful uses for nuclear energy in Japan, the only country to have been atom-bombed, came only ten years after Hiroshima and Nagasaki. We were able to reach such a decision because we were ready to establish and practice the principle by which nuclear energy would never be used for military purposes but only for peaceful purposes, aiming to benefit all mankind. That has provided a basis for a national consensus on the subject. I believe these decisions have been achieved. As a result, nuclear energy has been developed here with an emphasis on safety and with a vision of its place in relation to industry and society. So I feel that the development of nuclear energy in Japan has broadly served to enhance business ethics and promote industrial modernization.

The world is now moving past differences of ideology toward the establishment of a new order based on world peace and mutual cooperation. One major task for mankind in the future will be to eliminate nuclear weapons and resolve the environmental crisis.

The elimination of nuclear weapons is a long-sought goal, not only by the interests involved in nuclear energy in this country, but also by the Japanese people at large and all mankind. Now that the tension between superpowers has eased, enabling rapid progress toward nuclear disarmament, this is a historic time when mankind's wishes begin to be realized. Meanwhile, however, certain countries are moving to develop nuclear weapons, showing the height of folly that humans can reach and going against the wishes of people around the world. Nuclear energy should not be used for annihilating mankind, but rather for assuring its lasting prosperity.

Nuclear disarmament and the elimination of nuclear weapons are goals that have long been called for in repeated appeals by the Japanese government and in energetic movements by the

Japanese people. Professor Hiromi Arisawa was the first Japanese person involved in nuclear energy to propose nuclear disarmament when he sent a message, in his capacity as JAIF chairman, to the second U.N. Special Session on Disarmament in June, 1982. In a symbolic declaration of intention to eliminate nuclear weapons, he proposed that nuclear weapons be dismantled in a way that nuclear materials would be taken out from them and offered as a stockpile of nuclear fuel to countries preparing to begin using nuclear energy for peaceful purposes. Today, the dismantling of nuclear weapons is already beginning in the United States of America and the Commonwealth of Independent States. We hope that this process will not allow the nuclear materials taken out to proliferate, but will instead put them to effective use for peaceful purposes.

In addition to nuclear disarmament, another important task for the future is the non-proliferation of nuclear weapons. National security cannot be assured through only owning nuclear weapons, as had been the case with the two superpowers. If any country seeks access to nuclear weapons, it will certainly be isolated from the rest of the world. No country can have nuclear weapons without endangering its people. To stop such a dangerous folly from repeating, it is important -- and even imperative -- that countries like Japan strive to promote exchanges of both information and personnel with nervous countries, reminding them of the stupidity of developing nuclear weapons.

To promote nuclear disarmament and prevent the spread of nuclear weapons, the Nuclear Non-Proliferation Treaty (NPT) must be maintained as the regime to keep world order. Some countries regard the treaty as too unfair to be adhered to. To be sure, it is an unfair treaty, but that only reflects the inequalities existing in the world. I think, however, that it is a treaty that can give birth to equality out of inequality by promoting nuclear disarmament and the non-proliferation of nuclear weapons. If all countries and peoples are to be dissuaded from making nuclear weapons, or to be motivated to reduce their numbers, close communication must be maintained between them just as if they were individual human beings. Incidentally, let me add that Japan should devote more energy to providing opportunities for talks and communication among many countries.

Energy security is an indispensable and important factor in preserving peace for mankind. The world's population is estimated to increase by 20 percent to 6.5 billion people in the year 2000, and 57 percent to 8.5 billion people in 2025. The increase of population alone will cause energy consumption to grow. If all countries try to maintain economic growth, they will need much more energy. Out of consideration for all mankind and for the world's environment, Japan and other large energy-consuming countries should work harder to conserve energy.

Research and development is being carried out on solar energy and other new energy sources, as well as nuclear fusion, in order to maintain a future energy supply. Japan should positively promote the development of technology and its economic viability in this field. However, all available energy sources should now be utilized, each making up for the other's drawbacks, to achieve the stability of energy supply. Nuclear power is an outstanding energy source that is "friendly to the earth", so to speak. Promoting the use of nuclear energy for peaceful purposes, with top priority placed on safety assurance, is a duty that technologically advanced nations should fulfill in resolving environmental issues.

Japan has come a long way, as I stated earlier, in promoting the peaceful use of nuclear energy. But Japan has yet to complete a supply system for nuclear energy, since problems remain about how to recycle plutonium and dispose high-level radioactive wastes. We have arranged a program in this year's conference for participants to discuss Japan's attitudes toward the development of nuclear energy, as well as how nuclear energy can be used peacefully worldwide, and related issues. We welcome your honest criticisms and opinions, as they may help to us in our future efforts to promote nuclear energy.

In closing, let me express my warmest regards to the chairman and members of the Program Committee for the JAIF Annual Conference, the chairmen of all the conference sessions, the presenters of papers to the conference, and the rest of the participants.

第２５回原産年次大会原子力委員長代理所感

原子力委員会委員長代理
大山　彰

（はじめに）

本日、第25回原産年次大会が、内外多数の方々の出席のもと、盛大に開催されることは誠に喜ばしく存じます。

向坊会長、石井大会準備委員長を始め、大会の開催に御尽力された皆様方に心からお祝いを申し上げますとともに、原子力分野で指導的な役割を果たされている皆様とこの場に会することができ、大変喜ばしく思います。

（エネルギー、環境と原子力）

世界のエネルギー需要は、開発途上国を中心に、今後とも着実な増大が見込まれ、エネルギーの安定供給はこれからの人類の重要な課題であると思われます。

先の湾岸危機においては、大過なく終始したものの、同危機は世界にエネルギー安定供給の重要性を再認識させるとともに、エネルギー源の多様化に貢献する原子力の重要性が改めて指摘されました。

本年６月には「環境と開発に関する国連会議」が開催されるなど、地球規模での環境問題の解決に向けた取組みが行われています。持続的な経済発展を確保しつつ、人間活動と環境保全の両立を図るため、化石燃料の使用抑制などのエネルギー政策面における対応が求められています。原子力は発電の過程で温室効果ガス等を排出しないことから、地球環境問題の解決に貢献する有力な手段として期待されます。

現在、世界の原子力発電は、世界の総発電電力量の約16%を占めております。国別にみますと、フランスの７５％が原子力というのを筆頭に、２５ヶ国で原子力発電所が運転中です。お隣の韓国では、ほぼ５０％が原子力であり、我が国では約２７％となっております。

このように供給安定性、経済性、環境影響の面で優れた特長を持つ原子力発電は、すでに電力供給の主要な担い手として重要な役割を果たしていると云えます。

（原子力の安全確保）

原子力の開発利用については、安全性を確保することがもっとも大切であります。我が国においては、厳格な安全規制を実施するとともに、事業者においても、安全管理に努力しているところであります。また、原子力の安全は、一国のみの問題ではなく、世界の共通の問題であるとの認識のもと世界の原子力の安全性向上に貢献していく所存であります。国際的に安全性が懸念されている東欧や旧ソ連の原子力発電所に関しては、できる限り支援したいと考えております。去る３月24日に発生したロシア連邦のレニングラード原子力発電所の事故につきましても、事故原因、影響等の調査を行うとともに、原子力の安全性確保についての意見交換を行い、今後の支援方策を検討するため、現在調査団を派遣しています。

（原子力のＰＡ）

さて、原子力の開発利用を円滑に進めるためには、国民の理解と支持が大切であります。しかしながら、原子力発電は、その安全性に対する不安感などを背景に、施設の新規立地などのスケジュールに大きな影響を与える場合が多くなっています。かかる状況に鑑み、まず安全確保の実績を着実に積み重ねるとともに、住民の疑問や不安に直接答えるべく講師を派遣するなど、原子力に関する理解の促進のための様々な活動を行っています。また、国際的な連携も必要であるとの認識の下に、海外諸国や、国際機関との協力の強化を図っております。

（基軸エネルギーとしての確立）

我が国は、エネルギーの安定供給を確保するため、原子力発電の着実な推進を図る一方、ウラン資源を有効に利用し、長期的な原子力発電の供給安定性を高めるため、来世紀における高速増殖炉実用化を目指しています。このため、原子力の開発利用に着手した段階から、使用済燃料を再処理し、回収されたプルトニウム及びウランを核燃料として利用するための技術開発を推進して参りました。本年は、英仏への再処理委託により回収されたプルトニウムの返還輸送が実施されるとともに、また、高速増殖炉原型炉「もんじゅ」については、臨界を目指した総合機能試験を実施する計画であり、これらを着実に実行することが重要であります。

青森県六ヶ所村においては、ウラン濃縮施設が去る３月２７日に操業を開始し、さらに低レベル放射性廃棄物埋設施設は、本年末の操業開始に向けた準備が進められております。また、再処理施設については、原子力委員会及び原子力安全委

員会による審査が行われています。今後地元との共存共栄をはかり、核燃料サイクル施設の建設計画が円滑に進められるよう、一層の努力が必要と考えております。

（研究開発の推進）

つぎに、原子力の先導的な研究開発について述べたいと思います。

人類が恒久的なエネルギー源を確保する可能性のある核融合の研究開発は、臨界プラズマ実験装置（ＪＴ－６０）により、現在重水素を用いた高性能化実験を実施しております。また、日本、米国、ＥＣ、ロシアの４極の国際協力により進められている国際熱核融合実験炉（ＩＴＥＲ）計画については、近々各極における工学設計活動の開始が予定されており、我が国としては、共同設計チームの一部を我が国に招致するなど、この計画に積極的に参加していくこととしております。

高温ガス炉技術に関しては、熱エネルギー供給による将来の原子力利用分野の拡大を担うものとして、基盤技術の確立のための研究を行うため、高温工学試験研究炉（ＨＴＴＲ）の建設を進めております。

放射線の利用は、医療、工業、農業などの分野への幅広い応用を通じて、国民生活の向上に大きく貢献するものであり、その一層の普及・拡大及び利用技術の向上を図ることが必要です。さらに、放射線高度利用のためのイオン照射施設、物理、化学など幅広い分野での応用が期待されている大型放射光施設（ＳＰｒｉｎｇ－８）、難治性がんの治療を可能とする重粒子がん治療装置などの建設を進めております。

原子力船の研究開発については、原子力船「むつ」が、関係者の努力により、ほぼ１年間にわたる実験航海を終了いたしました。「むつ」は、今後、解役する予定でありますが、「むつ」の実験航海で得られたデータ、知見、経験などは、舶用炉の研究開発などに十分に活用していくこととなります。

（積極的な国際貢献）

原子力を巡る国際情勢は大きく変動しております。

旧ソ連の核兵器の削減に伴い発生する核物質の管理、核兵器関連の技術・人材の流出の問題などが、国際的に懸念されております。また、先の湾岸危機の後、イラクの未申告核物質保有が判明したことから、国際原子力機関（ＩＡＥＡ）に

おいて保障措置の整備・強化に関する検討が進められているところであります。さらに、北朝鮮については、保障措置協定の早期批准、確実な履行が強く望まれているところです。

こうした世界的な核兵器拡散に関する懸念に対して、原子力基本法に基づき厳に平和目的に限り、原子力開発利用を進めてきた我が国としては、諸外国との連携のもと、核不拡散体制のより一層の強化に積極的に対応する所存であります。旧ソ連における核兵器の削減に伴い発生する核物質については、厳格な管理の実施が基本と認識しているところでありますが、核物質の処理に関し、国際的な連携のもと、我が国がこれまで培ってきた原子力平和利用技術の応用により、如何なる協力があり得るかについて、検討したいと思います。

先ほど向坊会長の所信表明の中で、第２回国連軍縮特別総会に対する有澤先生のメッセージのお話がありました。私も、今日このメッセージを思い起こしているものであり、１０年前の先生の先見の明に敬意を表するとともに、この度の事態が核兵器拡散につながることなく、先生の御提案の実現の第１歩となることを希望するものであります。

次に、開発途上国との協力については、相手国の国情を勘案しつつ、研究基盤の整備と人材養成に重点を置き、協力を進めております。このうち、我が国と歴史的、地理的、経済的に密接な関係にある近隣アジア諸国との協力においては、本地域全体の原子力技術水準の向上に貢献して参る所存です。この一環として、先月第３回アジア地域原子力協力国際会議を行い、地域協力についての検討を進めました。さらに、先進諸国との間においても、核融合、高速増殖炉、高レベル放射性廃棄物の処理処分などに関する協力を積極的に進めております。

（おわりに）

我が国の原子力の開発利用を進めるに当たっては、平和利用に限定することと安全の確保が基本であります。私としてはこれらの基本を守り、適切かつ着実な計画の推進に努める所存でありますので、皆様方におかれましても、一層の御支援、御協力をお願いする次第であります。

本日から３日間、内外の有識者・専門家の方々の間で忌憚のない活発な意見交換が行われ、また貴重な提言がなされ、本大会が成功を収められんことを心から祈念して、私の所感とさせて頂きます。

セッション１

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THE PROSPECTS OF NUCLEAR ENERGY IN FRANCE AND IN EUROPE AT THE DAWN OF THE 21st CENTURY

by
Philippe Rouvillois
Administrator General
Commissariat à l'Energie Atomique

The past thirty years have seen nuclear energy assume a significant part of the world's energy supply. Its contribution is even essential in many industrialized nations; as regards France, I need only mention that three quarters of the electricity generated is of nuclear origin, to illustrate the importance which my country assigns to this power source. But, there is no need to dwell on this point in this forum, when Japan is setting an example of steady growth and consistency in the development of nuclear energy.

In recent times, nuclear energy has been very much in the news, and continues to attract attention from the public at large: The Chernobyl accident and its consequences have shown the importance of safety considerations, as well as the fragility of the consensual attitude which formerly prevailed towards nuclear power. The Gulf Crisis stressed once again the potential asset nuclear power represents for countries with scant fossil resources. Last, the end-of-cycle and waste aspects of nuclear power are also a source of questions.

An unquestionable technical and industrial success, an economic success in countries such as Japan or France, nuclear power is still the subject of debate. We may wonder now this dual aspect will affect its future development and the part it will play in meeting the energy requirements of the next two or three decades.

1. WHAT WILL BE TOMORROW'S PLACE OF NUCLEAR POWER IN FRANCE AND IN EUROPE?

We may be sure that there is a growing need for energy, which will require the mobilization of all the available sources. Nuclear power will be one of those sources; in Europe, and particularly in France, it will continue to be very important.

In addition to this demand, which will continue to grow at a rate depending on many factors of national or international nature, we must consider the need to renew existing production facilities. In France, the first replacements of existing facilities should take place in the 2005-2010 period, based on the 30-year lifetime currently assigned to generating plants.

We are planning for the future. The technology is well-proven;

it has reached the industrial development stage, and the new challenge facing Europeans is to concentrate on its improvement by taking advantage of field experience and developing new approaches and processes.

. At the front end of **the full cycle**, enrichment process development is of paramount importance. The 1980's fears of material shortages have been replaced by an actual glut of material available on the market or on a mediumterm basis.

The U.K. and Germany base their strategies on the centrifugal enrichment process, and are investigating laser techniques.

France places the bulk of its research effort on **isotopic separation by laser**, to supplement and eventually replace the gaseous diffusion facilities developed and operated in the EURODIF plant. Recently, a 10-gram quantity of PWR-grade enriched uranium was produced in just over two hours by the SILVA pilot plant in Saclay. This is a important step which proves the feasibility of the process and gives our research staff confidence in the reliability of the laser systems involved.

In the next few years, the separator of the process will be subjected to testing on experimental models, with a view to industrialization.

Approaches to the back end of the fuel cycle reflect different philosophies. In contrast to Swedish and U.S. civilian practice, which is based on the direct disposal of spent fuel, the **reprocessing** approach has been chosen by France, Germany and the U.K. as well as Japan; reprocessing entails the recycling of plutonium in the form of **MOX fuel**, the final **storage** of low-activity waste **above ground**, and research on the disposal of high-activity waste.

. **Light water reactors** are the predominant reactor type in France and throughout the world. Development is conducted within European structures, among which Nuclear Power International (N.P.I.), a French-German corporation in which SIEMENS/KWU and FRAMATOME are associated. Design options for the N.P.I. Nuclear Island were chosen by manufacturers in 1991. Although European power generating companies have yet to comment on those options, it is very likely that the new reactor will be a large unit (over 1000 MWe), incorporating new features such as simplified system design, improved man/machine interfacing, the use of passive-type system in some cases, and improved solutions for the containment of active products, aimed at mitigating the consequences of serious accidents.

When introducing such innovations, one must however retain the benefits of component standardization and large production runs, which are essential to keep costs under control and take advantage of experience feedback. Extended plant life, the widespread use of MOX fuel and higher burn-up, will help make nuclear power economically more attractive.

. **Fast breeder reactors.** The development of fast breeder reactors continues within a European cooperation structure which benefits from the experience accumulated with the "Phénix" and "PFR" demonstration reactors and the "Superphénix" industrial prototype. Cooperation programs are being conducted with other countries, among which Japan and the United States.

Uranium prices have dropped to such low levels that fast breeder reactors have no short-term prospects of competing with light water reactors. The breeder concept may however become attractive again in 20 to 30 years' time. Meanwhile, this type of reactor could make a worthwhile contribution to the disposal of plutonium and perhaps of the other actinides.

. **Controlled fusion.** Beyond the medium-term solution provided by fast breeders, controlled fusion may be the answer to the power demand of the second half of the next century. Research programs, in which French teams are involved, are proceeding in the form of projects which are currently either French-European (TORE SUPRA) or European (JET) and are most likely to be world-wide in the future (ITER).

The prerequisites. Nuclear power is affected by a number of issues, among which **safety, competitiveness, regulatory environment** and **public opinion;** its future depends on the satisfactory handling of these issues. I will revert to the first issue later, but I would now like to comment on the last two.

. **The regulatory environment** which govern nuclear activities play an essential part in their development. In this respect, I feel that three recent moves are of special significance.

In the United States, a country whose regulations have been instrumental in creating the conditions experienced by the nuclear industry in the past 15 years, we now observe a move toward flexibility which should facilitate a revival favoured by the administration. This will necessitate passing new laws simplifying the requirements of former legislation. One such bill, recently passed by the Senate (but not yet by the House of Representatives), would simplify the licensing process for future generating plants by instituting a single license for construction and operation.

In Germany, the 1959 Atomic Energy Law has been amended several times, particularly in 1989, and further changes could be expected in that country also.

In France, a law on radwaste management was passed in 1992. This is an important step which clarifies, in the eyes of the public, the approach to the storage of high-activity radwaste, while providing the expected assurance at political level.

. **Public opinion** is an essential factor, since the development of nuclear power against public opposition is unthinkable. We must provide answers to questions raised by the public, especially in the area of environmental protection. Provided that the radwaste issue is suitably resolved, the environmental aspect could prove highly positive in view of the contribution of nuclear power to the fight against the greenhouse effect. We must show and explain that satisfactory solutions exist. Also a prerequisite to public support is safety, which requires the highest standards in the construction of plants, in their maintenance and in the competence of their operators. For allowing our arguments to be credible, **transparency** and **easy access to information** must be the rule; and there must be no serious accident with world-wide consequences.

2. AN EUROPEAN APPROACH TO WORLD-WIDE PROBLEMS

We are now witnessing **a world-wide extension of major issues.** There is no way to find in-depth, lasting solutions for the challenges confronting nuclear power unless they are approached in an international context. May I mention that Europe and France have always believed this to be self-evident, as attested by our past attitude and positions, particularly within the IAEA.

I just wish to comment briefly on three of these global issues.

- safety in Central and Eastern Europe,
- access of developing countries to nuclear technology,
- non-proliferation

A. In Eastern Europe: the problem is to maintain production level under adequate safety conditions

It is in this part of the world that the greatest changes have occurred since 1989. This is due to a number of causes: the countries of the former Soviet empire are drifting further apart; public opinion is asserting itself through claims which are both nationalistic and ecological; industrial structures are collapsing, and severe technological deficiencies are obvious.

Eastern European countries rely mainly on oil, gas, and coal for their energy supply, with very high pollution levels due to the lack of environmental policies for many decades. However, they also use a substantial amount of nuclear power: 12% of the electricity generated in the former Soviet Union in 1990 was of nuclear origin; the shares of nuclear power in Czechoslovakia (28%), in Bulgaria (35%) and Hungary (48%) show the interest of these nations in nuclear power.

A total of 65 reactors are currently installed in Eastern and Central Europe. The Chernobyl accident brought to light the potential hazards existing in that area. This type of reactor, known as RBMK (water-graphite) was developed by the former Soviet Union in a context of technological isolation. Following the accident, several changes were made in the plants. A study, soon to be undertaken under IAEA sponsorship, in response to a request made by the CIS (Community of Independent States) at the General Conference last September, should permit assessing the requirements and the actions to be taken.

The other reactor type operating in Eastern Europe is the VVER pressurized water reactor, which is closer to Western technology. Reactors of this type have varying safety levels. Safety deficiencies are found mainly in VVER 440/230 reactors designed in the 1960s, because of their age, the absence of containment systems, and the inadequacy of accident studies.

VVER 440/213 and VVER 1000 reactors are more recent, but also exhibit deficiencies which require less urgent attention but will have to be corrected.

The technological uncertainties and safety deficiencies found in these reactors have prompted the international nuclear community to participate in a survey of existing reactors and propose improvements, the objective being to reduce accident probability to the lowest possible level. **Eastern Europe urgently needs assistance** of this type; reactor surveys and safety evaluations should be continued, as well as actions aiming at rehabilitating reactors, upgrading their safety and improving operator qualification and training. The international community should undertake **concerted** actions to rationalize assistance programs, optimize their effects and share their costs, which the recipients cannot be expected to assume in full. An international program with political support is the only way to maintain power generation levels in those countries, thus preserving their economy, while ensuring an acceptable safety level.

B. I just wish to mention now the case of developing countries.

To meet their demand in energy mobilization of all the available sources will be required. In spite of its high capital cost, nuclear power seems to be worthy of consideration to cover part of the needs of developing countries, many of which lack natural energy resources.

I will go no further than stating the case, knowing that the introduction of nuclear power must rest on a strong technological background, and a good industrial infrastructure; another prerequisite is the availability of suitably trained personnel to ensure the highest possible safety level.

Moreover, there is the non-proliferation issue. Industrialized countries will play an essential part in resolving those difficulties, and nothing short of a planetary approach will ensure lasting progress in this area.

C. I would like finally to make a comment on the non-proliferation issue. As we witnessed the resurgence of Eastern Europe, the East/West detente and the foreseen reduction in the nuclear weapon stockpile, our feeling of satisfaction was dimmed by the discovery, at the end of the Gulf War, of a characterized breach of commitments made to the international community by a signatory of the non-proliferation treaty.

The international community reacted immediately. On a unanimous proposal by the European Community, measures aimed at strengthening the safeguards were put forward at the IAEA General Conference in September 1991, and approved by the Council of Governors in February 1992.

These measures include the effective enforcement of existing provisions for special inspections, and the institution of mandatory reporting of nuclear installations to the Agency, well before construction begins.

As I mentioned at the IAEA general conference in Vienna last September, our present situation is clear: either we demonstrate our ability to quickly learn the lessons of the sharp recall to **vigilance** which we have just received, or we may jeopardize international nuclear trade through a lack of confidence in the effectiveness of safeguards.

We must therefore find ways to reconcile the non-proliferation and safety concerns with the **international growth** of civilian nuclear power. This precludes overly-suspicious attitudes toward civilian applications; transparency and control, which are not yet complete, should permit that reconciliation.

Before I conclude, I would like to return to the subject of Eastern and Central Europe and the changes it is now undergoing. The international community must make a joint effort to help these countries, one of the purposes being to control the potential hazards which confront them.

Solutions exist in the areas of human resources and technology. I will only mention the creation of an International Centre for Science and Technology in Moscow, the offer by several nations, including France, to assist in the dismantling of weapons, and in the peaceful recycling of the nuclear material thus retrieved.

Of course, these proposals must be coordinated by international authorities; their consistency should be verified and arrangements have to be made for financing their cost.

In conclusion, I will just make a remark which I feel is appropriate to the subject: nuclear power bears great promises, as well as great difficulties. For promises to be fulfilled and difficulties overcome, we must be unfailing in our perseverance, making ours the Japanese proverb.

> Ishi no ue nimo san-nen
> (perseverance overcomes everything)

Thank you for your attention.

**UNITED STATES
NUCLEAR REGULATORY COMMISSION**
**Office of Governmental and Public Affairs
Washington, D.C. 20555**

Remarks by Ivan Selin
Chairman, U.S. Nuclear Regulatory Commission
at the
Japan Atomic Industrial Forum Conference
Yokohama, Japan
Wednesday, April 8, 1992

"GLOBAL SAFETY AND AN INTERNATIONAL CONVENTION"

Good afternoon ladies and gentlemen. It gives me great pleasure to be here today to open Session 1 of the 25th Japan Atomic Industrial Forum Conference. While I have been to Japan many times before, this is my first visit as Chairman of the U.S. Nuclear Regulatory Commission. I am most honored to have this opportunity to share with you my thoughts about some of the issues that I believe are of great importance to the nuclear industry.

Since assuming my post ten months ago, I have taken the opportunity to learn as much as I could about nuclear power as an energy source. I have talked to technical experts, utility executives, the environmental community, and government leaders involved in nuclear energy matters. I have visited over 40 nuclear power plants in the United States, plus plants in Eastern and Western Europe, and plan to visit several more facilities while I am here in the Far East. Combined, these activities have allowed me to confirm some old and also form some new impressions of the nuclear industry as a whole.

I would like to share some of these impressions with you. I will begin with several general observations and comments about nuclear power. Then, I will direct my remarks to the area that I believe impacts many of us here -- the issue of global safety and an international convention.

Let me start along the lines of the conference theme, "Challenges in Another Fifty Years to Come -- the Positioning of Nuclear Energy and Future Energy Tasks." The Nuclear Regulatory Commission sees the future of nuclear power as involving the resolution of several important issues. In the United States, these include waste disposal, plant aging, licensing reform, and standardization. Many of you face similar issues to varying degrees. However, one priority shared by all of us here today is the safety of currently operating reactors.

All of us who are regulators share the duty of ensuring that existing nuclear power plants are operated safely and with proper regard for national security and for environmental values. But safety is not just the obligation of the regulator -- it is first and foremost, the duty of the nuclear industry. The operators of the world's nuclear power plants realize better than anyone that without safety -- safety which is demonstrable, consistent, and proven -- there will be no future for the nuclear industry. Enlightened self-interest is a powerful motivator for sustaining the efforts required to keep the nuclear house in order. All facets of the nuclear industry have a common interest in having a well run, well regulated nuclear power program. Yet, it is the regulator's primary duty to assure that the health and safety of the public is protected at all times.

Looking forward to the years ahead, if nuclear power is to survive and continue to be a viable source of energy, three goals will have to be achieved. The first of these is increased openness and candor with our public. Not only does the public have the right to know how every plant operates, without public understanding of key issues and decisions there will be no acceptance or support for nuclear power. Open, thorough, and prompt communication channels must be available and used between the industry, the regulator, and the public, and among national and international organizations.

While our first obligation is to the public, we also have an obligation to the regulated community as well. By letting the industry know what is expected of it -- measuring off the playing field in advance, so to speak -- everyone's interest is served. It is here where we can all be better served by an international convention, if properly established and applied. An international nuclear safety convention could help rebuild public confidence and sustain the nuclear option.

In our environmentally conscious global village, the future of nuclear power depends on safe reactor performance everywhere. It depends on the nuclear plants of each country achieving and maintaining an adequate margin of safety. It also depends on developing public confidence that these safety margins can be assured in each and every country with nuclear power. The value of an international safety convention would be to help strengthen the hand of the regulator and of those involved in safe reactor operations. Currently, the International Atomic Energy Agency, the IAEA, is putting the final touches on a recommended set of international safety fundamentals. I believe the development and universal acceptance of such safety fundamentals can lead to improved plant performance and can help to encourage public confidence in reactor safety.

Looking back over the past year, we have all seen phenomenal change. The Soviet Union collapsed. The United States announced plans to bring nuclear weapons home from Europe. In addition, a concern over the safety of nuclear power plants worldwide continued to grow. Questions still remain as to the likelihood of another Chernobyl-type accident, given the serious safety inadequacies of many of the nuclear power plants in the former Soviet Union and in Eastern Europe. Changes in the governments of these countries have heightened this concern and have raised the additional question of the ability of nations to reduce the dangers.

Certainly, of great concern are many of the Soviet-designed nuclear reactors operating in Eastern Europe and the former Soviet Union. They represent about 10 percent of the world's operating reactors. Six of these reactors -- four located in the former East Germany, and two in the former Soviet Union -- have been shut down for safety reasons. Bulgaria has, at least temporarily, shut down two of its oldest reactors.

Yet, the need for power and the economic considerations inherent in these countries leave little flexibility as to whether these plants are shut down or continue to operate. This situation, coupled with the public's awareness of previously unknown problems with these Soviet-designed reactors, further contributes to anxiety about the safety of nuclear power everywhere. The lack of convincing evidence or independent assurances from credible authorities that nuclear reactors are operating safely in all countries continues to adversely affect public confidence.

The public is seeing the growth of commercial nuclear power in places like Taiwan and Korea, and the beginning of a new program in Indonesia. The international community will expect these national nuclear programs to achieve objectives established in an international safety convention.

The nuclear accident at Chernobyl had significant effects on Ukraine's neighbors; it led many to realize that while they might be in control of their own nuclear power plants, apparently there was little they could do to ensure the safety of plants in neighboring countries. As a result, there is a strong and growing incentive for all countries to bind together in a commitment to uniform safety fundamentals and to safety regimes that will provide the public with the confidence, now lacking, that their health and safety will be protected.

This has provided the basic rationale for a convention -- to provide assurance that all countries who utilize nuclear power meet an adequate level of safety. Let me stress, at the outset, that a convention is just one tool that is needed to raise the level of safety in problem nuclear power plants. And while not the most crucial tool, it is one that will be useful and productive for those countries which have weak regulatory authorities, and whose power plants, generally, have not been built with the margins of safety necessary to address a full spectrum of accident scenarios.

Given international concerns about the potential hazards posed by some early Soviet-designed nuclear power plants, the international community at large believes it is vital to provide additional, internationally endorsed, mechanisms for nuclear power plant safety. As most of you know, formal efforts are underway, under IAEA auspices, to establish an international nuclear safety convention which would codify the basic fundamentals of an effective nuclear safety regime. The prospect is ripe for collective actions on a truly global scale. The United States supports and is actively participating in this effort. Four fundamental tenets are guiding the U.S. policy towards the convention.

First, the scope of the convention should be limited to nuclear power plants -- the area of most immediate international concern. Civilian power reactor safety is the area of greatest international consensus and, thus, agreement on a convention should be attained on the urgent time schedule necessary for assisting Eastern Europe and the former Soviet Union.

Second, consistent with the premise of specifically focusing on power reactors, we believe that the convention should be negotiated and agreed to as an integral effort -- a single document. We believe that proposals to agree only on general objectives, with individual protocols negotiated over time, would be a complicated and difficult process. Such an approach would certainly tend to reduce the prospects of bringing an effective convention into force in a timely manner.

Third, the convention should commit all signature countries to the full implementation of essential nuclear safety principles, but should not impose mandatory, detailed safety standards. Broadly based and fundamental principles, such as those embodied in the IAEA's draft <u>SAFETY FUNDAMENTALS: THE SAFETY OF NUCLEAR INSTALLATIONS</u>, provide an effective framework for identifying needed changes and for subsequent peer review discussions. Further, such principles will assist member states, such as those in Eastern Europe and the former Soviet Union, in developing their own nuclear safety regime. I would be very concerned if we attempt to develop and impose detailed standards that try to encompass the variations in plant design, siting, governmental organization, safety culture, and national laws and regulations of the various member states.

Fourth, and most importantly, nuclear power plant safety regulation must remain a national responsibility. The ultimate safety of commercial nuclear power plants must reside with plant and regulatory officials with day-to-day operational oversight responsibility. The concept of an international regulator, be it the IAEA or some new organization, would not be effective. It would dilute national responsibility and infringe on the sovereign role of member states in the governance of activities within their territories. Beyond that, I believe the IAEA already has an enormous job to do with respect to its safeguards and non-proliferation responsibilities.

Many of you know that the IAEA convened a nuclear safety experts group in December 1991 to discuss the proposed nuclear safety convention. The delegates supported the formation of the safety convention while expressing strong approval for the principle of national responsibility and opposition to the formation of a new international regulatory agency. Also, the idea of a convention based on fundamentals rather than standards was widely accepted. These general views were further endorsed in discussions by the IAEA Board of Governors in February. Additionally, there was agreement with the IAEA Director General's recommendations to continue the necessary planning process for an early convention.

Such a convention can be an important element in ensuring nuclear safety worldwide; however, it must be viewed in context. Several international efforts to improve nuclear safety are already underway in the Nuclear Energy Agency (NEA) of the Organization for Economic Cooperation and Development (OECD), in the Commission of the European Communities (CEC), and in bilateral assistance programs offered by countries such as the U.S., U.K., France, Germany, Finland, Sweden, Belgium, and Japan. Additionally, the Europeans have initiated an effort to establish an Energy Charter among Eastern and Western Europe, and the former USSR, the U.S., Australia, Canada, New Zealand, and Japan. A Nuclear Protocol stressing nuclear safety and encouraging nuclear safety cooperation will be an integral element of the Charter. The Energy Charter was initialed by governments in December 1991 and efforts to complete its protocols are underway. The U.S. believes that implementation of effective nuclear safety regimes can best be encouraged through cooperation and interaction between those countries with effective safety regimes and those countries seeking to improve their safety practices.

A convention would help to improve safety by committing all signatory governments, particularly countries where safety is weak, to abide by reasonable safety fundamentals. It should permit the development of consensus on a "high minimum" level of safety without enforcement sanctions that would interfere with national legal structures and national sovereignty. It would ensure that signatories to the convention are engaged at the center of current discussions on safety of nuclear power worldwide. It could also help put added pressure on policy makers, especially in the former Soviet Union and Eastern Europe, who will be allocating the scarce resources of their economies.

Importantly, it avoids the pitfalls of creating a new institutional structure in the IAEA that would be hard pressed to fulfill its responsibility. Even with an increase in IAEA resources, which many nations cannot afford, it would be difficult for the IAEA to add the long-term expertise and experience required. Moreover, a major increase in IAEA resources for safety is probably unrealistic, especially when there is a sentiment to strengthen the safeguards and non-proliferation regime.

As I conclude my remarks, I return to the point I made earlier -- namely, that countries with nuclear plants that may have inadequate margins of safety need help now. In this regard, perhaps the most expeditious and effective approach to improving nuclear safety is for the countries with mature safety programs to provide strong technical and regulatory support to countries with plants having known or perceived safety weaknesses. This should be on a plant-to-plant, regulator-to-regulator and government-to-government basis. These efforts should foster the establishment of competent national regulatory authorities which can effectively monitor changes in plant operations and impose needed requirements to assure adequate safety margins in plant design and operation.

We should encourage both formal and informal interactions among professional peer groups in the nuclear industry. The IAEA could help to nurture the kind of internal self-criticism that is essential to the development of safety discipline. Further, we need to take advantage of other organizations that can contribute to an international safety culture, such as the Institute of Nuclear Power Operations (INPO), which has helped the U.S. industry to improve nuclear safety, and the World Association of Nuclear Operators (WANO), which is doing similar work on the international front.

Let me conclude by noting that the United States strongly endorses an international safety convention, along the lines I have outlined. However, binding standards, no matter how well stated, will not on their own bring about change. To achieve the desired levels of safety in every power plant throughout the world, those with the safety knowledge must share it without restraint. This must be coupled with a commitment of those seeking assistance, to listen, to learn, and to make the necessary changes. Policy makers need to commit the scarce resources necessary to establish an effective regulatory authority, to modify facilities, and to install a systematic and disciplined approach to safety. An international safety convention is only one of a number of steps that need to be taken. No one action or one approach will bring about the desired final outcome, but by working together in an open and positive environment, the necessary changes can be achieved. In turn, safe nuclear power may continue to be a viable option as a source of energy for all countries.

DEVELOPMENT AND PROSPECT OF NUCLEAR ENERGY IN CHINA

MIN Yaozhong
Assistant President
China National Nuclear Corporation

April 1992

Development and Prospect of Nuclear Energy in China

by MIN Yaozhong
Assistant president
China National Nuclear Corporation

Respected Mr. Chairman
Ladies and Gentlemen,

First of all, please allow me on behalf of the Delegation of the China National Nuclear Corporation to express my warm congratulations on the convening of the 25th Annual Conference of the Japanese Atomic Industrial Forum, and to thank the hosts for invitation to the Chinese Delegation. Now, I would like to take this opportunity to report the status of energy resources and the development of nuclear energy in China to counterparts in Japan and other participants coming from various countries.

1. Status of Energy Resources in China

The Chinese Government consistently attaches major importance to the development of energy resources. In 1991, the gross output of primary energy was up to 1.047 billion tons of standard coal (1.09 billion tons of raw coal, 0.139 billion tons of crude oil, 15.2 billion cubic metres of natural gas, etc.), therefore China has become the third largest country in production and consumption of energy in the world.

During last decade, China's national economy has been developing at a rapid pace with an average annual growth rate of GNP approaching 8%. However the supply of energy has become a serious problem in many areas in short of coal and electricity. In this case, some mines and factories have to limit, or even to stop their production sometimes, thus seriously constraining the development of the national economy there.

Though China is rich in coal resources, there is only 4.4% of the coal reserves in the northeast part of China as well as in the southeast coastal areas with highly-developed industries and dense population. "Transporting the coal from the North to the South" is restricted by the railway transport capability. At present, the coal transport in China covers 40% of the total freight transport. Moreover, coal burning in large quantites will cause many serious problems to the environment and ecological equilibrium, for example, the acid rain phenomena have been found in some areas. Therefore, it is difficult to mitigate the energy shortages only by increasing output of coal.

Concerning hydroelectric resources, China takes the first place in the world, the capacity for potential exploitation totals 0.37 billion kW. However, most of the resources are distributed in the southwest part of China. Factors such as inconvenient transportation, difficulties for exploitation, land inundation, immigration, ecological equilibrium, etc. are seriously restraining the development of the hydroelectric resources there.

As predicated by energy experts, the prerequisite for the Chinese people to live a relatively comfortable life by the end of this century is that the national output of primary energy should reach 1.5 billion tons of standard coal. Analysing current various factors, only 1.4 billion tons of standard coal can be supplied by conventional energy by then, that represents a gap of over 0.1 billion tons. Citing an example of electric power, if China wants to keep the pace with moderately industrialized nations by the mid 21th century——1 kW generating capacity per capita, i. e., the total installed capacity of generators should be 1.5 billion kW. It is estimated that about 0.37 billion kW could be supplied by exploiting the hydroelectric resources, and only 0.9 billion kW by exploiting the coal resources, taking account of the maximum output and transport capability of coal; therefore, the gap totals about 0.3 billion kW. In this context, the basic way out to resolve this contradiction between supply and demand of energy in China, is to develop nuclear power in a planned way while developing the hydroelectric and thermal power. Moreover, in consideration of a long-term strategy, as affirmed by energy experts, the final solution to the energy shortage is to develop nuclear energy.

2. Development of China's Nuclear Energy

(1) Status of Nuclear Power

In the 1970s, the development of nuclear power in China was deliberated, and initiated in the 1980s.

The first phase of the Qinshan Project is to construct a PWR prototype nuclear power plant with an installed capacity of 300 MWe. The first concrete was poured in March 1985. The cold hydro test was completed in November 1990. 121 fuel assemblies (15×15) were loaded into the reactor core in July 1991. The rotating test of the turbine driven by nuclear steam was fulfilled in November 1991. The plant was connected to the grid and started to generate electricity on December 15, 1991. It is now under on-load testing. It is predicted that the power will be escalated up to 50% in the mid year, and the full power trial finished by the end of this year.

The successful construction of Qinshan Nuclear Power Plant results from making full use of achievements in science and technology of our country during the past 30 years or more, and also from absorbing advanced experience of other countries thanks to the policy of opening to the outside world. The connection to the grid implies that the plant is constructed on a sound design, and the manufacture and installation quality of equipment meets the related requirements.

The first concrete was poured for the Daya Bay Nuclear Power Plant (2×900 MWe) in August 1987; by the end of 1991, the equipment installation of the nuclear island and conventional island in Unit 1 accounts for 70.2% and 97.8% respectively, and 46.5% and 61.7% in Unit 2 respectively. The commissioning tests are being carried out in an all-round way, and from a single system gradually to a local integrated system. The turbine in Unit 1 reached the rated speed last year, and in last January it succeeded in commissioning of connection to the grid with electricity produced by a generator driven with non-nuclear steam from an alternative boiler. All pre-operation preparations, such as personnel training, regulations compilation and the coordination and supplement of organizations after normal operation, have been carried out as scheduled. It can be expected that the Unit 1 will be connected to the grid in 1993.

As to the second phase of Qinshan Project, 2×600 MWe nuclear power project has been brought into line with the National Plan as one of the major items. The preliminary design has been basically completed in March, scientific researches in different sectors are being arranged, and the preparations for the construction site have begun.

In the course of nuclear power development and construction, the Chinese Government consistently adheres to the hard and fast principle, "Safety First and Quality First" for nuclear industry. The National Nuclear Safety Administration (NNSA), established in 1984, is authorized by the State to independently perform the nuclear safety supervision for the civilian nuclear installations. It establishes and promulgates the national nuclear safety codes and guides with IAEA NUSS documents as references, which have been used in safety review and evaluation on construction of the Qinshan Nuclear Power Plant and the Daya Bay Nuclear Power Plant.

There is a complete set of strict quality assurance system to control each stage in design, equipment manufacture, civil construction, installation, commissioning and operation, covering formulation of QA programs, establishment of QA organizations, arrangement of full-time QA professionals, and the QA activities are effectively carried out throughout the construction period.

A successful design is never meant for a desirable operation, the human factor is a matter of great importance. From the very beginning of development of nuclear power, all the constructors and operators are always instructed to have a strong sense in safety and quality, and also to have high professional moral concepts to the State and the people. Learning the experience in construction of nuclear power plants from various countries, all the operators of nuclear power plant shall be strictly trained, e. g. , in nuclear safety, nuclear engineering, training at a full-scale simulator, or shall be sent abroad for on-job training. They are allowed to take their posts, provided that they have passed the strict examinations and obtained the licenses.

Furthermore, according to the progress of the project, the IAEA OSART experts are invited to review the construction of the nuclear power plant. They performed such activities twice for the Qinshan Nuclear Power

Plant, and once for the Daya Bay Nuclear Power Plant, and they made an affirmative evaluation to the design, construction, quality assurance, management, production preparations, etc. of these two plants, and proposed some valuable suggestions. Based on comments given by experts from various countries, our work has been improved for the benefit of further strengthening the safety for nuclear power plant.

(2)Nuclear Fuel Cycle

During recent years, further progress has been made in this field.

In respect of use of uranium resources, the exploration activities have been strengthened in both northern and western parts of China, and several prospective minerogenetic provinces with fairly significant reserves discovered.

In respect of uranium mining and milling, the heap-leaching technology has been widely used, and the application of the in-situ leaching technology further developed.

In respect of uranium isotope separation, following achievements in centrifugal technology, macro-quantitative separation test by means of the atomic laser technology has been completed, which marks a new phase for the research of this technology in China.

In respect of fabrication of nuclear fuel elements for nuclear power plants, the domestic nuclear fuel assemplies with 3% enrichment of U-235 have been provided to the Qinshan Nuclear Power Plant. At present, the imported advanced technology is being used to improve the production line of fuel elements, and it is expected that the Daya Bay Nuclear Power Plant can be provided with the domestic nuclear fuel assemplies by the end of 1993.

In respect of reprocessing of spent fuels of power reactors, a pilot plant, which is now under construction, is expected to start operation in 1998.

The Chinese Government consistently attaches the first and most importance to treatment and disposal of radioactive wastes, and decommissioning of nuclear installations.

Treatment of high- and intermediate-level liquid wastes is mainly developed, and progress has been made in research of vitrification and other technologies. The decommissioning work for nuclear installations has been placed in the National Plan, and now this project is being arranged for practical implementation.

3. Prospect of the Nuclear Power Development in China

As I mentioned at the beginning of my statement, to reach the set target for economic development in China, nuclear power shall be an essential part in the energy infrastructure.

However, realization of such a target shall be closely associated with some factors such as national economy development, technology capability and level of industrialization.

So far, the nuclear power capacity of 3300 MWe has been officially approved by the Government, nuclear power development projects in other provinces and municipalities in short of power are also under consideration. In order to lay a good foundation for more successful development in the next century, the main tasks for nuclear power development in China by 2000 include moderate development, control of technology, and personnel training.

As to the technology line of nuclear power development, an assumption of "Three-steps Approach" has been put forward by some experts concerned, with an objective to solve the energy shortage strategically. The first step is to develop thermal neutron reactor; the second step, fast neutron reactor; and the third step, fusion reactor or fusion-fission hybrid reactor as the most promising approach to final solution of the energy shortage.

At present, some feasibility studies and scientific research and development have already been started in China on the development of advanced pressurized-water reactor, high-temperature gas-cooled reactor, low-temperature heating reactor and co-generation reactor.

China's principle for developing nuclear power is "Relying mainly on our own efforts while co-operating with foreign countries". "Relying mainly on our own efforts" means to rely mainly on the scientific and technological capacity and the industrial basis of our country. With a history of the nuclear industry in China more than 30 years, a comparatively complete scientific, technological and industrial regime with rich human resources in all sectors has been formed. In respect of conventional island, there is a strong manufacture capacity in China for electricity generation equipment. The manufacture technology of 300 MWe units has been mastered while that of 600 MWe units has been introduced and absorbed in recent years. Besides, there is a large demand for electricity in China. China being a developing country, it is not practical to rely only on importing complete sets of equipment for nuclear power construction; only following the way out as mentioned above, "Relying mainly on our own efforts while co-operating with foreign countries", can we develop successfully the nuclear power industry in China.

Taking account of the specific conditions in China, 600 MWe nuclear power units are selected as the basic units to be localized and it is expected to realize, step by step, self-design, equipment localization, technology standardization and manufacture on large scale. At the same time, we do not rule out the possibility of constructing 1000 MWe grade units as well as other types of nuclear power plants.

"Reforming and opening to the outside world" is an essential State policy. In development of our nuclear power, we shall learn advanced experience from other countries, to introduce necessary technologies and equipment, and to actively promote international exchange and co-operation.

Japan and China are close neighbours separated only by a strip of water. During construction of Qinshan Nuclear Power Project, Japanese experts came over to China for lectures, which provided valuable experience to our nuclear power construction. The exchange and co-operation between China and Japan nuclear energy communities in the fields such as geological exploration, uranium mining and milling, nuclear power technology, safety and radiation protection, etc. are of great significance. Please allow me , on behalf of the China National Nuclear Corporation, to express our thanks to the Japanese counterparts for their sincere co-operation and excellent services, and also to those friends of other countries for their support and assistance.

At present, Qinshan Nuclear Power Plant has entered into the phase of on-load commissioning, but we are still in need of experience in operating and managing nuclear power plant, we should like to have further exchange and co-operation with our counterparts in Japan and other countries in the field of nuclear power.

Thank you.

THE ELECTRIFICATION OF AMERICA:
NUCLEAR POWER IN THE 1990s

Remarks By

Phillip Bayne

President and Chief Executive Officer

U.S. Council for Energy Awareness

To

The Japan Atomic Industrial Forum

April 8, 1992

THE ELECTRIFICATION OF AMERICA:

NUCLEAR POWER IN THE 1990s

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To

The Japan Atomic Industrial Forum

April 8, 1992

Thank you ... and good afternoon.

It's a great pleasure to be here today.

This afternoon I want to cover several areas.

First ... I want to discuss one or two key energy trends in the United States.

Second ... I want to explain why — in light of these trends — nuclear power makes more sense than ever.

And third ... I want to give you a status report on the U.S. nuclear industry's plan for ordering and building new nuclear power plants.

Let me start by reminding you about some key trends.

The examples I will give ... and the numbers that I will use ... are drawn from the United States.

But I'm sure that all of you will recognize similarities with your own country.

Since 1973, the year of the Arab oil embargo, one energy trend in the United States overshadows all the others.

I'm not talking about my country's dangerous and chronic dependence on imported oil.

I'm not talking about the ebb and flow in the fortunes of the natural gas industry.

I am talking about the steady electrification of the U.S. economy ... the continuing substitution of electric power for direct burning of other fuels.

Since 1973, the U.S. economy — measured by gross domestic product — has grown just over 50 percent.

Electricity use has grown by about 60 percent.

For the last 19 years, since the 1973 oil embargo, economic growth and electricity use in the United States have run virtually parallel — not quite a one-to-one relationship, but close.

By the way, in this same period ... the use of non-electric energy declined about 5 percent.

Now ... simple common sense suggests that the close relationship between economic growth and electricity use will continue.

To meet the electricity needs of a growing economy, the United States will need between 190,000 megawatts and 275,000 megawatts of new generating capacity in the next 20 years, according to the U.S. Department of Energy.

We have about 700,000 megawatts of capacity installed in the U.S. today ... so you can see we're talking about a large increase.

This brings me to my second point.

Nuclear power makes more sense today than ever.

We know that electricity is the cleanest, most efficient use of energy we have.

And of all the ways we can generate electricity, nuclear power plants are the cleanest.

No carbon dioxide.

No sulfur dioxide.

No nitrogen oxides.

No particulates.

In the United States, at least, we have nothing else that can compete.

The only source of electricity that comes close is hydro power ... and it is almost impossible to find sites for new hydroelectric development.

This brings me to my third point.

What are we doing in the United States to make sure that electric utilities start ordering and building new nuclear power plants?

In November 1990, the U.S. nuclear power industry published a *Strategic Plan for Building New Nuclear Power Plants.*

Our goal?

To create the conditions under which utilities can place an order or orders by the mid-1990s, with the first new nuclear unit on line around the turn of the century.

The plan is supported by the entire industry — private and public electric utilities, equipment suppliers and architect-engineers.

As you may know ... the plan focuses on the light water reactor.

This focus on light water reactors was deliberate.

It reflects our utility industry's conviction that the next nuclear plants ordered in the United States must be based on a mature, successful technology that has proven its worth around the world.

And it reflects the U.S. utility industry's conviction that the job of resurrecting the nuclear option will be difficult enough ... without the added challenge of proving out a new technology.

But if we succeed in getting orders for new light water reactors ... I'm confident that orders for advanced technologies — like gas-cooled and sodium-cooled reactors — will soon follow.

To satisfy the American utilities, new nuclear plants must provide very high protection of the utility's investment.

That means predictable construction costs and schedules ... assured licensability ... predictable operating and maintenance costs ... higher reliability ... and very low risk of accidents.

The U.S. utilities took careful note of all the lessons learned during the construction and operation of the 110 commercial nuclear plants now operating in the U.S. ... and the 400-plus units on line around the world.

These lessons involved such things as ways to improve safety ... economics ... construction management and construction practices ... ease of operation and maintenance.

These lessons have been incorporated into the four new designs now being developed.

They are:

The Advanced Boiling Water Reactor (ABWR), a large, 1,300-megawatt design being developed by General Electric Co. As you well know, the first two of these are being built by Tokyo Electric Power Company.

The System 80+, a large, 1,300-megawatt pressurized water reactor being developed by ABB Combustion Engineering.

The AP-600, a smaller, 600-megawatt design being developed by Westinghouse Electric Corp.

The SBWR (or Simplified Boiling Water Reactor), a 600-megawatt design being developed by General Electric Co.

Our plan identified 14 key issues or "building blocks" ... assigned responsibility for managing them ... and set timetables and milestones against which progress could be measured.

Some of the building blocks are very specific ... like securing regulatory approval for the new designs.

Some are rather broad... like building public acceptance for nuclear energy ... or enhancing government support for new nuclear plant construction ... or developing arrangements for financing, building and operating new plants.

Some are within the industry's direct control ... like continuing to improve the performance of our operating plants.

Some require action by ... and the industry's cooperation with ... regulatory agencies and the federal government.

Securing approval and acceptance for new nuclear plant sites is one of these.

Now ... we recognize that implementing this plan will not be easy.

It is a long-term, 10-year assignment.

Even in the short time ... about 15 months ... since the plan was published, we've made much progress.

Let me list just a few items.

First ... the basic engineering ...

In late February, the Department of Energy and a consortium of electric utilities called the Advanced Reactor Corporation (ARC) signed a contract to launch a five-year, $200-million program to do detailed engineering on at least two advanced-design nuclear power plants.

The federal government will kick in $100 million ... to be matched by $50 million from electric utilities and $50 million from nuclear plant vendors.

So far, 15 utilities have agreed to participate, although others may join.

This so-called first-of-a-kind engineering will produce designs that are sufficiently detailed to allow utilities to place orders ... confident that they know what the plant will cost.

Second ... performance ...

Our plan recognizes that we must continue to improve the performance of America's 110 operating nuclear plants.

The U.S. industry met this challenge in 1991.

Last year, U.S. nuclear plants posted record output for the second year in a row.

In 1991, output rose 6.1 percent to 643.5 billion kilowatt-hours, according to preliminary data.

The average capacity factor reached 69.3 percent, up from 67.5 percent in 1990.

Third ... regulation ...

Certification or pre-approval of plant designs by the Nuclear Regulatory Commission is crucial.

As you know ... design changes during construction tripped up many a construction schedule in the 1980s.

Late last year, the industry and the NRC agreed on a satisfactory schedule for certification of the four new plant designs.

On one key issue — how much design detail manufacturers must submit — industry and NRC were much closer than either side realized.

Fourth ... siting ...

The NRC's new licensing rules allow pre-approval of nuclear plant sites.

In 1991, subsidiaries of Southern Co., Public Service Electric & Gas and Commonwealth Edison joined forces to demonstrate this provision.

This is a three-phase, $20-million program, cost-shared with the Department of Energy.

Phase one will review all applicable federal regulations, and develop criteria to assess potential sites.

In phase two, a site will be selected. That will occur later this year or early next.

Phase three involves site characterization ... preparation of an environmental impact report ... and submittal of an early site permit to the NRC.

The NRC would issue the early site permit by the end of 1995.

Fifth ... licensing reform ...

The NRC took a big step in April 1989 when it issued new licensing rules.

Those rules allow approval of nuclear plant sites and designs before construction begins and billions of dollars are at risk.

The new approach also provides a single license for construction and operation.

Just to be sure a new group of commissioners doesn't change the rules, however, the industry wants legislation to make them stick.

In February, the Senate passed licensing reform legislation as part of the comprehensive energy bill, S. 2166.

The bill provides for public hearings when a plant design is certified ... when a site permit is issued ... and when a construction/operating license is sought.

It also limits the opportunities for mischief and delay by anti-nuclear groups once a plant is built and approved as safe by the NRC.

Sixth ... standardization ...

Last year, utilities and vendors made a binding commitment to standardize new nuclear power plants.

This commitment to standardization covers future plant designs, operations, maintenance and training.

Seventh ... nuclear waste ...

Last July, the Department of Energy resumed exploratory drilling at Yucca Mountain in Nevada for the first time since 1986.

Although Congress ordered the agency to study the feasibility of building a permanent repository there, the program had stalled, because Nevada refused to issue permits.

After Congress threatened legislation, state officials issued the permits, and subsurface studies resumed.

Last year, the federal courts also cleared a backlog of lawsuits brought by Nevada officials against the repository program.

Nevada has instigated nine lawsuits since 1985, and ultimately lost them all.

Eighth ... public acceptance ...

Americans show more support for a nuclear future.

An August 1991 Gallup poll showed that 73 percent of U.S. adults believe nuclear energy "should play an important role in meeting the future energy needs of the United States."

That's up eight percentage points from February 1990.

Ninth ... industry support ...

The strategic plan's goal — a new nuclear plant order by the mid-1990s or soon after — fits well with the utility industry's needs.

In a recent poll, about 80 percent of nuclear utility CEOs said they'll need more baseload generating capacity in the first decade of the next century.

Of that 80 percent, about three-quarters of them would seriously consider an advanced-design nuclear power plant — if the industry's strategic plan is executed as envisioned.

This is just a partial list of the progress we have achieved in the last 12 to 15 months.

I believe the nuclear industry's strategic plan was the catalyst for much of that progress.

Let me digress just a moment to remind you that the American nuclear power industry is not in this alone.

Building public and political support for nuclear power is a worldwide challenge.

Continuing the expansion of nuclear power is a worldwide imperative.

This world faces enormous challenges as we move into the 21st century ... managing a historic transition in patterns of energy supply and demand.

Nuclear power can — and must — play a major role in that transition.

First ...

... in my country, we must manage a transition from a dangerous level of dependence on imported oil to more secure energy sources.

Oil is still abundant, and it's still relatively inexpensive.

But almost two-thirds of the world's oil reserves are in the Middle East and we all know how dangerous and unpredictable that region is.

The United States is living on the brink — still depending on oil for more than 40 percent of its energy, and for essentially all of its transportation needs.

For the sake of our economy and our national security, we must manage our dependence on oil, by switching to other forms of energy.

Second ...

... the industrialized nations must manage a transition from almost total reliance on carbon-based fuels to other energy sources, and to greater efficiency.

It may be years before we have conclusive information about global warming.

But most experts agree that the world should at least adopt a strategy of "prudent avoidance" in terms of burning fossil fuels.

Third ...

... the world community must manage the epic transition of under-developed and industrializing nations, as they struggle to advance.

Nations that are still industrializing pose a very special challenge, with obvious implications for energy policy.

These countries are increasing their use of energy far more rapidly than the fully industrialized economies ... and that means they are also increasing their burning of fossil fuels.

The country that burns the most coal — nearly 20 percent more than the United States — is China.

It burns over a billion tons a year — one-third more than it did just a decade ago.

India's use of coal rose by two-thirds in the 1980s.

South Korea's coal use more than doubled.

These are some of the key elements of the great energy transition that we must manage over the next couple of decades ...

...weaning ourselves from such a dangerous dependence on oil ... prudently avoiding fossil fuels where we can ... and helping countries still trying to industrialize.

There is no single answer to this huge, complex problem.

To make this historic transition, we must throw everything we have into the breach ...

... improved energy efficiency ...

... cleaner fossil fuel technologies ...

... increased electrification, especially in industry and transportation ...

... the use of photovoltaics and other renewables wherever they are appropriate ...

... and, of course, nuclear energy.

In the United States, the nuclear industry is very fortunate.

I believe we are building our future on a very solid base.

Nuclear energy enjoys strong public and political support.

Our existing plants operate well, and are operating better all the time.

And now ... we have the one thing we were missing ...

... a plan for the future ...

... and the will to make it come true.

USCEA

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Retrospection on Nuclear Power and Future Energy Prospects

W. Kenneth Davis

25th Anniversary Meeting of Japan Atomic Industrial Forum
Yokohama, Japan, 8 April 1992

Introduction

It is an honor to address this 25th Anniversary Meeting of the Japan Atomic Industrial Forum and a great personal pleasure to participate and to see so many friends. I would particularly like to pay tribute to Mamoru Sueda who invited me here and who was instrumental in establishing these meetings 25 years ago.

In reviewing nuclear power history and examining the prospects I will not give a detailed history or technical explanations, and I make no representations with respect to completeness. I shall note what appears to me, based on my personal experience and observations, to be the most important factors in the development of nuclear power--past, present and future--the "milestones". I am afraid that many of us no longer think much about how we arrived at the present state of nuclear power development--but I believe this is a critical factor in looking at the future. In particular, I believe the vision, initiatives, and leadership demonstrated in the past must be re-established for a successful future.

I shall start with a quotation:

> **"The most vitally interesting question which the physics of the future has to face is, Is it possible for man to gain control of this tremendous store of subatomic energy and to use it for his own ends? Such a result does not now seem likely or even possible; and yet the transformations which the study of physics has wrought in the world within a hundred years were once just as incredible as this. In view of what physics has done, is doing, and can yet do for the progress of the world, can any one be insensible either to its value or to its fascination?"**

This is the last paragraph in "A First Course in Physics" **published in 1906**. The authors, Millikan (who later received a Nobel Prize) and Gale concluded their book with these words after noting the work of Curie and Labord showing that the energy from the radioactive decay of radium was about three hundred thousand times that of burning the same weight of coal.

This visionary goal was made feasible by the discovery of the neutron by Chadwick in 1932 and of neutron induced uranium fission by Meitner, Hahn, Strassman, Fermi and others in 1939--coupled with the realization that a kilogram of uranium if completely fissioned had the same energy as burning of 3 million kilograms of coal.

Early Development of Nuclear Power

The first demonstration of a sustained nuclear chain reaction, as you will recall, was on December 2, 1942 in Chicago. This was followed by the construction of production reactors, plants for enriching uranium, and the development and production of the atomic bomb. After the war there was a great political debate in the U.S., about the control of nuclear energy, resulting in the formation in 1946 of a civilian agency, the Atomic Energy Commission. The Commission was empowered to do all related research and development, the production of nuclear materials, the design, testing and manufacture of nuclear weapons, and longer range applications such as nuclear power.

There was great interest in potential power applications in the early days by the laboratories and industry. Several studies were made which were optimistic--although severely constrained by the very extensive and strict classification.

The Argonne Laboratory led by Walter Zinn, for example, was pursuing the liquid metal cooled fast breeder and demonstrated the first production of nuclear electricity at the Experimental Breeder Reactor in Idaho on December 20, 1951.

A monumental event was President Eisenhower's famous "Atoms for Peace Speech" to the United Nations on December 8, 1953, which led to the formation of the International Atomic Energy Agency and to the program for civilian power reactors in the United States.

The main early nuclear power development resulted from the vision and drive of Captain Hyman G. Rickover who, despite considerable opposition from the Navy, undertook the development of nuclear reactors to power submarines which he believed would have extraordinary capabilities. In order to provide a vehicle for this work a Division of Reactor Development was established in the AEC with its principal component a Naval Reactors Branch headed by Rickover. In 1953 Rickover also proposed a larger reactor for an aircraft carrier (the CVR).

The next key event, not long after I joined the AEC in 1954, was passage of the Atomic Act of 1954 which supported developing power reactors as well as allowing for substantial declassification and private ownership of nuclear power plants. As the result of considerable politics it was decided that the CVR, would be built as a land based power plant--this became the Shippingport reactor (60 MW electrical) built by the Naval Reactors Branch and first operating on December 2, 1957--reaching full power just three weeks later!

Another direct result of President Eisenhower's speech was that the United Nations convened a Conference on the Peaceful Uses of Atomic Energy in Geneva in 1955. This was a remarkable conference particularly since a very large amount of information related to nuclear power was declassified and presented there by all of the countries interested in pursuing nuclear power.

The evolving program led to expansion of the embryonic Civilian Power Reactors Branch of the Reactor Development Division as well as the establishment of branches for Aircraft Nuclear Propulsion and Army Reactors. It also led to a great proliferation in the number of candidate nuclear reactor types--once estimated by Alvin Weinberg at 1,500. A great variety of studies, massive amounts of research, and several experimental and demonstration reactors resulted from this broad attempt to develop economical power reactors of various sizes.

Many of us felt overwhelmed by the large number of competing concepts and that a very long time, large manpower resources, and large amounts of funding unlikely to be obtained would be required to pursue more than a bare handful of them. Despite considerable argument, we concluded that the best course would be to focus on the light water reactors (LWR's). These appeared to have the advantages of 1) being "inherently safe" (if the water boiled the reaction stopped), 2) compact and most likely to be economic, and 3) to have the enormous benefit of the brilliant development and demonstration work of the Naval Reactors Branch led by, now, **Admiral** Rickover. The innovative and very extensive development of ceramic fuel (uranium oxide) resistant to high temperatures, the use of zirconium for cladding, the pressure vessel approach and technology, and the effective control and safety systems made this appear the most practical approach.

It was, of course, necessary to "extract" this technology from the Naval Reactors Branch (no easy task) and adapt it to larger plants and ones using low enrichment instead of the high enrichment of the naval reactors.

One other Rickover concept, that of containment which was also pioneered (in early form) at Shippingport, also proved critical for the future of the LWR reactors.

The result was that the United States had a large advantage over many other countries who had little realistic choice but to try to adapt their production reactor technologies for power production (gas cooled reactors in the U.K. and France, the RMBK reactor in the U.S.S.R., etc.).

Effort on the breeder reactor was also intensified. It was recognized that it might only be needed when uranium became scarce and expensive. Then it would be essential to realize the full potential of nuclear power since it could result in producing more than 50 % of the energy in natural uranium. In turn this would make it economical to recover much lower grades of uranium available in far larger amounts, thus enabling the use of nuclear power for several hundred years.

It was recognized that the low enrichment reactors such as the LWR's--and most of the U.S. concepts--as well as the breeder would require a complete fuel cycle--processing of spent fuel, recycling of uranium and plutonium for fuel, and recovery and disposition of the fission product wastes. The path followed on the processing and recycling was adapted from that used by the production facilities, aqueous processing; and studies were initiated in the mid-1950's of disposal of high level wastes from reprocessing. These led to the report by the National Academy of Sciences recommending geologic disposal and nearly 40 years of R & D on permanent geologic disposal.

Expansion of Nuclear Power in 1970's and 1980's

The early reactor experiments were followed by a number of pioneer nuclear plants such as Dresden, Yankee Atomic, San Onofre, Connecticut Yankee and Oyster Creek (which was generally considered the first really economic nuclear power plant). These were the direct result of the vision, initiatives, and leadership of outstanding figures in the utility industry.

These early plants were then followed by a generation of larger and more economic plants with unit sizes increasing up to 1100 to 1300 MW. By the end of 1973 and early 1974 there were over 200 units either operating or on order. The orders were based on the 7 % per year growth rate in the demand for electric power which had been nearly constant for more than 25 years. However, as you know, the 1973 Arab oil embargo and the dramatic increase in prices by the OPEC cartel caused serious economic disruption and an abrupt decline in the rate of increase in the demand for electric power as well as other forms of energy in the U.S. as well as much of the rest of the world.

The result was that only about half of the nuclear power plants on order in the U.S. at that time were ever completed and those were often delayed (due to licensing problems, shortages of funds in an era of enormously rapid construction cost escalation, and lack of demand for the power). The fact is that no plant ordered after 1973 has been completed.

This result did not come about, as often suggested, because of the inherent high cost of nuclear power or anti-nuclear activities. This result, and the lack of orders since that time in the U.S., has been almost wholly the result of a lack of a **need** to invest in large new central station power plants of any sort, with the prevailing excess generating capacity.

This situation is now changing and it seems likely that substantial new central station capacity will need to be in operation by around the year 2000 AD on order to maintain reliable supplies of electric power in the U.S. This in addition to the non-utility and other projects contemplated, such as those utilizing gas turbines,

Safety of Nuclear Power

The safety of nuclear power plants has been, and continues to be, a major issue with respect to public acceptance. The impact of the public perception is, of course, related to the perceived **need** for more electric power--a renewed **need** which is now emerging in the U.S.

In the 1960's the USAEC sought to devise experimental programs to demonstrate the safety of the containment and safety systems for nuclear power plants. While some work was done, it was not definitive. What still seems to be largely overlooked, and of great significance, is the implications of the accident at Three Mile Island Unit No. 2 on March 28, 1979. The fact is that, although enormously expensive as an experiment, it demonstrated in a unique way the ability of older designs of safety and containment systems to deal with a major reactor accident--the almost complete melting of a reactor core. Nobody in or out of the plant was injured in any way or killed and the release of radioactivity was trivial. This was achieved under the most adverse circumstances and it is hard to imagine a more difficult test at any price.

On the other hand, the tragic accident to Unit 4 at Chernobyl on April 26, 1986, which also led to almost complete destruction of the reactor core had a much greater effect (although it now appears to have been somewhat overstated). This type of reactor, basically a production reactor, and far different from the LWR reactors, was known to be unstable particularly under the conditions which it was being operated at Chernobyl. The reactor plant contained very few safety systems and essentially nothing significant in terms of containment. The vast differences in the consequences as between Three Mile Island and Chernobyl should serve as a reassuring lesson to all, rather than being lumped together as similar, as is often the case.

Future Energy Needs

A combination of rapidly increasing population and improved standards of living in the developing countries (most of the world) and slower rates of growth and energy demands in the industrialized countries mean that the world will require ever larger amounts of energy for sustained economic growth during the decades ahead.

The reality is that the bulk of this energy must come from fossil fuels--coal, oil, and gas--along with some non-commercial fuels and hydro in the developing countries. An increasing fraction of energy requirements will be furnished as electricity, even in the developing countries.

One inevitable result is that the bulk of what we now define as **reserves** of fossil fuels will be largely used up in a few decades. We will convert what we now regard as **resources** to reserves by application of new technologies and higher prices. The energy supply pattern, with respect to sources and geographic distribution, as well as technologies must change. If the long lead time (a generation at least) for developing and applying new technologies and sources on a substantial scale is recognized, this means that decisions with respect to changed energy supply and use systems must be made during the next few years. This can only be done with far-sighted vision, leadership and political skill.

This is the situation regardless of which particular forecast one might favor or, indeed, of views of the impact of environmental constraints, including potential global climate change. There are choices which can be made to change the directions to some extent--but the broad picture is unlikely to change substantially and it is foolish to count on it doing so.

Role of Advanced and Renewable Energy Sources

In this context, improved energy efficiency must be considered a substantial source. However, this is largely driven by prices and technology once the existing advantageous measures are implemented. There are indeed many such possibilities which can have a significant impact, many in the developed as well as developing countries. However, once these are realized (a slow process and only partly responsive to evident cost savings) the further potential impact declines. The inevitable conclusion must be that energy efficiency while important will not change the broad picture of what is needed and likely to happen in the decades ahead.

Renewable energy resources such as solar thermal, photovoltaics, wind, biomass, etc., and advanced but not renewable sources such as geothermal will find increasing use where local conditions are advantageous, and as costs and economics improve and technologies are disseminated. However, while important in many areas, again the total impact, perhaps a few percent during the next few decades on a worldwide basis, will not alter significantly the inevitable increasing demand for primary sources of energy.

It should be noted that many of the renewable and advanced energy sources are consistent with the increased use of electricity. This is, of course, true, of hydroelectric power where large amounts are still available in many developing countries subject to practical large scale utilization and financing.

The Role of Nuclear Power

Against such a background, the logic for greatly expanded use of nuclear power in the coming decades appears absolutely inescapable. Future historians would, I am sure, regard it as utterly foolish if nuclear power was not utilized to the fullest extent possible.

Nuclear power has several characteristics which will dictate where and how it is used, and it cannot, at least as now visualized, be considered a general purpose solution for many situations in the world. Despite many attempts to make small nuclear power plants economically attractive it remains clear that larger and multiple units are necessary for economic and management reasons--at least 600 MW and, in most cases, 1000 MW and up.

It is also necessary to have the critical infrastructure for training, repair and maintenance, fuel handling, assurance of safety, and overall management for nuclear power to be an acceptable choice. It is impossible to visualize this being accomplished for smaller single units unless as a part of a larger international framework.

These considerations will surely limit the practical, economic, and safe use of nuclear power to the developed countries and some of the newly industrialized countries (or areas where joint action is feasible). The rapidly increasing demand for fossil fuels in developing countries is unlikely to be affected very much by their use of nuclear power, at least during the next few decades.

Implementation of Nuclear Power Potential

What is necessary in order to renew the practical utilization of nuclear power?

One major milestone will be the resumption of ordering of nuclear power plants by the electric utilities in the United States. The initiatives in Japan are most constructive and would appear to provide a convincing example for similar actions in the U.S.--the start of construction of two Advanced Boiling Water Reactors by Tokyo Electric. The recent Korean order for two Combustion Engineering Advanced System 80 units is also encouraging.

This leads to the observation that the initial large-scale use of nuclear power in the U.S. was largely the result of **leadership** by individuals in industry and the government, with close cooperation, which must be re-established for the future. While good planning is important I would stress that it is not a substitute for leadership.

Much depends on the situation with respect to licensing in the U.S. and while the Nuclear Regulatory Commission unanimously passed 10 CFR Part 52, a new basis for licensing, in 1989, the electric utilities have insisted that this be written into law. Legislation to do this has been before Congress for nearly three years and little is likely to be done until this is resolved one way or the other.

The supply of enriched uranium fuel on a once-thru basis appears assured for the near future. However, it seems inevitable that more and more will come from outside the U.S. because of the increasing costs of the old U.S. diffusion plants. The U.S. has failed to take practical steps to implement a commercial AVLIS plant on a timely basis which would allow the U.S. to remain competitive. In the longer term it will be necessary to recycle fuel and, most importantly, to commence the use of breeder reactors. These will require fuel recycling and make processing of LWR fuels highly desirable to provide the initial breeder inventories (some of which could come from the dismantling of weapons).

It appears to me that future nuclear power programs will almost inevitably be based on advanced and improved LWR's. The demonstrated performance, economics, reliability and safety of LWR's will make it difficult, in my opinion, for any new types to obtain the very large funds needed for development and demonstration and to gain acceptance by the utility industry.

This leads to four issues which must be dealt with: 1) the interim storage of spent LWR fuel, 2) the permanent disposal of high level radioactive wastes (which I do not believe should include spent fuel), 3) the establishment of fuel processing facilities, and 4) considerable strengthening of the worldwide non-proliferation regime.

Other countries are providing for the interim storage of spent LWR fuel. The U.S. is undertaking some steps in this direction and will, I believe, provide for this although some changes in the current law may be required.

The U.S. permanent repository project is mired in politics after more than 25 years of intensive research and development on the subject plus 10 years of debate after legislation was initially passed. Eventually it will be settled. However, with **interim storage** this does not seem an insuperable barrier for new nuclear power plants.

Fuel processing is a perplexing issue and while it is being provided for in other countries, the U.K., France, and, of course Japan, it has had a frustrating history in the United States for a variety of reasons. The use of the aqueous process, pioneered and used by the production plants, leads to severe regulatory requirements and costs which, more than anything, have made processing uneconomic and difficult in the U.S. (The Carter ban on processing was reversed while I was Deputy Secretary). There is some work underway on modification or new processes and my own conviction is that a new process needs to be developed and utilized to make fuel reprocessing practical in the U.S.

The fourth issue is that of proliferation. Recent events have shown that reliance on the NPT and normal IAEA inspections and export controls is inadequate to prevent proliferation. A solution clearly is needed and now is probably the ideal time to achieve one. It has been my view for many years that the United Nations should outlaw proliferation on a worldwide basis. I am pleased that a statement has been unanimously agreed to by the Security Council meeting for the first time at the Heads of State level on January 31, 1992, which asserts this position for all weapons of mass destruction including nuclear and states strong sanctions will be taken against violators. The Statement asks the Secretary-General for his recommendations on implementation by July 1, 1992 and states as a goal a **universal** non-proliferation regime by 1995. In February the IAEA Board of Governors took measures to strengthen further the Agency's safeguards system. These important actions do not seem widely known and should do much to alleviate worldwide concern when recognized.

Conclusion

I have spent a large portion of my time over the past 45 years on matters related to the development and use of nuclear power in the firm belief that this was a major contribution to the welfare of mankind. Frustrating as the past few years have been, I have no regrets about my work and continue to be optimistic that history will, in fact, vindicate this judgement by many of us. I believe that nuclear power will play an essential role in providing for our future prosperity and health on a worldwide basis--and will be rightly regarded as the most important scientific and engineering achievement of the 20th Century. Imagination, leadership, and practical initiatives are still necessary to fulfil this promise.

Thank you.

March 24, 1992 10:29am

『第２５回原産年次大会』講演原稿

－演　題：わが国のエネルギー政策－

日　時：平成４年４月８日（水）
14時00分～18時15分の内30分
場　所：パシフィコ横浜
国際会議ｾﾝﾀｰ１階ﾒｲﾝﾎｰﾙ
講演者：原子力委員会　委　員
新エネルギー・産業技術総合開発機構　理事長
林　　政　義

原子力委員をしております林でございます。本日は、このような会議の席上におきまして発言の機会をいただき光栄に存じます。

本日の講演テーマは「わが国のエネルギー政策」ということで、講演者として私が必ずしも適任とは思いませんが、私は、原子力委員であるとともに、新エネルギー・産業技術総合開発機構－ＮＥＤＯ－の理事長でもありますので、本日はわが国のエネルギー政策に関わってきた者の一人として、話をさせて頂きたいと思います。

わが国に限らず人間は誰でも、人間としてより豊かに生活したいと思うのは当り前のことだと思います。そしてその豊かさを物質面で支えるのがエネルギーです。しかし、そのエネルギー資源は世界中に平等には存在していません。

石油資源が偏在していることはよく知られていますが、一般の人が平等だと誤解しがちな太陽エネルギーですら日照時間で大きな地域格差があります。

過去、エネルギー資源を求めての人間の争いが後を断たないのは残念ですが、エネルギー需要が増大すればするほど、争いがまた繰り返される恐れが出てきます。世界のエネルギー消費量は、人口の増加と相まって今後とも増大すると予想されていますが、これは世界の安定にとっても大変なことです。

申し上げるまでもなく、すべての国がそのエネルギー需要を石油で賄うことは不可能です。各国は資源の有限性の中でその経済発展に必要なエネルギーを国際的な調和を図りつつ安定的に確保していかなければなりません。

限られたエネルギー資源を有効に活用しつつ世界経済の安定的・持続的発展を維持していくことが必要なのです。そのためのエネルギー供給の枠組みを国際的な協調のもとで構築していくことが求められることになると思います。

しかも、これまで化石エネルギーを大量に使い続けた結果、酸性雨問題は国境を越えました。さらに、地球全体の自然循環のバランスを崩すと言われる二酸化炭素やフロン等の温室効果ガスによる地球温暖化問題の顕在化への懸念が叫ばれるようになりました。我々は、今、これまでの経済発展が人類に対して新たな代償を求め始めていることに気付きつつあります。

このような状況の中で世界のエネルギー需要をどのようにして満たしていけば良いのでしょうか。自国のことについては自国のエネルギー政策で責任を持つのが原則ですが、わが国のエネルギー政策の方向性は必ずや世界の参考になるのではないかと思います。というのは、わが国の置かれている状況が、将来の世界の状況と近似している点が幾つかあるように思うのです。

将来の世界の状況を考えてみますと、人口が途上国を中心に爆発的に増加します。２０３０年頃には９０億人近くになると言われています。また、途上国の生活レベルや工業レベルも当然向上するでしょう。その結果、先進国のエネルギー消費量がほとんど変わらないとしても、２０３０年頃の世界のエネルギー消費量は現在の約2倍に増加するという予測もあります。

これに対し、わが国は、現在、人口は世界第7位、ＧＮＰは世界第2位。エネルギー消費は世界第4位。ところが、国内にはほとんどエネルギー資源を有しないので、エネルギー供給の対外依存度は約８０％。まさに世界最大のエネルギー輸入国であります。

すなわち、わが国は、人口も多く、生活レベルや工業水準もある程度高く、エネルギー資源が不足しているということです。この意味で将来の世界の状況と近似していると思うのです。

それではわが国のエネルギー政策について話したいと思い

ます。わが国のエネルギー供給構造が極めて脆弱であるというのは、エネルギー資源を国内にほとんど有しないということが根本にありますが、むしろ現代のエネルギーの主役である石油資源がわが国にはほとんど無く、かつ世界的にも偏在しているという資源制約があることが最も大きな要因と言った方が適切かと思います。

従って、これまで、わが国は、原子力を中心とする石油代替エネルギーの導入と特定のエネルギー資源に過度に依存することのない各種エネルギー資源の適切な組み合わせ、すなわち、適切なエネルギーミックスによって資源制約をなるべく緩和しようとしてきました。途上国等の今後の飛躍的な経済発展を考えれば、この資源制約は今後更に厳しくなると予想されます。

ところが、エネルギーは、先程申し上げたように、もう一つの大きな問題に直面しています。地球環境問題です。とりわけ、温室効果による地球温暖化問題は、問題解決の技術の登場を待たないまま、大きな環境制約となろうとしています。この温室効果の約５割が二酸化炭素によるものであり、その二酸化炭素の約８割が化石エネルギーの燃焼によるものとされているのです。

世界規模での経済発展に伴うエネルギー消費量の増大、石油需給逼迫等の資源制約の顕在化、そして、地球環境問題による環境制約の出現。この三つの問題に対して、わが国は、持続的な発展を図りながら、いかに調和的に対処していけば

良いのでしょうか。

一方、わが国は今や、世界第２位の経済大国であり、わが国の経済は世界経済の中で大きな責任を持っていると言えましょう。わが国のこれからのエネルギー政策においては、資源制約と環境制約を克服しつつ、わが国のみならず世界全体の持続的な発展の実現に向けてわが国の責任を認識することが重要だと思います。

このような背景の下で、わが国はエネルギー政策のレビューを行いました。その結果、１９９０年６月に通商産業大臣の諮問機関である総合エネルギー調査会が「長期エネルギー需給見通し」を策定し、これに基づき同年１０月に「石油代替エネルギー供給目標」が閣議決定されました。一方、地球環境問題に対しても同年１０月に「地球温暖化防止行動計画」を閣議決定し、エネルギー政策面での整合性を図っています。

これらの策定からすでに２年近くが経過しています。また、この間に、世界情勢が歴史的な激動の様相を呈していることはご承知の通りですが、世界の情勢がいかに変わろうとも、わが国のエネルギー政策の中に流れているエネルギー確保への指針は、わが国が進むべき進路を明確に指し示していると思っています。

１９９０年６月に策定された「長期エネルギー需給見通し」は、二酸化炭素排出量の抑制、省エネルギー対策の強力な推進、石油代替エネルギーの引き続きの積極的導入を柱としています。特に二酸化炭素排出量の抑制という環境制約に配慮

したことが大きな特徴となっています。

地球温暖化問題を解決するためには、原子力や新エネルギーのような非化石エネルギーの開発、エネルギー利用の効率化技術の開発、二酸化炭素固定化などの地球環境に対する負荷を直接低減させる技術の開発、を加速化することが必要です。

しかし、環境負荷を直接低減させる二酸化炭素固定化などの技術開発は鋭意研究開発が推進されているところですが、今だ実用化に至っていません。

従来、環境問題の解決手法というのは原因物質を排出規制するというのが通常の手段ですが、現状の技術開発状況において、二酸化炭素の排出規制をすると、エネルギー利用への強い制約となり、国民生活全般にわたる極めて大きな影響は避けられません。

「長期エネルギー需給見通し」では、このような難しい側面も配慮して、省エネルギー対策の強力な推進と石油代替エネルギーの引き続きの積極的導入により、２０００年以降のわが国の二酸化炭素とフロンガスの総排出量を１９８８年度より低いレベルで安定化させようとしています。

まず省エネルギー対策について見てみたいと思います。この見通しでは省エネルギー対策を強力に推進することにより、エネルギー消費のＧＮＰ原単位で２０１０年までの間に全体として３６％の改善の達成を目指しています。

この３６％の改善というのは二度の石油危機を含む１９７

３～１９８８年度の実績に匹敵する数値です。当時のわが国の省エネルギー実績は先進国の中で最高水準であったことから考えれば、いかに大変な数値であるか分かっていただけると思います。その結果、１９８８年度から２０１０年度までのエネルギー伸び率は年率１％台とかなり低く押さえることができるとしています。

エネルギー価格が比較的低廉で安定している状況下において、一般の国民が省エネルギーの重要性を石油危機の頃と同じくらいに理解することは極めて難しいと言わざるをえません。従って、この省エネルギー目標を達成するためには政府と民間の最大限の努力が必要であると言えます。

次に石油代替エネルギーについてですが、これは使えそうなエネルギーは何でも使えるようにしようというのが基本的な考え方と言えましょう。しかし、当然ながら石炭は環境制約の関係で一定量に止まらざるを得ないと考えています。また、ＬＮＧは、環境制約上、石炭よりは有利であり、導入を推進するのが適当ですが、大幅な導入は難しい状況にあると考えています。従って、今回の見通しでは、非化石エネルギーである原子力や新エネルギー等が注目されています。

本日は世界各国から原子力の専門家の方が参加されていると思いますが、原子力は、現在、世界２５カ国で約４２０基の発電所が稼働し、１９９０年実績で総発電電力量の約１６％を占めるまでに至っています。つまり人類は原子力という大いなる手段を既に掌中に収めているのです。

わが国としては、原子力は量的にも、価格的にも、供給安定性の高いエネルギーであり、また、国際エネルギー需給の緩和、地球環境問題への対応といった国際貢献の観点からも優れたエネルギーだと考え、引き続き石油代替エネルギーの主力に位置付けています。

わが国の１９９１年度実績の原子力発電の設備容量は３３４０万ｋＷですが、この見通しでは２０００年度には５０５０万ｋＷ、２０１０年度には７２５０万ｋＷを目指しています。

わが国としては、原子力は２１世紀においてもエネルギーミックスの中で重要な役割を担うと期待しており、平和利用の堅持と安全の確保を大前提に今後とも着実に推進していくことが重要だと考えています。

特に、わが国では、より効率的に資源を利用するため、福井県において高速増殖炉原型炉「もんじゅ」を建設中であり、また、再処理リサイクル路線の早期実現を目指して青森県六ヶ所村において、民間再処理施設等の建設計画を引き続き推進しているところです。

今後何倍にもなる全世界のエネルギー需要を賄っていくためには、プルトニウムの利用、とくに最終的には高速増殖炉での利用が世界のエネルギーセキュリティ上不可欠と考えています。しかし、プルトニウム利用については、国際的な理解が必要です。

従って、わが国としては、核不拡散上、国際的に懸念を招

かないように、透明性に配慮するとともに、国際動向を見極めながら世界の核不拡散体制の強化に貢献していくことが大切だと思っています。そういう努力によって、わが国は世界のエネルギーセキュリティの確立に貢献できると考えています。

しかし、どこの国でもそうだと思うのですが、原子力には原子力が持つ潜在的危険性に起因するパブリックアクセプタンスの問題があります。確かに原子力が持つ潜在的危険性は、チェルノブイリ事故により顕在化しました。たとえそれが日本で使っている軽水炉とは違う炉型での事故であっても私たちは他山の石として胆に命じなければいけないと思っています。安全に対して原子力に携わる一人一人が厳しい目を持ち続けることによって、チェルノブイリのような事故は決して起こさないと自信を持って言えるのです。

国民意識の中に一旦芽ばえた原子力に対する不信、不安を払拭することは容易なことではありませんが、原子力開発利用を進めていくためにはどうしてもこれらの不信、不安を取り除かなければなりません。そうでないと、この見通しにおける２０００年度末で５０５０万ｋＷ、２０１０年度末で７２５０万ｋＷという目標の達成は難しいという認識を持たざるを得ません。

原子力開発利用を進展させるためには、発電所の立地難、高レベル放射性廃棄物の処分の問題、プルトニウムの平和利用に関する国際的理解の獲得、ＦＢＲ開発等のいずれも容易

ではない問題が山積みしていますが、一歩づつ解決していくことが必要です。

次に、新エネルギー等についてお話ししたいと思います。私が理事長をしています新エネルギー・産業技術総合開発機構－ＮＥＤＯ－は、１９８０年１０月に設立以来、わが国の新エネルギー開発に係る中核的推進母体として、太陽エネルギーの技術開発、石炭エネルギーの技術開発・資源開発、地熱エネルギーの技術開発・資源開発、さらには燃料貯蔵、アルコール・バイオマスに関する技術の開発など多岐にわたる事業を展開し、新エネルギーの開発・導入の促進に努力してきました。

１９９０年１０月に政府が決定した石油代替エネルギー供給目標では、２０１０年における一次エネルギー総供給量に占める新エネルギー等の割合は５．３％、地熱エネルギーと合わせ６．２％という目標が設定されています。この６．２％という数字については、政府・民間の最大限の努力を要するものという位置付けがなされており、決して手をこまねいていて達成できるものではありません。

新エネルギーについては、太陽光発電、風力発電、地熱発電などが有望だと思っています。しかし、そのコストはまだ割高であり、信頼性の実証も十分とは言いがたいのが現状です。従って、独立分散型電源などの実用化できる分野から導入していくとともに、今一層の技術開発に取り組むことが必要だと考えています。

太陽光発電の現在の変換効率は約１５％です。つまり光エネルギーは晴天時でだいたい１㎡当り１ｋＷですので、その１５％の１５０Ｗの発電が可能ということです。計算してみるまでもなく非常に広い面積を必要としますので、私たちが考えているのは、一般家庭の屋根瓦の中に太陽電池を組み込む方法であります。だいたい一般家庭で標準的に冷暖房等々を考えて２ｋＷとすると、現在のところ数百万円掛かります。

太陽光発電と風力発電を合わせてですが、２０１０年には４７０万ｋＷと想定しています。太陽光発電は将来の本格的実用化のためには２０％以上の効率が必要ですし、また発電コストについては２０００年には１ｋＷｈ当り現在の７分の１の２０～３０円程度まで引き下げるよう努力が必要です。

現在、新エネルギー利用技術の中から現実に実用化の見通しが得られるところまで成熟したものが出てくるようになってきました。今後は更なる技術開発と共にこれらの技術を具体的な導入に結び付けるための努力が重要な課題となってくると思っています。

具体的には、まず第一に、新エネルギー技術開発の強化・充実です。新エネルギーの導入を促進するためには、信頼性の実証・大容量化、コスト低減、利用率の向上などに向けた技術開発を引き続き加速化して取り組むことが必要です。

第二に、新エネルギーの先導的導入の促進と導入に向けた積極的助成策の創設・拡充です。

第三は、導入促進のための条件整備です。新エネルギー導

入のためには、基本技術の確立、信頼性の実証、競合エネルギーとの比較における経済性の実現等が必要条件となりますが、さらに具体的導入を進めていく上では、既存の諸規制や手続き、システム等を見直し、新エネルギーの特性に即した改善を図っていくことが極めて重要な要件となります。

新エネルギーでよく誤解されるのが、例えば太陽光発電の潜在的設置能力は約７０００万ｋＷ、風力は数百万ｋＷという試算があるというと、すぐにでも実現が可能だと思われてしまい、それなら原子力は必要ないという意見が出てくることです。エネルギー問題というのは、単に量的な問題だけではなく、いずれのエネルギーにしても技術開発、環境影響評価、経済評価等が必要であり、一朝一夕にできるものではないことやエネルギー毎に特性があるということを理解してもらうことが非常に大切だと思います。

エネルギーベストミックスの中核を担うためには、大量、安定的、経済的という観点が必要ですが、見通し得る将来において、その中核を担い得るのはやはり、現在のところ原子力をおいて他にないと思っています。しかし、新エネルギーの技術開発を着実に推進していくと共に、国が中心となってその導入促進策を講ずることにより、近い将来、新エネルギーがベストミックスの中の重要な部分を占めるのではないかと考えています。

それは直ちにエネルギーの大宗を占めるというような過大な評価は適当ではないものの、かといって単なる過少なエネ

ルギーといった見方も不適当であろうと考えています。新エネルギー導入に最大限の努力を払いつつ、原子力についても着実に推進することが、エネルギーセキュリティ上求められているのだと信じています。新エネルギーと原子力は、決して相反するものではなく、共に補い合って初めてエネルギー問題を解決できるのではないでしょうか。

現在の計画では、２０１０年度における一次エネルギー供給に占める非化石エネルギーのシェアは２７％になると見込んでいます。内訳は、新エネルギー等が５．２％、水力が３．７％、地熱が０．９％、原子力が１６．７％です。特に、太陽エネルギーについては、クリーンな石油代替エネルギーであり、その特性を踏まえつつ最大限の導入を図ることとしています。２０１０年度までの太陽エネルギーの導入規模は、一戸建ての住宅の約半数でその利用が行われることに相当する規模です。

このようにわが国のエネルギー政策は非常にチャレンジングな計画となっています。簡単にまとめてみますと、エネルギー需要の側では省エネルギー、エネルギー供給の側では原子力と新エネルギーの推進がポイントになると思います。省エネルギーについては社会がその気になるか、原子力については不安を払拭できるか、新エネルギーにしても小規模・高価格という欠点を克服できるか、というようにそれぞれ問題があり、いずれも、社会に受け入れられるかどうかが成否の鍵となると思います。

世界規模でエネルギー需要が増大していく中で、地球環境問題はエネルギーと環境との調和を益々クローズアップさせてくるものと思います。こうした中にあって、資源保護、環境保護に貢献し得るのは原子力及び新エネルギーだと思いますが、共に技術を必要とするエネルギーです。その意味では、わが国も含め先進国の責務は極めて大きいと言えます。

先進国は、まず、原子力や新エネルギーなど技術開発を必要とするエネルギーを責任をもって開発し、その利用を進めていくことが必要です。ここで重要になってくるのが国際協力だと思います。これまでも様々な技術情報交換が行われていますが、技術情報の国際交流を一層進めるとともに、国際的な共同研究として技術の開発を進めていくことが重要であると思います。

地球環境問題に対処する技術の開発は、国際的に共通するものです。また、その技術は、２１世紀を展望したとき、宇宙発電、核融合などの革新的なエネルギー技術となり、開発に長い期間と膨大な資金を要するものもありましょう。このような技術の開発は、一国のみで賄えるものではなく、全世界の英知を結集して初めて展望が開けるものでもあります。

先進国は、次に、開発した技術を途上国に対し、その実情に見合う形で移転を図っていく、ということが重要だと思います。先進国から途上国への技術の移転が、地球規模でのエネルギー問題、地球環境問題を解決する上で、大切なことだと考えています。

この技術移転で実質的に効果を上げるには、相手国の国情に配慮することが大きなポイントだと思います。例えば、いくら環境対策が万全であっても、高すぎては採用はされないし、かといって押し付ける訳にもいかないと思うのです。

今日のエネルギー問題は地球環境問題、核不拡散体制等地球規模の広がりを持っています。自国のセキュリティの確保という狭い視点だけではなく国際的な視点が必要です。反面、我々の生活がエネルギーの限りない恩恵の上に成り立っていることを考えると、一人一人の極めて身近な問題であるとも言えます。

すなわち、持続的な経済発展を確保しつつ、人間活動と地球環境保全の両立を図るためには、個人から国家に至るまで各レベルでエネルギー面での最大限の努力が求められているということです。

また、国際社会の中で増大しつつあるわが国の役割を十分自覚し、わが国の国際的責務として、世界のエネルギーセキュリティの確保と地球環境問題への対応のため、積極的な国際貢献を行うことが必要だと思っています。

ご静聴ありがとうございました。

BMU
Der Bundesminister für Umwelt, Naturschutz und Reaktorsicherheit
PRESSEMITTEILUNG

Speech

by

Prof. Dr. Klaus Töpfer

Environment Minister of the Federal Republic of Germany

at the Japan Atomic Industrial Forum (JAIF) meeting at Yokohama

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"International Cooperation on Nuclear Safety"

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Nuclear Safety in International Cooperation

I.

The past few years have been marked by historic developments which have given completely new significance to international cooperation in all areas of policy. On the one hand, we see the unification process within the European Community which will reach a further peak with the completion of the Single Market on 1 January 1993. However, this does not mean at all that this process has come to a halt. The course has been set for more far-reaching political, economic, social and ecological integration.

The basic feature of this development which has so far been limited to western Europe have been clearly predefined for years. All the more surprising, impressive and moving, then, is another historic event the effects of which are certain to have an even greater impact on the international community: the breakdown of what the Communists termed "real existing socialism" in eastern Europe and what one is tempted to call the quiet disintegration of the former Super Power Soviet Union. The political and economic opening-up of the countries in central and eastern Europe and the corresponding re-orientation towards market economy and the development of political and economic relations with the western industrialised nations mark the present international situation and underline in all policy areas the need for increased international cooperation.

Opening-up of the former eastern bloc means at the same time that the process of European integration has gained a new dimension. It has become clear that the development in central and eastern Europe on the one hand and the European unification process on the other hand cannot be considered to be independent and unrelated developments. The unification process of Europe cannot and must not be restricted to the member states of the European Community. The reforming countries of central and eastern Europe ought to be incorporated into this process. What is required at least is that the scope for action as a result of continuing European integration and the instruments for jointly coping with the economic, social and ecological problems of the central and eastern European countries inherited from collectivism, state planning and mismanagement has to be used in a fruitful way. For it is above all in the interests of us as Europeans that the political and economic processes of reform initiated in central and eastern Europe including the former Soviet Union should not fail due to economic, social or ecological problems of transition.

The importance of international cooperation has become manifest in particular in the area of nuclear safety. However, the importance attached to the intensification of international cooperation in this field had been recognised a lot earlier, when the present situation could not yet be foreseen at all. The mere fact that the world has over 400 nuclear power stations of different conceptions, different age and in different legal, economic and social systems has always been something which suggests increased international cooperation. Based on this recognition, the International Atomic Energy Agency in Vienna has been developing initial elements of an international scheme for nuclear safety over the past few decades. I should like to mention in particular the IAEA safety standards regulations for nuclear power stations, the so-called NUSS codes. During the safety and the general conference of the IAEA last year, the impetus was given for developing these safety standards, which had been non-obligatory up to then, into a convention on nuclear safety. However, we do not aim at an agreement on the smallest common denominator. We rather want to use the opportunity to lay down basic safety requirements under internationally binding law at as a high a level as possible especially for the existing nuclear power stations and in the field of disposal of nuclear waste. Preparations for this are under way. I should like to ask that Japan continue to support the speedy continuation of the process.

In the bilateral field we have reached agreements on early notification, technical support and exchange of experience with a large number of countries, including Japan (STA). Worthy of note here is in particular the cooperation with France and Great Britain in the fields of disposal of nuclear wastes and nuclear safety including the development of new reactor lines. I consider this cooperation the foundation for a European safety partnership. Within the framework of this partnership with France and Great Britain we are engaged in an intensive exchange of information on individual plants and their technical features as well as on safety targets and technical innovations. This cooperation is not a "closed shop". It is also open for non-European countries such as Japan.

In this context we share a basic position: nuclear energy will only have a chance as an option for the future if existing technical concepts are considerably further developed. It must be the aim in particular to restrict damage caused by possible core melt-down accidents to the respective plant itself.

The necessity of intensifying international cooperation in order to achieve protection from the dangers of nuclear energy was brought home to us by the events of Chernobyl. However, it was only after the iron curtain fell and in

Germany in particular thanks to the fact that direct access to the plants of the former GDR became possible within the framework of the reunification process that western experts gained truely broad access to information on the operational and safety technology-related features of the reactors used in the former CMEA countries. The outcome is - to put it mildly - alarming: almost all plants of Soviet design show considerable operational and safety technology-related deficits, even though these may be different according to the type and the operating country. The safety technology-related design of systems and components alone has proven inefficient to a large extent, in particular with regard to older reactor lines. At the same time deviations from the conditions as prescribed from the outset by the design have also been noted. Inadequate quality assurance, repair and maintenance deficits as well as a lack of organisational structures in the concerns and insufficient qualification and motivation of the staff add on to these factors.

In general it must be said that continued operation of most of the nuclear power plants in the former eastern bloc would not be possible according to our standards. This was the reason why I ordered the operational stop of the nuclear power plants in Rheinsberg and Greifswald at the earliest possible date - even before the accession of the new Federal Länder. At the same time, I have continuously urged that the particularly problematic nuclear power plants in the countries of the former eastern bloc be shut down. In Kozloduy blocks 1 and 2 have been switched off. Due to the expected bottlenecks in the energy supply, however, it is not certain that they will not be switched on again.

After my visit to Chernobyl, the Ukrainian parliament decided that the blocks 1 to 3 would be switched off by the end of next year. Time is running out - and this is brought home to us quite clearly by the incidents in Chernobyl on 11 October 1991 and in Sosnovy Bor on 24 March 1992.

Due to the fact that plants for nuclear supply and disposal in the former Soviet Union were also of military significance, the curtain of secrecy is only slowly being lifted. First findings reveal disastrous conditions for example in the nuclear reprocessing complex in the southern Urals which places an almost unconceivable burden on man and the environment. If this damage can be repaired at all, it will only be possible with enormous effort.

However, improving safety technology and switching off particularly problematic nuclear power plants is not enough. Serious control deficits as well as insufficient legal bases and insufficient regulatory systems became evident as contacts with the competent authorities of the Soviet Union or the independent republics now formed on the territory of the former Soviet Union and with the other reforming countries of the former eastern bloc were intensified. In most cases, formal acts of preventative control by the authorities in the form of licences are not provided for. To some extent, this is due to the political system which put energy, policy and entrepreneurial decisions, planning, implementation and control under one roof. Difficulties have also arisen as a result of the reform process. In particular the disintegration of the former Soviet Union has led to the responsibility of the former central government being passed on to the newly created republics without efficient and experienced administration existing there.

The description of the situation in the reforming countries of central and eastern Europe, however, is not complete if one fails to mention that the energy situation is, as a whole, characterised by low efficiency both of energy protection and consumption, of extreme environmental incompatibility even in the conventional area and unilateral dependencies of some part of the former CMEA countries on energy imports from the republics of the Commonwealth of Independent States which was created following the disintegration of the Soviet Union. This results in the fact that substitution of nuclear electricity would lead to not inconsiderable damage under the aspect of environmental compatibility due to obsolete techniques in the conventional field. Also, closure of the nuclear power plants in the new republics of the CIS would lead to bottlenecks for example in Bulgaria which again would lead to the fact that close-down of the obsolete nuclear power plant blocks in Kozloduy would be made more difficult.

The situation is aleviated merely by the drop-back in energy demand which has already been observed and which is expected to continue. This means that, if they increase their efficiency at the same time, the countries of central and eastern Europe now have the possibility to get rid of obsolete and environmentally damaging plants or to retrofit appropriate plants up to a reasonable level. However, one fact has become clear already now and has been expressed again and again by those responsible in the countries concerned. These countries will not be able to cope with the problems of safety technology, administration and economy by themselves. What is required therefore, is the support of the international community, above all for setting-up administrative structures, compiling safety analyses, retrofitting plants as far as they can still be switched off or further operation seems to be justifiable after retrofitting and finally, for substituting the power supply resulting from closures.

Given the particularly exposed situation of Germany and having realised that another disaster like Chernobyl would mean the end of the peaceful use of nuclear energy even for us, the Federal Government offered and granted specific support at a very early stage. Findings made during safety analyses of the nuclear power plants in Greifswald, Rheinsberg and Stendal and within the framework of an investigation programme on the safety of east European plants are made available to the former CMEA states within the framework of bilateral agreements. The Federal Government has already provided specific material support in the case of the nuclear plant of Kozloduy by supplying spare parts from Greifswald. To prevent misunderstandings, however, I should like to mention here that this support is only meant to be emergency aid. Priority is given to closing down unsafe plants.

Intensive cooperation continues in the administrative and regulatory area. In November of last year I initiated cooperation with the republics replacing the former Soviet Union together with the heads of the Russian and Ukrainian authorities responsible for nuclear safety. We defined the areas of cooperation in a joint declaration. The Gesellschaft für Reaktorsicherheit (Company for Nuclear Safety) will set up branch offices in Moscow and Kiev - probably jointly with its French counterpart IPSN. Due to the fact that the structures in the individual republics are still only being set up, support in creating effective licensing and supervisory structures as well as help and new ideas for establishing coordinating structures between the individual republics is even more required than was the case in cooperation with the former Soviet Union.

However, the efforts of the Federal Government have shown that the problems emerging in the process of reform in the former CMEA states can only be coped with to a small extent on a bilateral basis. A solution of the problems will only be possible within the framework of broad international support. Therefore, the Federal Government calls for increased commitment of the western industrialised nations. In doing so, however, it has to make one thing clear right from the start: we do not want internationalisation of the responsibilities for the safety of nuclear power plants - neither in the reforming countries of central and eastern Europe nor elsewhere. Intensification of the international cooperation which we call for in general cannot and must not be misunderstood as the call for shifting the operator country's or the operator's responsibility to the international community. The responsibility of the operator must not more or less disappear in a wealth of abstract terms.

The international commitment for coping with the problems of central and eastern Europe ought to focus on cooperation between all European countries with the inclusion of the United States, Japan and Canada. I have already mentioned that the process of European cooperation must not be restricted to the members of the European Community but has to include the reforming countries of central and eastern Europe. At present it is only the EC which has the organisatory ressources to cope with the coordinating tasks at hand.

Quite a number of international relief actions have been started. As the first step towards a joint European action I should like to mention first of all the joint declaration of France, Great Britain, Belgium and Germany of 25 March 1991. Also the special programme of the IAEA on the supervision of the safety of older reactors in the countries of central and eastern Europe as well as the EC programme for immediate support for the nuclear power plant in Kozloduy in Bulgaria and the EC support programme for the USSR which, however, ought to be renegotiated following the disintegration of the Soviet Union also have to be underlined in this context. Finally, special mention has to be made of the PHARE programme of the G 24 countries, which comprise all western industrialised nations including the twelve EC countries. The goal of the PHARE programme is the reconstruction of the former CMEA countries and thus also includes questions of nuclear safety.

Even though the subject of nuclear safety in the former CMEA countries was already dealt with during the last World Economic Summit in London, the international support measures still leave a lot to be desired. One reason is that the international financing institutions do not have sufficient means at their disposal even though the reconstruction process in the reforming countries is supported by the **European Bank for Reconstruction and Development** which was founded in 1991 and the **World Bank**.

Coordination of the bilateral and multilateral support measures, however, is also unsatisfactory. In my opinion, the EC ought to play a particular rôle here. A first step towards this goal has already been made. Multilateral support measures including the PHARE programme of the G 24 as well as bilateral actions of the industrialised countries are to be coordinated under the chairmanship of the EC Commission. During the last meeting of the EC G 24 expert group on the PHARE sectoral programme on **nuclear safety** first coordination structures were defined.

The Federal Government hopes that the next World Economic Summit in Munich will provide further impetus. The Federal Government will use its presidency in order to avoid isolated actions by individual states for the sake of a coordinated approach and in order to set in motion a coordinated support programme of the western industrialised nations.

All efforts must be geared towards the goal of enabling the countries of central and eastern Europe to bring about the necessary improvement of nuclear safety as well as of the energy and environmental situation altogether, on their own. Only this way can it be avoided in the long run that responsibility for nuclear safety in the countries concerned is in practice shifted to the international community.

A coordinated support programme of the western industrialised nations will cost money. Specific retrofitting measures must be carried out for which, however, the appropriate components are only available in the western industrialised nations in particular in the field of instrumentation and controlled technology. Furthermore, staff has to be educated and trained whereby Japan's initiative in this context is very much welcomed. Finally, assistance is required to set up control structures.

According to our estimates costs within a period of five years will amount to approxiamtely 15 billion DM. These estimates are based on the fact that the uranium-graphite-pressure tube reactors (RBMK reactors) and the WWER 440/230 cannot not be retrofitted in an economically efficient way. Only in individual cases can a limited phase-out period be considered for the WWER 440/230 type reactors - provided, however, that they too are retrofitted at least to a minimum extent. WWER 440/213 type reactors seem to be retrofittable, even if only at considerable effort and expense. The most favourable situation is given in the case of WWER 1000 type reactors, even though, they too, have to be retrofitted if they are to continue operation on a long-term basis. The prospects for lasting operation are particularly favourable in the case of WWER 440/213 and WWER 1000 type reactors if they are still under construction because then retrofitting is easier and less expensive. Costs for finding replacement electricity supply and shut-downs due to retrofitting measures are not included in these cost estimates.

In principle we have to differentiate between three different cases:

1. Nuclear power plants lasting operation of which is possible in an economically efficient way. These power plants include

   - WWER 1000 type plants suitable for lasting operation and for retrofitting measures and to a certain extent also WWER 440/213 type plants

   - and which are operated within an economic system which guarantees investment security and at least guarantee cost-covering energy prices, and where contributions towards their financing are possible by supplying energy and making compensation transactions.

   These cases can be solved by cooperation between various companies.

2. Nuclear power plants which

   - allow only limited operation after retrofitting or

   - do not fulfill the above mentioned economic framework conditions.

   However, only WWER 1000 and WWER 440/213 type plants fall under this category. They represent an economic risk and a solution will not be found therefore without long-term loans under particularly favourable conditions and above all without guarantees from western countries.

3. Nuclear power plants for which only limited phase-out operation after retrofitting can be considered. These include in particular WWER 440/230 type reactors of recent construction. They cannot be operated economically in any case. Solutions can be found for these cases only by governmental support, for example via an international fund. However, these are the most urgent cases with regard to safety aspects. Therefore, an international immediate aid programme financed by government is particularly urgent.

It is not only a question of offering such programmes. They also have to be accepted by the countries concerned. This means that these countries have to be prepared to give highest priority to these questions according to what political action is most urgently required and to create the necessary economic framework conditions. Also the question of the political pressure which will be necessary for this will be dealt with during the G 7 Summit.

The question of **nuclear safety in the former eastern bloc countries** will also play an important rôle in connection with the European **energy charter** which is currently being prepared. The background for the initiative towards a pan-European energy charter is provided by a decision of the European Council of 1990 which reacted to a corresponding proposal of the Dutch Prime Minister Lubbers. We have given this initiative every support right from the start, not least because of its possible importance for the reform processes in the former eastern bloc countries. **Nuclear safety will be the subject of an internationally binding protocol** which is currently being negotiated. Subjects to be dealt with in this protocol will include definition of basic goals of protection as well as the development of joint technical specifications and safety technological requirements. If we succeed in incorporating the former eastern bloc countries this would ensure that reasonable **minimum requirements** would be applicable also in these countries.

However, I consider the following aspects just as important: **the pan-European energy charter provides an opportunity for creating the basis to connect central and eastern Europe with the western European interlinked network.** Such an interlinkage would facilitate the substitution of environmentally hazardous forms of energy protection which is necessary to some extent and which is required to solve the safety and environment-related problems in the former eastern bloc countries. It is not in the least because of this, however, that the pan-European energy charter also is to facilitate entrepreneurial investment in the reforming countries in central and eastern Europe. This would create the basis for the transfer of capital and technology which is required for modernising the energy sector in the reforming countries. In the long term, this would mean a better contribution towards solving the problems than governmental support programmes irrespective of the question as to how large and well-coordinated they are.

The European energy charter will only be effective in the medium and long-term. Needless to say, however, support is required now. Short-term technological, financial and administrative support measures of the western industrialised nations therefore must not be postponed by referring to the European energy charta.

After the collapse of the Soviet Union we are now confronted increasingly clearly not only with the question of nuclear safety but also with the problem of non-proliferation. We are aware of the danger presented by the communication of technical knowledge in the military field by disreputable traders with nuclear knowledge and by the dangers which can possibly arise if fissionable material is not sufficiently protected. It will be a question of whether the technical staff in the military field can be given some perspectives for the future. When safeguarding nuclear material used in the military area the IAEA and the USA will play a particular rôle. Certainly the most urgent approach is simply safeguarding the material by storing it. Following this step, however, lasting solutions have to be found. This means that technologies from the civil area too will have to be used to solve the problems arising in the military field. I should like to mention here the technology for using plutonium in fuel elements. This technology is suitable in principle towards contributing to a solution of the problems.

II.

The increased international cooperation in the field of nuclear energy and the situation in the central and eastern European reforming countries also sheds a new light on the situation in Germany. The efforts to set up binding international safety provisions and the necessity to help the countries of the former eastern bloc in coping with their technical problems and in establsihing efficient administrative structures also force us to critically review both our own situation and our own concepts. In the field of energy policy as in many other policy areas, we are required today more than ever before, to take a look beyond our national horizon and to fulfill our obligations in international, and above all, pan-European cooperation.

This means that we have to make every effort to give our energy policy an ecological face which again implies that energy saving measures and tapping of renewable energies along the lines of energy mix called for by the Federal Government and also holding up the option of nuclear energy has to be promoted. However, this requires - and that is what I mean when I use the term "option nuclear energy" - that the development of new reactor concepts with even more far-reaching inherent safety characteristics be vigourously pursued.

Holding up the option of nuclear energy also means that we have to remain in the position to take action and political decisions, given the situation in central and eastern Europe. Germany will only be able to make its contribution towards international cooperation and in particular towards support action for the former eastern bloc if it continues to have an efficient nuclear technology at its disposal.

セッション２

安全とは何か－統一的見解を目指して

〈基調講演〉

原子力発電の安全確保について

通商産業省資源エネルギー庁長官

山　本　貞　一

〈パネル討論〉

ドイツ原子炉安全協会理事長

A．ビルクホーファー

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ブルガリア原子力委員会委員長

Y．ヤネフ

「原子力発電の安全確保について」

通産省資源エネルギー庁長官

山本　貞一

1．はじめに

本日、第２５回日本原子力産業会議年次大会が、内外から多数の原子力関係者の出席のもと、かくも盛大に開催される運びとなり、向坊会長、石井大会準備委員長を始め、大会の開催に御尽力された皆様方に心からお祝いを申し上げます。

今回で２５回目を迎え、四半世紀を数えるにいたった今年の年次大会のテーマは、「２１世紀への課題ー社会の中の原子力」ということであります。3日間にわたり原子力を巡る内外の課題について、各分野の関係者の皆様方により、積極的な議論が行われることとなっておりまして、実り多き成果を大いに期待しております。

さて、このセッションのテーマは、「安全とは何かー統一的見解を目指して」ということで、これから海外における原子力安全に対する実状や考え方を御紹介いただき、安全とは何かをあらためて検討し、世界の原子力関係者が安全に対する統一的な見解をもつことについて御議論いただくわけですが、その口火を切る意味で私の方から我が国における原子力発電の安全確保に対する取り組みについてお話しさせていただきます。パネリストの皆様の御議論のきっかけになれば幸いに存じます。

話の前提として、まず、最近の我が国におけるエネルギー情勢、原子力を取り巻く環境、原子力政策の基本的方向等について御説明させていただきます。

２．我が国をとりまくエネルギー情勢

エネルギーは、各国の経済発展、人間生活の基盤であることは明らかであり、国際エネルギー機関の展望によれば、今後とも世界のエネルギー需要の着実な増加が見込されており、その安定供給の必要性はますます高まりを見せることが予想されます。現在、エネル

ギー問題を考える時には、「資源の安定供給」の観点はもちろんのこと、地球温暖化問題を始めとする「地球環境問題への対応」という観点からも考えることが必要となってきております。

とりわけ、化石エネルギーの消費に密接に関連している地球温暖化問題については、国際的枠組みの下に取り組まれている問題であることは周知の事実でありますが、我が国においても、これまで官民挙げてエネルギーの効率的利用に努めてきたのに加えまして、１９９０年、地球温暖化防止のため、二酸化炭素大量排出国としての責任と役割を果たすべく「地球温暖化防止行動計画」を策定したところであります。

本行動計画においては、地球温暖化防止のため、都市構造、交通体系、発電、ライフスタイル等広範にわたる対策を総合的に講じていくこととし、特に、二酸化炭素の排出抑制目標として、こうした対策を着実に実施していくことにより、一人当たりの二酸化炭素排出量を２０００年以降概ね１９９０年レベルで安定化させることを目標としております。

３．我が国のエネルギー政策の基本的方向

このようにエネルギーを巡る局面が難しいものとなっている中で、通産省では、１９９０年、通商産業大臣の諮問機関であります「総合エネルギー調査会」において、今後、世界全体の中で大きな役割を果たしている我が国として、我が国及び世界全体の持続的な発展を、「地球温暖化防止行動計画」の目標を達成しつつ、どのように実現させていくかについての総合的なエネルギー政策をとりまとめました。まず、この内容について簡単に触れつつ、その中における原子力政策の位置付け及び概要について御紹介したいと存じます。

総合エネルギー調査会の報告は、今後の国内のエネルギー政策の基本的方向として、「エネルギー利用の効率化」及び「適切なエネルギー供給構造の構築」を提言いたしました。また、併せて、この基本的方向を踏まえて、２０１０年度における我が国のエネルギー需給のあるべき姿を「長期エネルギー需給見通し」として示し、その後の閣議決定を経て、「石油代替エネルギーの供給目標」を策定したところであります。

ただいまの２つの基本的方向について簡単に申し上げますと、第１の「エネルギー利用の効率化」につきましては、国民生活におけるゆとりと豊かさの追求を背景としたエネルギーに対するニーズの増大に対して、それを最大限抑制することを政策目標としております。具体的には、国民に対して無駄なエネルギーを使わないようお願いすることはもとより、発電廃熱、都市廃熱等の未利用エネルギーの活用、省エネ設備や機器の開発・導入等各種省エネルギー対策を抜本的に強化することが必要であることを盛り込んでおります。

第２の「適切なエネルギー供給構造の構築」につきましては、過度に石油等特定のエネルギー源に依存することなく、様々なエネルギー源を適切に組み合わせて、すなわち、適切なエネルギーミックスによってエネルギーの安定供給を確保することの必要性を唱えております。具体的には、石油依存率を現段階の５７％からさらに低減させ、２０１０年には４５％とすることを目標としております。その裏返しとして、非化石エネルギーの中核として位置づけられている原子力については、現段階の約９％から２０１０年には約１７％まで高めることとしています。これを発電規模で言えば、現行の３，３００万ｋＷから、７，２５０万ｋＷに引き上げることになります。このうち、既に着工中のもの及び着工準備中地点が約１，３００万ｋＷあり、こうしたものを除いた今後の開発規模としては、約２，６００万ｋＷ、最新型の発電プラントに換算すると約２０基分となります。

４．我が国の原子力政策

それでは、この石油代替エネルギーの中核を占める原子力の今後の開発・利用推進の考え方についてお話ししたいと思います。

我が国においては、これまで平和利用の堅持と安全の確保を大前提に原子力開発を進めてきております。また、原子力は供給安定性、経済性に優れ、環境負荷が小さいなどの特徴を有することから、エネルギー供給構造の脆弱な我が国においては、適切なエネルギー需給構造を構築する上でその推進が必要不可欠であります。我が国のみならず、世界的にもサミットなどの場においてその重要性が確認されたのは皆様ご承知のとおりであります。

このような原子力を推進するために、我が国においては、先ほどの7，250万kWの発電規模の目標に向けて、次の4本の柱を中心にした各種施策を講じております。その4本とは、安全確保対策、核燃料サイクルの確立、立地促進対策、広報対策であります。これらについて簡単にご紹介したのち、本日のセッション2の議題であります安全の話題に入ってまいりたいと思います。

4本の柱の第1番目に掲げております安全確保対策につきましては、後ほど詳しくご紹介いたしますので、割愛させていただきますが、原子力発電の安全性確保は、原子力を推進するうえでの大前提と位置付け、安全性の一層の向上のための不断の努力を払っているところであります。

第2の核燃料サイクル確立につきましては、資源に乏しく今後のエネルギーの多くを原子力に頼らなければならない我が国においては、最初の原料以外は国産エネルギーとして推進していくこととしておりまして、現在、青森県六ケ所村においてウラン濃縮、再処理、低レベル放射性廃棄物埋設の各施設を建設しているところであります。このうち、ウラン濃縮施設が最も早く、すでに先月、操業を開始したところであります。しかしながら、核燃料サイクルは、高レベル放射性廃棄物の最後の処分をしっかり行ってはじめて完結するものですから、今後最優先ですすめていくべき課題の1つと位置付けることが必要であると考えております。

第3の立地促進対策につきましては、先程の2010年の7，250万kWの目標の達成のためには最も直接的に響いてくるものでありますが、一方で、我が国全体が豊かになってきたことに伴って、一部の地域では、電源立地を契機に地域振興を図っていこうという気持ちが薄れてきたのではないかというのが考えられます。こうした事態を打開するため、従来から行っている公共事業的なものをつくっていくだけではなく、もっと商業的に活性化するなど地元側が誘致をする気を起こすようなインセンティブになるようなものが必要と考え、各般の施策に取り組んでおります。

第4の広報対策につきましては、原子力推進のための方策を地道に進めていくだけでな

く、原子力発電の必要性、安全性、故障・トラブル等に関する情報や、政府の考え方、あるいは推進方策の内容などを国民にわかりやすい形で積極的に提供することにより国民への透明性を高め、原子力発電に対する理解を一層促進することを目的として行っております。そのため、国民が原子力情報に簡単に触れることができるように、原子力情報提供システムを全国に展開するなど、情報提供インフラの整備等に力を入れて推進しております。

５．我が国の原子力発電安全確保の現状

それでは、本セッションのテーマであります原子力発電の安全に関して話を進めていきたいとおもいます。まず、これから行う議論のきっかけとなるよう、我が国として原子力発電の安全確保の現状についてご紹介いたします。

原子力発電の開発利用に当たりましては、安全性の確保が大前提であり、我が国においては、法令に基づき、設計、建設、運転の各段階において国が厳重な安全規制を実施しております。また、電気事業者においても品質保証活動、自主点検、予防保全対策等の安全確保対策が講じられております。このような国による厳重な規制と電気事業者における自主保安により我が国の原子力発電所の安全確保が図られる体制となっております。このため１９６６年に我が国において初の商業用原子力発電所が運転を開始して以来、周辺公衆に影響を与えるような事例は存在せず、世界的にもトップレベルの安全性を確保していると言うことができます。

従いまして、我が国の原子力発電所の運転状況に関しましては、１９９１年度の原子力発電所の設備利用率は、営業運転中の４１基の発電所の平均で７３．８％であり、１９８３年以来、９年間引き続いて７０％代と長期間にわたって良好な水準で推移しております。１９９１年度における運転停止の要因は、ほとんどが実施が法令で義務付けられている定期検査であり、故障・トラブル等による運転停止にともなう設備利用率の低下は０．７％と極めて低く、諸外国と比較しましても、我が国における長い定期検査の期間を考慮いたしますと優れた設備利用率であると言えます。また、１９９１年度に法令に基づき報告のありました故障・トラブル等の件数は２０件であり、１基当たりの報告件数は年平均で

０．５件であり、世界的にみても優れた運転実績を示していると言うことができると考えております。

このように我が国においては、国による厳しい安全規制等により、原子力発電の安全性は十分確保され、また優れた運転実績を示していると言うことができますが、原子力発電のプラント基数の増大、運転年数の長期化等、原子力発電を取り巻く環境は大きく変化することが予想されます。このため、国といたしましても現行の安全規制を一層充実させるとともに、経年劣化対策、ヒューマンファクターに係る対策、シビアアクシデント対策等新たな課題への取組みも検討していくことが重要と考えております。

６．通産省における安全確保の具体的取組み

それでは、我が国における安全規制について、具体的に述べたいと思います。

原子力発電所の建設、運転等に当たっては、電気事業者の自主保安管理体制によって安全を確保することが前提となりますが、公共の安全の確保等の観点から、通産大臣が法令に基づき、設置許可から工事計画の認可、使用前検査等及び運転開始後の定期検査並びに運転管理監督まで一貫して厳正な安全規制を実施しております。

(1) 原子炉の設置許可

まず、実用発電用原子炉を設置する際は、法令に基づき、その設置について通産大臣の許可を必要とします。

事業者から原子炉の設置許可申請がなされると、通産省は当該原子炉の基本設計が安全上妥当なものであるかどうか等について審査を行います。その際、技術上の諸問題については必要に応じ学識経験者の集まりである原子力発電技術顧問会の意見を聴いています。その後、通産大臣は、安全審査結果を原子力委員会及び原子力安全委員会に諮問し、そのダブルチェックを受け、さらに内閣総理大臣の同意を得た上で許可を行っています。

(2) 技術基準

また、法令に基づき、電気工作物の工事、維持及び運用に関し、保安の確保上必要な技術的事項を技術基準として定め所要の規制を行っています。

技術基準は、電気事業者の自主保安確保のための一手段としての意味を持ち、電気事業者にはその電気事業の用に供する電気工作物を技術基準に適合するように維持すべき義務が課せられています。

(3) 工事計画の認可及び検査

重要な電気工作物の設置または変更の工事については、その工事の計画を認可の対象としています。

その後、使用前検査により工事計画の認可という計画段階での規制に対応して実際の工事が計画どおりに行われているか否か等について、その工事の工程ごとに確認します。

また、原子炉の燃料として使用する核燃料物質については、その設計を認可の対象としており、その設計どおりに製造されているか否か等について、燃料体検査として加工の工程毎に通産大臣が検査を行うことにしております。さらに、格納容器等あるいは高温高圧の蒸気等を内臓している耐圧容器類は、製作過程の重要な部分を占める溶接について一定の工程ごとに検査を行い電気工作物の安全を確保することとしています。

さらに、運転を開始してからも法令の規定により、定期検査として約1年に1度数カ月かけて発電所の電気工作物のうち、保安の確保等の観点から重要なものについて通産大臣が検査を行い、プラントの経年的な変化等を確認し、使用にともなう機能の性能低下等に対し適切な対応をすることによりその安全を確保します。

また、我が国の原子力発電所の安全対策は、今まで述べました技術基準や安全審査、検査により行われているだけでなく、法令に基づき電気事業者が通産大臣の認可を受けて定めた保安規定によっても措置されており、この中で原子炉の運転等に当たって遵守すべき事項を定めさせるとともに、違反した場合には、運転停止命令を含む厳しい措置を講ずることができるようになっています。

また、原子力発電所には原子炉の運転に関して保安の監督を行わせるため、国の行う試験に合格したもの等の中から原子炉主任技術者を選任し配置するほか、実際の運転を行う運転員のうち、運転責任者についても資格認定制度を設けています。さらに通産省から国の職員として運転管理専門官を各発電所に派遣し、電気事業者の運転管理に関する監督を

行う等万全の体制をとっています。

7．美浜２号機事象の調査結果及び今後の取組みについて

昨年２月９日に関西電力㈱美浜発電所２号機で発生した蒸気発生器伝熱管損傷事象については、事象発生にともなう放射性物質の放出による周辺公衆に対する影響は認められませんでしたが、我が国において非常用炉心冷却装置（ＥＣＣＳ）が初めて実作動したことより国民に原子力発電の関する不安を抱かせたものであり、通産省としても、本事象の安全上の重要性等にかんがみ、事象発生以来、原因の究明及び再発防止対策の確立に関する徹底的な調査を行ってきたところです。

今回の事象の原因は、蒸気発生器の振動を防止するための振止め金具が設計どおりの範囲まで挿入されておらず、このような状態のまま蒸気発生器を長期間にわたり使用してきたことにあり、電気事業者の品質保証活動の重要性等が改めて認識されたところです。

通産省といたしましては、今後の原子力発電の安全確保を一層推進するとの観点から再発防止対策を確立するとともに、幅広く教訓事項を導出したところです。

その内容といたしましては、まず、国による審査、検査等の安全規制の一層の充実を図るとともに、電気事業者による品質保証活動に対する指導・監督の強化を行うこととしています。

また、電気事業者に対しましても、品質保証活動の強化、蒸気発生器伝熱管の健全性の向上、保守管理方法の改善、運転マニュアルの充実等幅広く指示を行ったところであり、今後ともこれらが着実に実施されるよう、通産省として指導・監督してまいります。

これらに加え、技術開発の推進等中長期的課題については、官民が協力して積極的に取り組むこととしており、特に検査技術の開発、ヒューマンファクターの研究、流動励起振動の評価手法の研究等に努めて行きたいと考えております。

今後、日本においても運転年数の長期化が進んでいくこともあり、経年変化への対応等に不断の努力をするとともに、新しい知見、技術や国内外の事故・故障等に関する教訓の既設プラントへの反映等を積極的に進めていくことが極めて重要だと認識しております。

8．原子力発電安全分野における国際協力

原子力発電所の安全確保に関する国際協力は従来から進められてきましたが、旧ソ連・東欧のソ連製旧型炉の安全性をめぐる危機感の高まり等から、各国において安全確保のための国際協力を一層積極的に推進することが重要との認識が高まっています。我が国におきましても、原子力発電所の安全性・信頼性についての優れた実績が注目され、諸外国からの協力要請が強まっており、こうした要請に応えるためにもより積極的に国際協力を推進しているところです。

我が国の国際協力体制は、国際機関対応、二国間対応、原子力発電事業者関係の３つに大きく区分されます。

国際機関対応といたしましては、世界の原子力平和利用の推進に必要とされる適切な国際環境整備に資するために、ＩＡＥＡ（国際原子力機関）及びＯＥＣＤ／ＮＥＡ（経済協力開発機構／原子力機関）の活動に対し、積極的に参画しております。その中では昨年実施された旧ソ連・東欧に存在する旧ソ連製旧型炉に対するＩＡＥＡ特別安全評価ミッションへの専門家の派遣、ＩＡＥＡ／ＯＳＡＲＴ（運転管理調査チーム）、ＩＲＳ（事故通報システム）、ＩＮＥＳ（国際原子力事故評価尺度）等への参画が挙げられます。原子力発電を行う国は、当然のことながら、一定の安全レベルを満足しなければなりません。かかる観点から、現在、ＩＡＥＡで検討されている安全条約は重要であり、我が国としても、この条約の実現に向けて積極的に検討に参加していくこととしています。

二国間協力といたしましては、我が国とアメリカ、ヨーロッパ諸国及び韓国との間で、原子力発電安全規制に関する情報及び意見交換会合を定期的に開催するとともに、アメリカ、フランスとの共同研究を実施しているところであります。また、中国、インドネシア等の開発途上国からの安全面での協力要請に対しては、専門家の派遣、研修生の受け入れなどの技術協力及び情報提供を行っています。

また、今年度から、原子力発電所運転管理等国際研修事業といたしまして、旧ソ連・

東欧、発展途上国の原子力発電所の安全に関する監督・管理者、保守・検査員、設計者等を中心として、技術レベルの向上、原子力に関する安全意識の向上を図るため、機器のメンテナンス、管理組織、体制整備、安全設計等に関して、今後１０年間で１０００人規模の研修生を受け入れ、訓練等を実施することといたしており、現在、そのための準備を精力的に行っているところです。

原子力発電事業者関係といたしましては、原子力発電に関する事業者の国際機関として、１９８９年春にＷＡＮＯ（世界原子力発電事業者協会）が発足し、東京、パリ、モスクワ、アトランタの４つの地域センターが設立されました。東京センターには、我が国の電気事業者を中心にアジア諸国の事業者が参加し、原子力発電所の運転状況、事故・故障などの情報交換を実施しております。

我が国といたしましては、こうした国際協力について、今後とも引き続き積極的に対応していきたいと考えております。

９．おわりに

以上、我が国の安全確保対策について簡単に御紹介させていただきましたが、今や、原子力発電所の安全確保は一国のみの問題ではなく、今後、万が一、チェルノブイル並みの事故が発生したら、それは全世界の国民の原子力に対する信頼感を著しく失うことになると同時に、世界中の原子力立地の促進に大きな悪影響を及ぼすこととなるのは明らかであります。

折しも、先月２４日、ロシア連邦共和国レニングラード原子力発電所において燃料チャンネルの損傷を原因として原子炉が停止する事象が発生したところであります。事象の評価はＩＡＥＡ国際評価尺度でレベル２に分類されるもので、公衆への影響がないものであったのは不幸中の幸いでありましたが、危険性が指摘されているプラントはこれ以外にも多く、再発防止には万全の構えで望むことが必要であることは言うまでもありません。我が国といたしましては、実状を把握するとともに、行い得る協力策について検討すること

が重要であると判断し、先週末、急遽調査ミッションを派遣したところであります。

加えて、東西冷戦構造の崩壊に伴って、ＣＩＳ保有核物質の取扱いについても大きくクローズアップされるなど、昨今の原子力を取り巻く環境は大きく変化してきており、今後、原子力の推進に当たりましては、安全確保対策を含めまして、世界的な枠組みの下で考えていく必要があると思っています。その意味においても、原産年次大会のような場において世界の原子力の将来について活発に意見交換をしていくことは大変意義のあることと存じます。

本日この場にお集まりの皆様方をはじめとして、各国の原子力関係者の皆様との協力の下、原子力開発に最大限の努力を払っていくことを申し上げまして、私の報告を終わらせていただきます。

ご静聴ありがとうございました。

25th JAIF Annual Conference, Yokohama

April 8 - 10, 1992

Session 2

WHAT IS SAFETY? - TOWARDS AN UNIFIED VIEW?

Panel Discussion Views

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The primary objective of nuclear safety have ever been the protection of individuals, society and environment against radiological hazards that may arise from the use of nuclear power. The methods to achieve this objective have been considerably improved over the past decades. Today, it is widely recognized that a very high level of nuclear safety can be achieved using the following essential fundamental principles:

1. Protection should be based on defence-in-depth providing different, highly independent physical barriers and levels of protection.
2. Design should effectively eliminate the influence of factors such as human error or common cause failures, which have a potential to jeopardize the independence of the levels of defence. An appropriate level of automation is of particular importance in this regard.
3. Quality assurance and in its broadest sense must be applied to all relevant sectors.
4. The organizational aspects of nuclear operation and the role of individuals need to be addressed in a very general way. That includes achieving a high level of safety culture as well as independence, responsibility, and competence of all involved technical and govemmental organisations.

Experience shows that the few accidents which happened so far involved violations of at least one of these fundamental principles.

In view of possible transboundary effects of accidents and the need of broad information and data bases regarding research and operating experience an International approach to nuclear safety is essential. An intemational safety regime should be based on some general safety principles, methods of verification, exchange of experiences and peer reviews. Existing international guide-lines such as INSAG-3 and the IAEA NUSS series provide a basis. However, this basis still constitutes in many regards rather a smallest common denominator than a demanding requirement enforcing highest levels of nuclear safety. Therefore, it will be necessary to develop more stringent and consistent safety criteria and guide-lines not only for operating plants but also for the design of future reactors.

In many countries the nuclear debate indicates that a mere probabilistic argument of a very small severe accident probability does not convince the majority the public. That may largely contribute to the lack of acceptance of nuclear technology. Further, accident consequences are looked at by the public not only in terms of human victims but also of in terms quantities of contaminated land. It seems required to provide future reactor designs with technical features assuring effective limitation of off-site consequences in the event of an accident. Therefore, the dual approach,

1. further reduction of the core melt probability compared to the level achieved at the best existing plants,

2. effective limitation of off-site consequences for all relevant severe core melt accident scenarios,

seems to satisfy both the technical and non-technical demands on improving nuclear safety in the future.

Panel Discussion
Session 2
25th JAIF

April 9, 1992
Yokohama, Japan

What is Safety ?

- A Korean Perspective -

Byung-Koo Kim

Sr Vice President
Korea Atomic Energy
Research Institute

What is Safety ?

- A Korean Perspective -

Topic for me this morning is to address the philosophy for securing safety of nuclear power from the Korean perspective in this rapidly changing world. Let me go over with you very briefly on the past and present status of nuclear power and its safety implications, and share some thoughts on the future outlooks in the Republic of Korea.

We are celebrating the 30th anniversary of the very first nuclear chain reaction in Korea with a small research reactor at KAERI in 1962. We have come a long way since then, most remarkable achievements were made in nuclear electricity generation among others. The nation enjoys 50 percent of its total electricity from nine nuclear power stations since 1988 and the nuclear share is expected to stay about the same in the future. This nuclear percentile is only about third or forth among all nuclear electricity producing nations, behind France and Belgium.

How did we get this far in nuclear power? (Refer to Figure 1. Chronology of Korean Nuclear Power Propram) We built nine nuclear stations in relatively short period of time during the seventies and eighties. We have acquired the generating capacity, and operating & maintenance experience during this time. However, all major components and systems including the nuclear steam supply system were imported entirely from foreign vendors; each project was contracted based on an international competitive bidding situation. As a consequence, we built reactors from three nuclear exporting countries; namely, USA, Canada and France. From the safety standpoint, we relied strictly on the safety standards of the country of origin since we lacked the Korean national standards to impose on all nuclear plants. As the nation's nuclear infrastructures were growing, so did the intricate difficulties of coping with three different national standard systems; namely, ASME, CSA and RCC standards. Nevertheless, past twelve year's operating history proves overall availability factors of all units well above world average in the high seventy percentile.(Refer to Figue 2. Nuclear Power Plants Availability Trend) In my opinion, this is attributed to two factors : number one, our masterminders in early seventies were very fortunate in selecting two most successful reactor types, PWR and PHWR-CANDU (Korea is the only country with such commercial power reactor combination) ; number two, Korean nuclear industries were established based on the western technologies with the highest standard of safety and system integrity.

At the present, five additional units are under construction at Yonggwang, Ulchin and Wolsong sites. Very important milestone was achieved in 1987 when Korean government decided to pursue technical self-reliance policy in all aspects of nuclear power technologies with the onset of Yonggwang 3&4 project. That meant the future nuclear units will be standardized with principal units of 1000 MWe PWR's supplemented by 700 MWe PHWR's. This implies the domestic technical bases are being established in design and manufacturing of nuclear fuel and nuclear steam supply system which are essential ingredient for ensuring domestic safety related capabilities. For instance, severe accident considerations were given from the design stages. Yonggwang 3&4 is the first unit to carry out the full scope Level I probabilistic safety assessment(PSA) calculations to estimate the quantitative aspects of the core damage frequency. Level II PSA is also being required for all future units to assess the probability of releasing significant amount of radioactivity out of the containment building. All existing nine units are undergoing the so-called individual plant examination(IPE) to assess possible back-fittings to take the severe accident scenario into account.

Looking down the future, we are near completion of the 10-year nuclear R&D planning for the 1992-2001 time frame. One of the major program in this plan includes the advanced PWR program which addresses the passive safety issue. By the end of 1994, series of in-depth feasibility studies will be conducted to determine the nation's choice between evolutionary advanced PWR's and more revolutionary passive reactors in compliance with the US EPRI's ALWR requirements. Perhaps a combination of an evolutionary advanced PWR with some passive design features could be possible. I will be very anxious to see the outcome by the end of 1994. Let me complete my talk in a positive note. Korea has come a long way in construction, operation and supporting R&D activities to acquire very safe and economic nuclear power. Korea plans to join the OECD/NEA in the near future, and safety research area will be of our principal interest. Our dependence on nuclear power can only be sustained with continued safety enhancements in design, construction and operation of nuclear stations supported by strong indigeneous R&D capabilites.

Thank you.

Fig. 1

CHRONOLOGY OF KOREAN NUCLEAR POWER PROGRAM

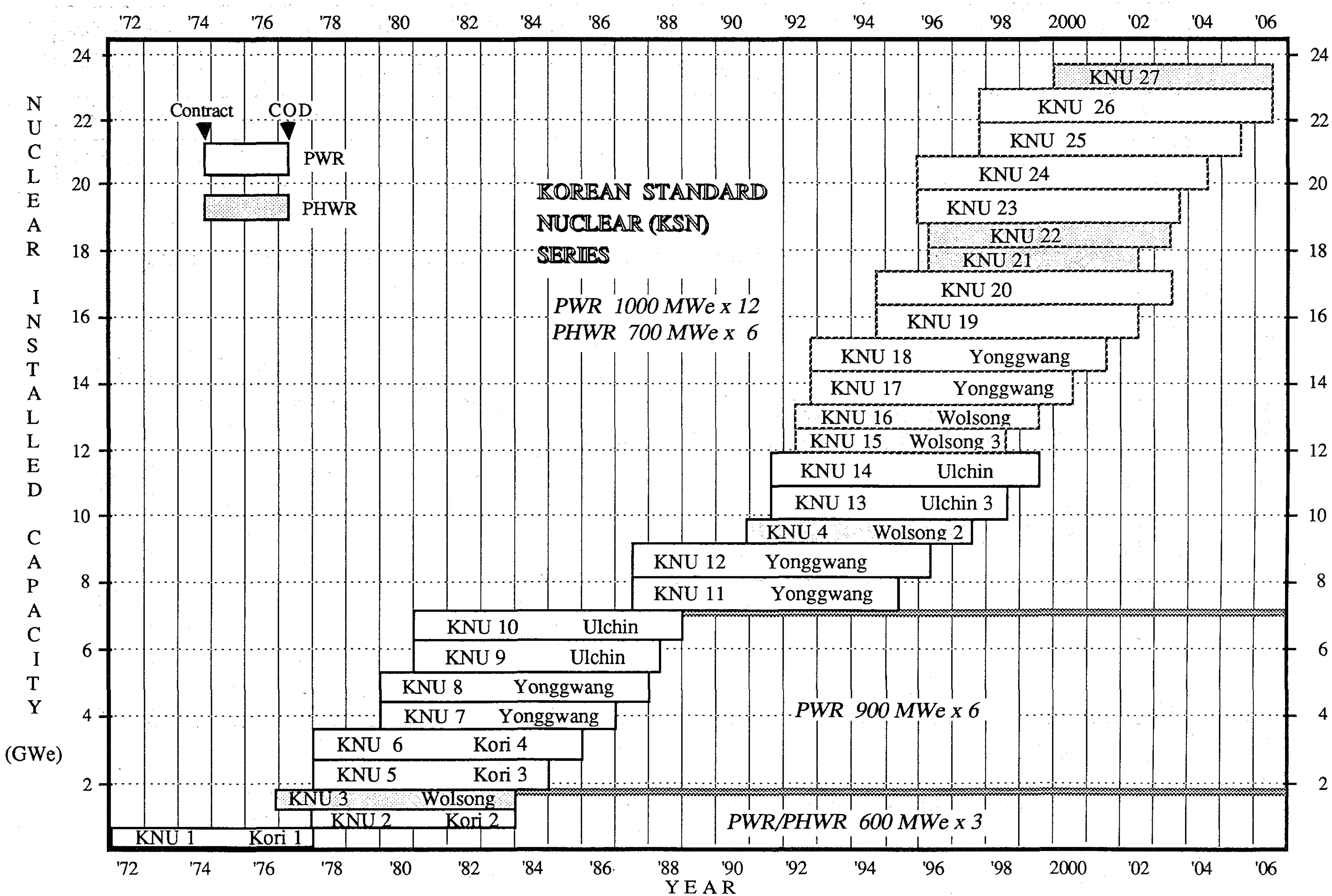
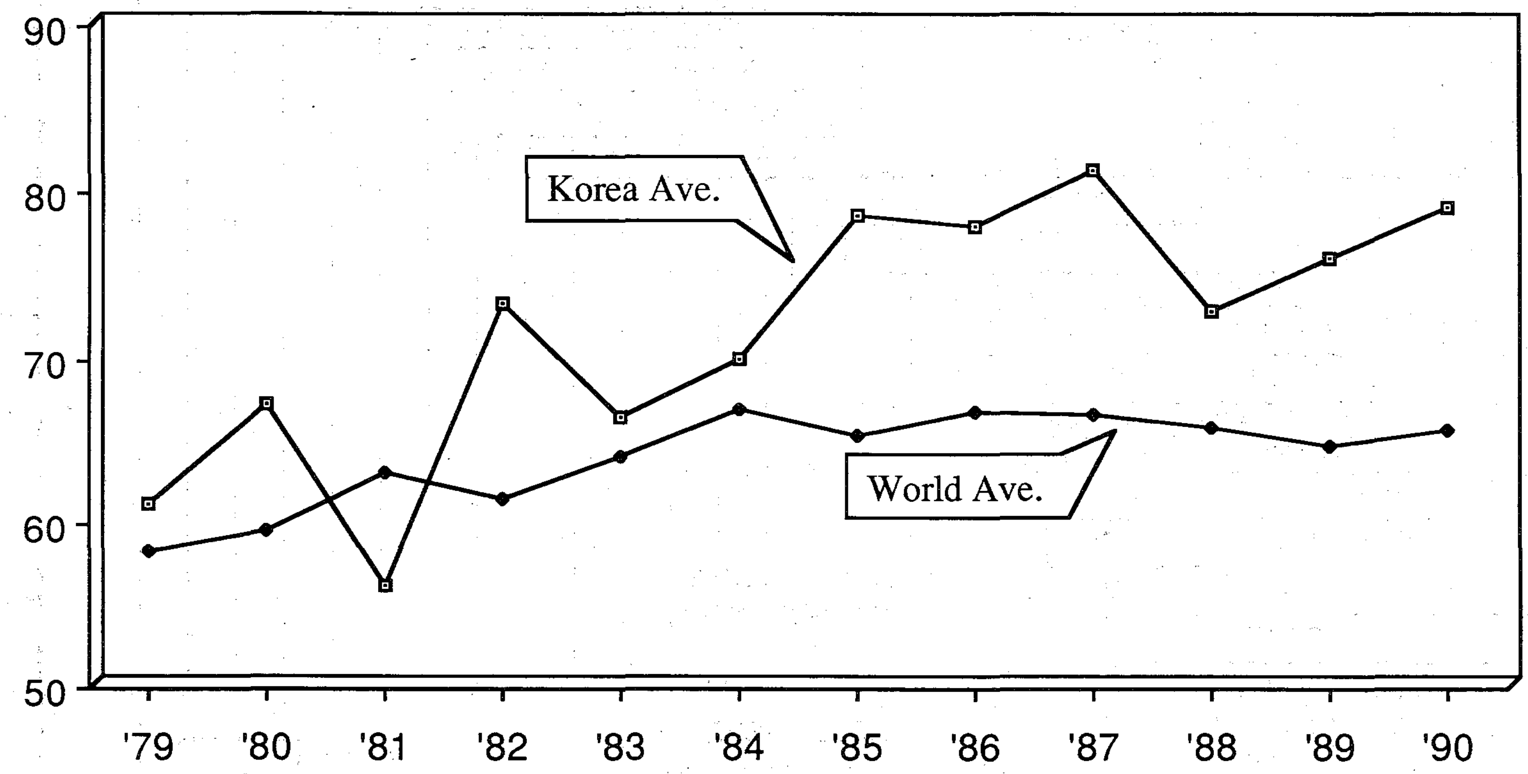


FIG. 2

NUCLEAR POWER PLANTS AVAILABILITY TREND

(unit : %)



Units	1	1	1	1	1	3	4	5	6	8	9	9
Year	'79	'80	'81	'82	'83	'84	'85	'86	'87	'88	'89	'90
Korea Ave.	61.3	67.4	56.3	73.5	66.6	70.1	78.7	78.1	81.5	73.0	76.2	79.3
World Ave.	58.4	59.7	63.2	61.6	64.2	67.0	65.4	66.9	66.7	65.9	64.8	65.7

source : *Nucleonics Week*

Japan Atomic Industrial Forum Inc
25th Annual Conference 8-10 April 1992

Session 2: "What is Safety: Towards a Unified View"

Edward James Varney
Deputy Chief Inspector
Her Majesty's Nuclear Installations Inspectorate
United Kingdom

Speaking Notes

Introductory Remarks

In this opening statement I would like to comment on three particular topics from my perspective as a regulator of nuclear installations in the United Kingdom.

1) Philosophy for Securing Safety of Nuclear Power
2) International Basic Safety Standards
3) Response to Severe Accidents

"What is Safety"

In trying to see what the public might consider the word "Safety" to imply I looked it up in my dictionary: one definition of "safety" is given as: "Freedom from danger or risks" I then felt I would need to see what "Risk" is defined as and I found it to be: "bad consequences" <u>or</u> "chance of bad consequences".

Taking these two definitions together it seems to me that a member of the public would be entitled to expect that "safety" means that there is no chance or probability of a bad consequence. Well I am sure that we are all aware that no industrial undertaking is "risk free" in the sense that there will always be a chance of a "bad consequence". To those of us who work in or with the nuclear industry the words "safe" and "safety" are usually interpreted as meaning that the "risk" or "chance of a bad consequence" must be made as small as it can reasonably be made. In fact UK law uses the phrase "safe so far as is reasonably practicable" in its principal safety legislation, the Health and Safety at Work etc Act 1974.

Thus the UK law recognises that no industrial undertaking can be made absolutely safe. For me, therefore, "safety" is associated with obtaining very high standards, and in licensing nuclear installations in the UK the debate, as I am sure it is in all developed countries, is about how very high standards of safety can be achieved.

For me the process of obtaining very high standards of safety starts with "people" and ends with "people". What I mean by that is that every step in the process of providing safe nuclear power is dominated by the need to have very high quality staff, appropriately educated, trained and motivated to make that step as safe as it can be made.

By this I mean that the licensee should design, construct, commission, operate, maintain and eventually decommission his plant and processes within a framework of arrangements, criteria and standards which are developed and implemented by well trained, competent staff who have safety as their highest priority. Central to this is the requirement that all operations which affect safety should be carried out within the limitations imposed by a safety case. For its part the regulatory organisation should encourage the licensee in his aims of achieving high standards and inspect plant and processes and assess safety cases according to its regulatory guidelines and principles designed to check that high standards are being attained. Again, the regulatory staff must be appropriately qualified, trained and dedicated to their task.

How all this is achieved in practice is perhaps the subject of another seminar which could address amongst other issues the development of Safety Culture, Management of Safety and Safety Goals. However, I do need to say a few words on the subject of "Towards a Unified View".

Towards A Unified View

I interpret this as meaning can an internationally acceptable set of safety standards be achieved which could be the basis for licensing nuclear plant in various countries? It seems to me that this is a difficult question because although the licensing arrangements in the developed countries have many similarities there are also some significant differences. For example, the extent to which probabilistic safety assessment techniques are used in the licensing process vary from country to country. Furthermore, if these techniques were to be used and a unified view obtained there would need to be agreement on what would be acceptable levels of risk. I would imagine that the concept of "acceptable" and "intolerable" levels of risk could well vary from country to country because of the differences in economic conditions, socio-political requirements and expectations.

In the UK the Health and Safety Executive published a discussion document on this subject in 1988 entitled "The Tolerability of Risk from Nuclear Power Stations". Comments have now been received from the industry, overseas sources, Government Departments, academics, consultants and individuals, and the implications of these comments are being considered.

However, having pointed to a difficulty, it seems to me that a way forward may well develop on the basis of particular nuclear plants being considered for licensing and found to be acceptable in several countries.

A unified approach might develop out of the common features and standards which were recognised in the designs and found to be acceptable. For progress to be made on achieving a unified view it seems to me that the first step must be for the operators of nuclear installations to get together and decide what they consider to be necessary in the interests of safety. However, it would then be necessary for the regulatory authorities in the countries concerned to consider the outcome of such discussions. This would mean considering whether any proposals which arise can be accepted in licensing in their countries without compromising the integrity of their countries' established procedures and requirements.

Response to Severe Accidents

I would like to conclude my observations with a few comments on how we in the UK deal with the possibility of a severe accident.

The NII, through the conditions attached to the nuclear site licence, has always required site operators to have emergency plans to deal with the potential of an uncontrolled release of fission products. Detailed plans have therefore always existed to deal with any event which could affect the public within an emergency planning zone of a few kilometres of every licensed site. The implementation of these plans with participation of all agencies including the operator, local authorities and emergency services such as fire, police and ambulance are regularly rehearsed, and at least once a year have to be demonstrated to the satisfaction of the NII.

The structure of the emergency plan allows for an increase in response for more severe accidents. However, the arrangements for responding to the most severe accidents become less detailed as the probability of the accident occurring decreases. This is because a balance must be struck between ensuring that detailed plans sufficiently extensive to cope with a serious accident are in place and the unjustified use of resources involved in planning in detail for very improbable events.

The emergency plans are thus robust and flexible. They are also kept under continuous review.

The accident at Chernobyl in April 1986 led to a major review of UK emergency planning arrangement. Following that review improvements incorporated into current plans include the enhanced consultation arrangements both locally and centrally, a nationwide scheme for monitoring radiation, an enhanced programme of exercises involving the centres for co-ordinating the off-site response and arrangements for a more rapid response from Central Government.

Finally, severe accidents call for the deployment of major resources in both people and materials. Current planning adequately addresses the "people" issues. As a final thought I would ask about the material resources. I believe consideration could be given to the provision of stocks of materials and equipment which could be useful in dealing with a severe accident. Perhaps a study of the materials used in recovering from the Chernobyl accident might be useful in this respect.

E J Varney
25 March 1992

NUCLEAR POWER IN BULGARIA AND THE PROSPECTS FOR FURURE DEVELOPMENT

Yanko Yanev
Committee on the Use of Atomic Energy for
Peaceful Purposes, Bulgaria

In the paper a review is made of the current energy situation in Bulgaria and especially of the present status of the nuclear generating capacities.
An in depth analysis of the electricity production shows that nuclear power plays a very important role and cannot simply be phased out by merely shutting down the reactors. On the other hand the well recognized defficiencies of WWER 440/230 reactors require a major interference dedicated to bring them to a reasonable level of safety which is acceptable for the nuclear industry and for the public.Some preliminary results of the PRA of Kozloduy 1 to 4 are also presented and the results support the assuption that upgrading of the reactors is feasible both technically and economically.

NUCLEAR POWER IN BULGARIA AND THE PROSPECTS FOR FUTURE DEVELOPMENT

Yanko Yanev, Bulgarian Atomic Energy Commission

ENERGY SITUATION

After forty five years of centrally planned development of the national economy presently Bulgaria has been placed in a difficult if not an insoluble energy supply problem. Historically a very intensive energy development policy has been persued. For many years the emphasis has been placed on development of heavy industry while energy resources were imported at favorable prices largely from the former Soviet Union. The main results from this unrealistic energy strategy were:

1.Higher share of industry in the GDP(48% in 1986) with a larger consumption of energy compared to the other components such as services.

2 Higher share of energy intensive industries such as production of organic and inorganic chemicals in total industrial output.

3.Low energy efficiency in technology used, compared to analogous type in the west.

All this results in a very energy intensive GNP which on average is 20 to 25% higher than for a compatible market economy when national incomes are compared on a basis of purchasing power parities and 35% or more higher when national incomes are compared on the basis of conventional exchange rates.

ELECTRICAL POWER INDUSTRY

Electrical energy in Bulgaria comes from a number of different sources and is most widely used in industry and households. The share of the different sources of electricity generation in the last years are presented in Table 1, and it's structure in the last quarterly of 1991 is shown in fig.1

Consumption of electricity in Bulgaria, after declining modestly in the beginning of 1990 is presently going down but the trend is somewhat deteriorating in the winter period due to extensive use of electricity for househeating. It is likely that dropping of consumption may further continue in 1992 and 1993 with further decline of industrial output and with further increase in the price. Nevertheless the experience in the winter of 1990 and 1991 showed that the nuclear power plant reliably supplies the country with the cheapest electrical power [1].

TABLE 1. Electricity generation in Bulgaria (mil.kWh).
(National Electric Company)*.

Year	Nuclear	Thermal	Hydro	Total
1980	6.165	20.326	3.713	30.204
1985	13.131	21.577	2.236	36.944
1989	14.565	22.722	2.691	39.978
1990	14.665	21.863	1.851	38.379

*_Producers outside the NEC supply of the order of 10% of the total electricity generation.

It is obvious that if one takes the economic situation Bulgaria happens to pass through, during the transition from a centrally planned to a market economy, nuclear generation of electrical power might become one of the reliable sources of the country energy supply. This is somehow supported by the extremely disastrous technical conditions of the conditions of the thermal generating units, the constantly decreasing amounts of local coal and the unreliable supplies from Russia and Ukraine.Last winter energy production (fig.2) supports this assumption.

NUCLEAR POWER

The only nuclear power plant in Bulgaria is situated at Kozloduy, on the Danube river, some 220 km. north from the capital Sofia , next to Romania. It comprises 4x440 MW PWR reactors designed in USSR and popular as model WWER 440/ mod.230. and2x1000 MW PWR also Russian design - WWER-1000/mod.320 ,fig.3.

Units 1 to 4 started commercial operation in 1974 /75 and 1981/82 respectively. Each unit supplies two turbine/ generators while condenser cooling is provided by water drawn from the Danube river. The nuclear steam supply system consists of six loops connected to the reactor pressure vessel, employing large horizontal steam generators , one reactor coolant pump per loop, connecting pipes with a diameter of 500 mm, and a pressuriser with relief and safety valves. Each loop can be effectively isolated from the pressure vessel by valves located both on the hot and the cold legs. Because of the difference in the time of construction as well as some development of the design though in principle being the same model Units 1 and 2 differ from 3 and 4 especially in the redundancy and number of safety systems. Principal differences are listed in Table 2.

TABLE 2. Design differences between Units 1,2 and 3,4 of the Kozloduy NPP.

Systems	1 and 2	3 and 4
ECCS	2x100%,3 high pressure pumps in each train, only high pressure longterm cooling	3x100% high and low pressure pumps,70 m^3 tank with 30g/l H_3BO_3 high pressure system
SPRAY SYS.	2 x 100 %	3 X 100 %
EFWS	2X100%,no physical separation,suction only from the main feed water tanks	3X100%, no physical separation, one additional 600 m^3storage tank outside the turbine hall.
SWS	1 system 8 pumps for both units.In normal operation 2 pumps per unit, one required.	3 trains with 2 x 100% pumps in each train per unit
SSEPS	2X100% diesel generators,spare diesel generator per unit.	3X100% per unit
	1X100% battery per unit	3X100% per unit
	1X100% battery for both units.	
I&C	2X100% no separation,no	3X100%,no physical separation,ECR adjacent to main control room No special protection.
RPV	Unit 1 -annealed Unit 2 -annealing in progress	Unit 3 - annealed Unit 4 - annealing presently not foreseen

ECCS - emergency core cooling system
SWS - service water system
EFWS - emergency feedwater system
SSEPS- station service and emergency power supply
I&C - instrumentation and control

When compared to PWR's of present western design the WWER-440 design exhibits a number of obvious deficiencies, very carefully studied and discussed in a number of already available papers and reports[2,3]. Basically these are the lack of containment structures, the very small design basis accident the systems can cope with and some lack of redundancy in some of the safety related equipment. A specific issue is the seismic protection of the operating units in Kozloduy. Most of these design deficiencies in the WWER's 230 are a result of the specific philosophy and attitude towards nuclear safety of the Russian designers, which were later on corrected in the design of the WWER-318 and the WWER 320.

On the other hand there are a number of unique positive safety features already well known by the western experts which to some extent, but not completely, compensate for some of the design deficiencies[4]. Of special interest is the user friendly behavior of the reactor in many transients and situations which gives a lot of credit to the operators to act properly.

Principle safety deficiencies of the WWER's mod.440 are concentrated in their inability to cope with large LOCAs, where the lack of containment structures might possibly bring to a contamination of the environment. This was recognized in Bulgaria, Czechoslovakia and the former Soviet Union in the late 80's and as of 1990 a special regime of operation was introduced comprising of 16 important measures in order to guarantee that an accident of such size will not occur. Nevertheless the measures (mainly organizational but also restriction of operational regimes, necessity of investigations of primary circuit integrity as well as 100% inservice inspection etc.) were considered unsatisfactory and both unit 1 and unit 2 were stopped for in depth inspection and also upgrading of operational and design safety in 1991.

UPGRADING OF OPERATING PRACTICES

Presently there is an extensive program of increasing the quality of operation at the NPP Kozloduy which is partly supported from the Commission of the European Community by an emergency industrial program within the PHARE activities.

The program covers HOUSEKEEPING action and TWINING arrangements for the operators under the supervision of WANO.In the same time a large investigation program of the generic safety deficiencies is in progress also carried out by WANO but also with the participation of vendor companies like Siemens/EdF,Westinghouse,Belgatom etc. All these programs are dedicated to solve the principle deficiencies of the operating experience and management problems. The seismic upgrading of the plant has also been launched and this will also be done with the assistance of western companies and consulting organizations.

At the same time a regulatory assistance has been rendered by a CONSORTIUM of regulatory and nuclear safety organizations (IPSN,GRS,AVN,NII,AEA Technology) in order to facilitate the introduction of a normal regulatory process in the nuclear energy field. It is recognized that a considerable amount of extremely important work has been and continues to be carried out at NPP Kozloduy to improve safety culture, housekeeping procedures and training.

MAJOR BACKFITTING AND RECONSTRUCTION

The studies which are in progress within the 6 month WANO are supposed to create the background data for some major reconstruction efforts which can bring the plant to a comparable level of safety with reactors of the same age in the west. A top level PRA has been already performed which shows that if certain additional systems are constructed the risk of a major accident can be reduced to a level which is comparable to that in the west.These proposals include basically the following[5]:

1. Diverse Emergency Supply System, segregated and protected from the existing reactor essential systems and completely self contained and protected against external hazards.

2. Installation of fast acting main steam isolation valves.

3.Seismic qualification of existing plant.Only those parts of the existing plant utilized by the DESS require to be qualified for seismic input up to an agreed free field peak ground acceleration(potentially 0.2g).

4.Filtered Vented Confinement. An additional filtered vented confinement system should be installed to cope with the pressure rise post fault.

In principle fig.4 and fig.5 give an idea of the gain in reducing the risk from a major accident as a result of the implementation of short term action and long term backfitting measures. If one may argue about the absolute numbers of the shown probabilities still there exists a 100 times increase in the safety of the existing plant.With the benefit from some of the positive features of this reactors such a solution of their design deficiencies may permit their further operation.

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1. Bulgaria-Energy Strategy Study,WB Rep.No 10143-BUL,December 1991.

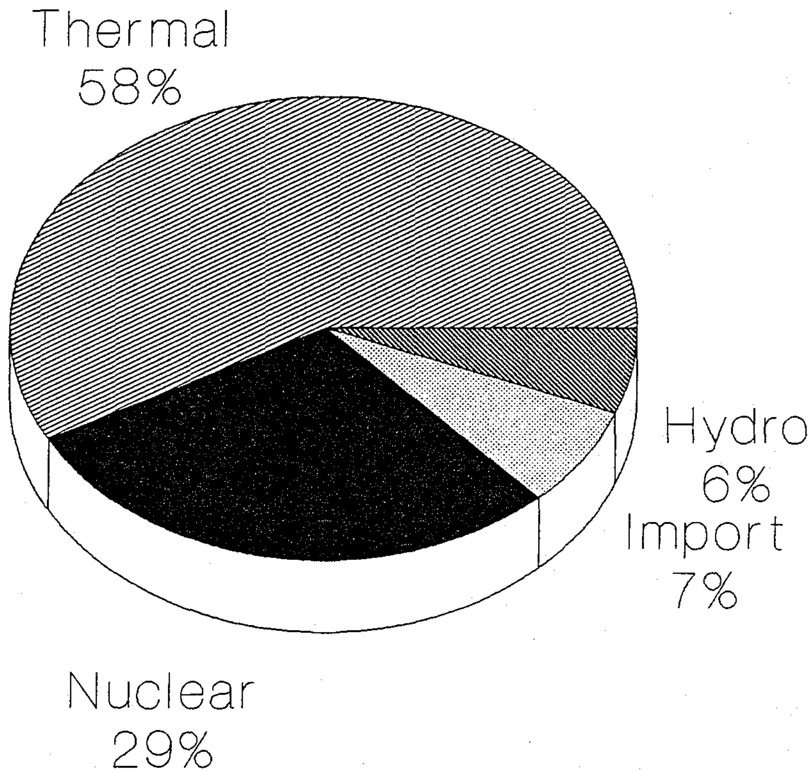
2. Ranking of safety issues for WWER-440 model 230 nuclear power plants, IAEA TECDOC 640, February 1992.

3. Safety of Soviet WWER-Type Reactors, Finnish Center for Radiation and Nuclear Safety,STUK, IAEA Information seminar, Budapest 1991.

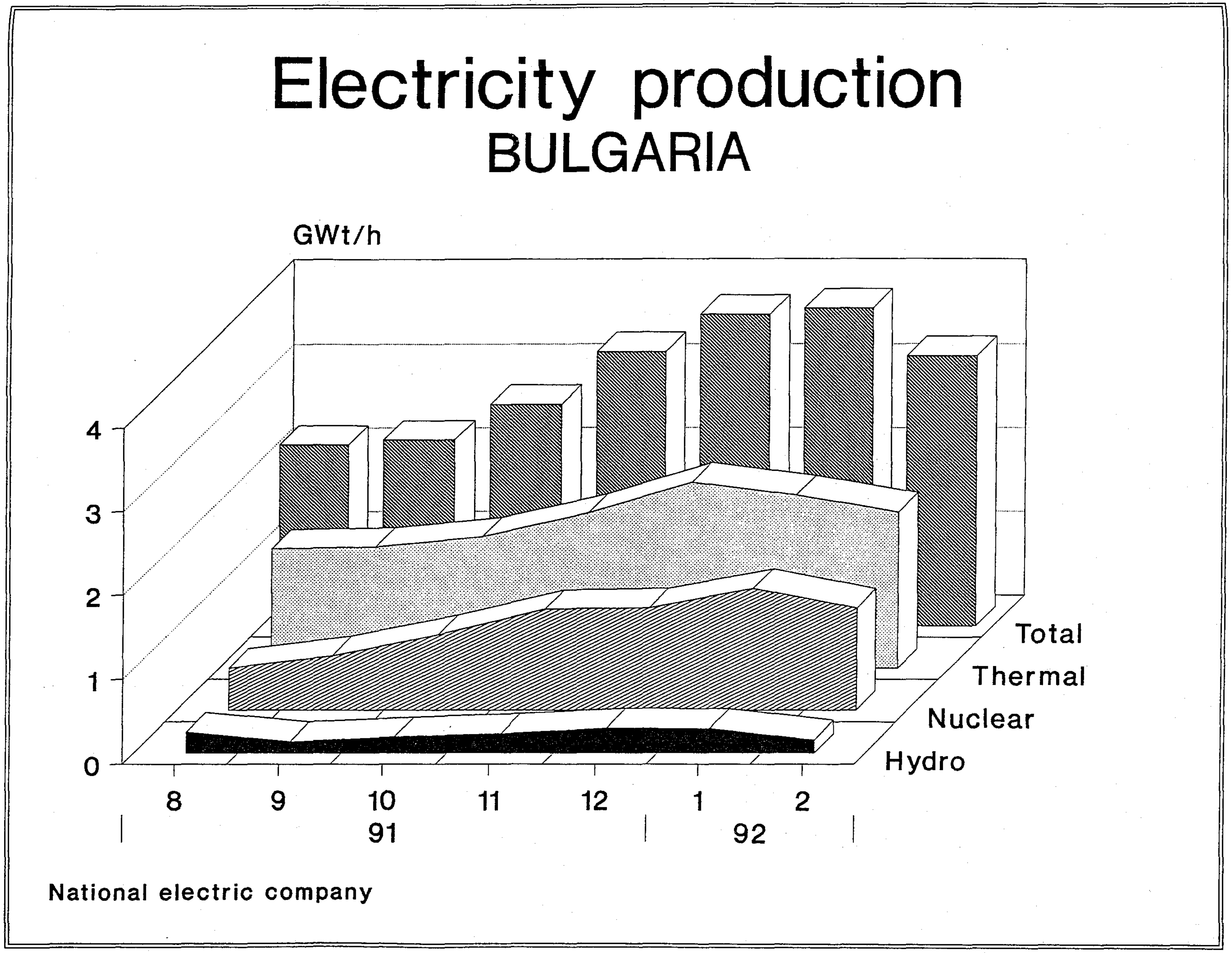
4. BEQE Report 58-01-R-001 , PRA of Kozloduy 1-4 and proposals for back fitting and upgrading.

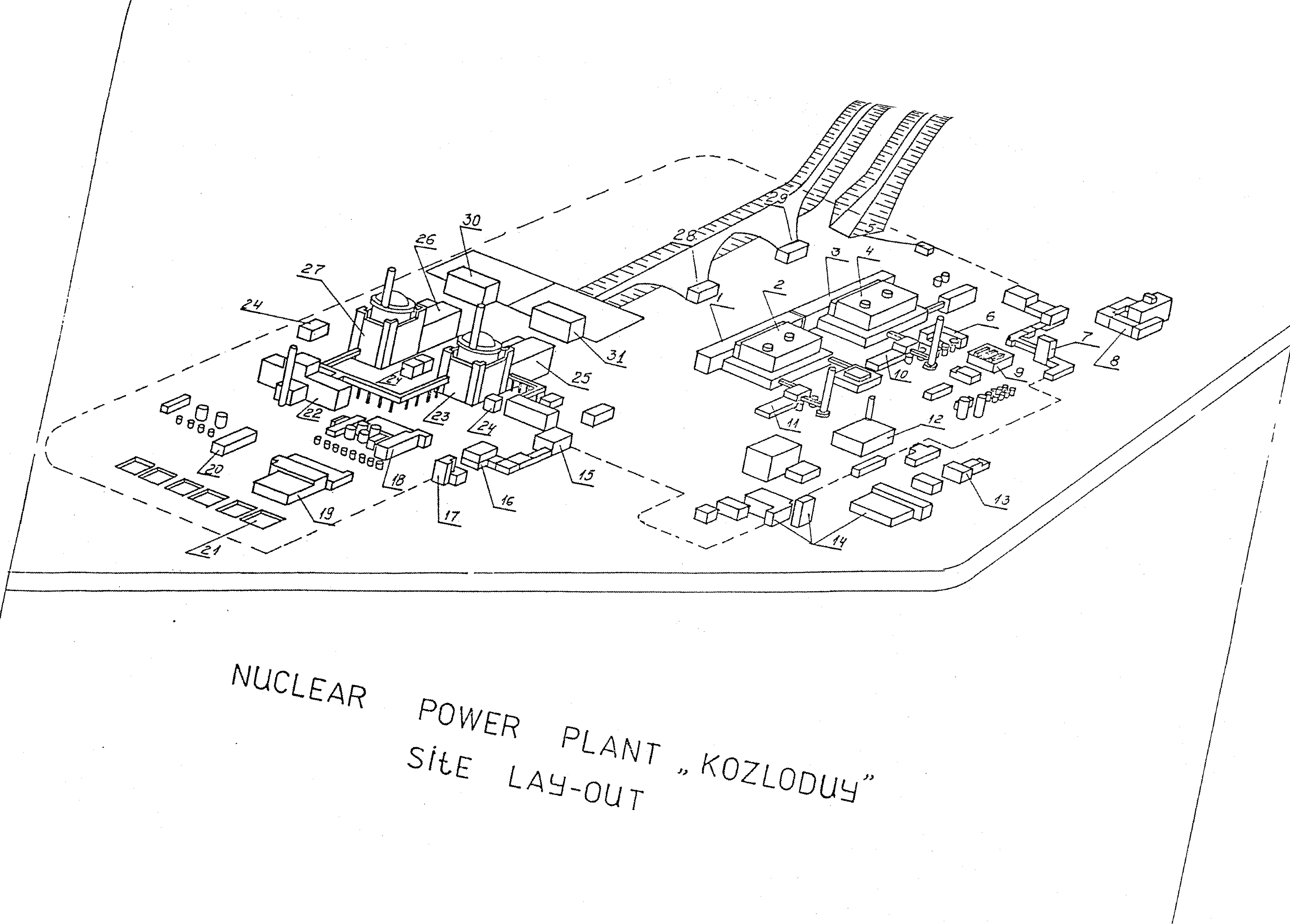
ELECTRICITY GENERATION

last quaterly of 1991



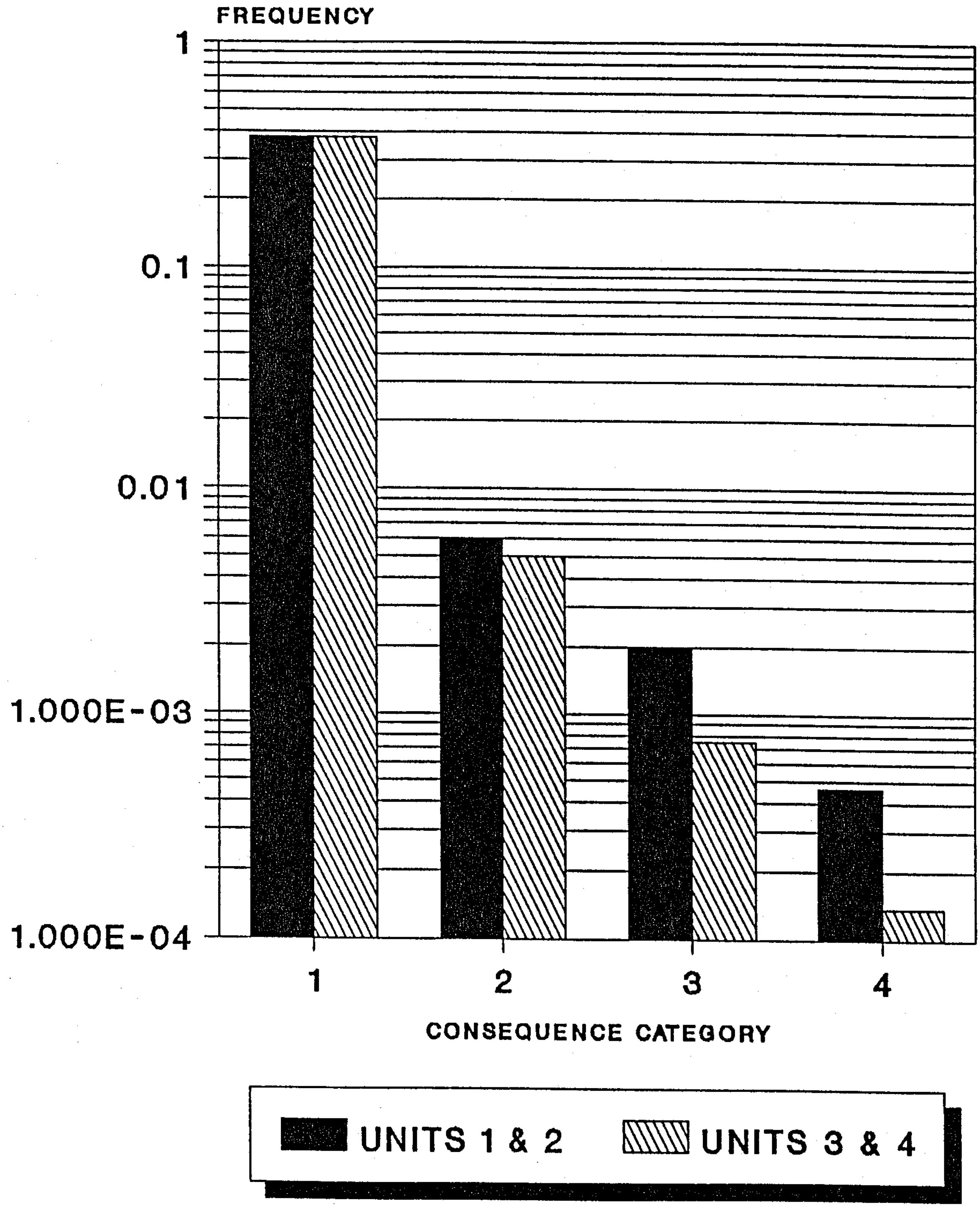
/National electric company/


Electricity production
BULGARIA
GWt/h
4
3
2
1
0
8
9
10
11
12
1
2
91
92
Total
Thermal
Nuclear
Hydro
National electric company

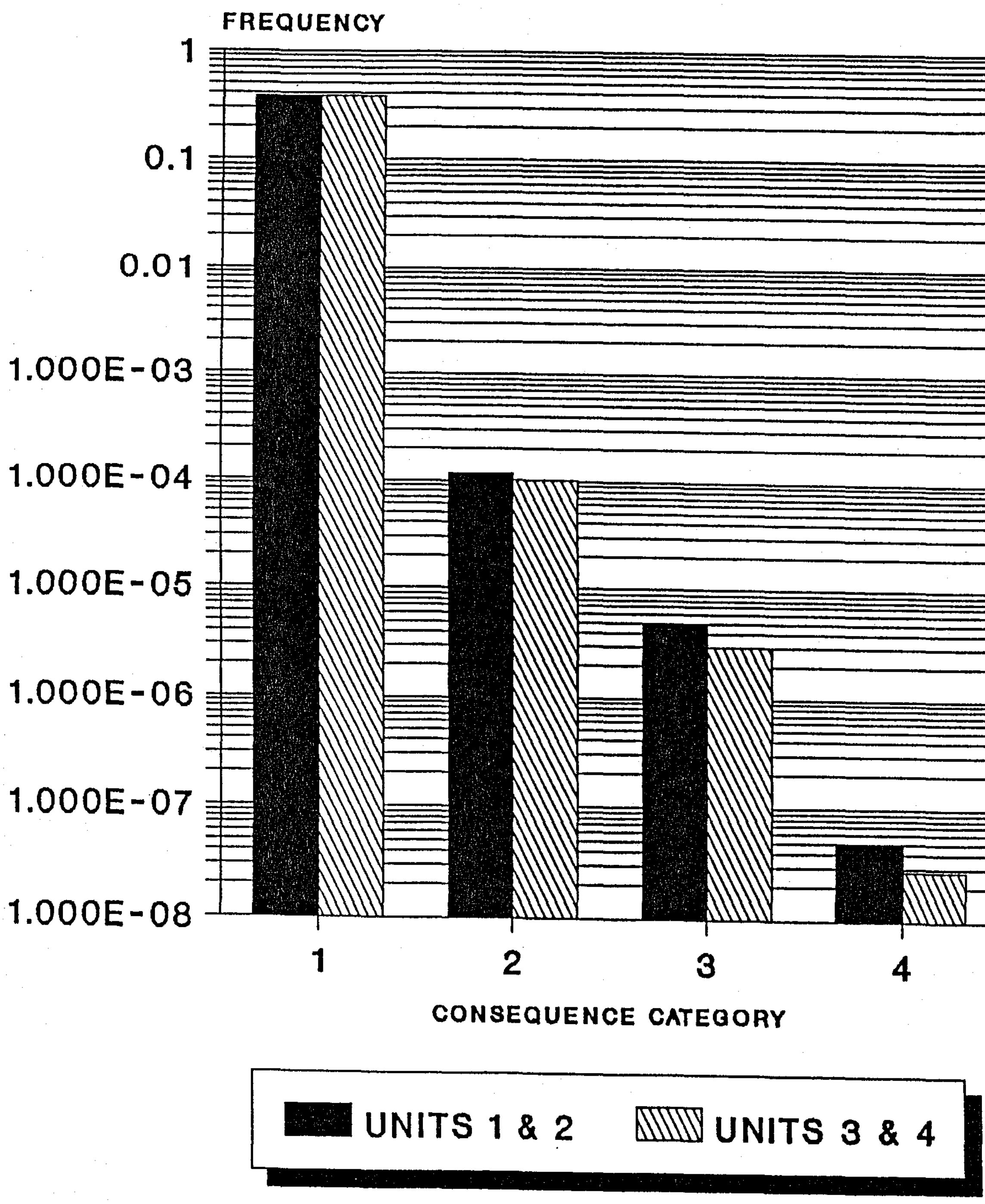


NUCLEAR POWER PLANT „KOZLODUY"
SitE LAY-OUT

TOTAL RISKS


FREQUENCY
1
0.1
0.01
1.000E-03
1.000E-04
1
2
3
4
CONSEQUENCE CATEGORY
UNITS 1 & 2
UNITS 3 & 4

TOTAL RISKS
WITH LTM AND FVC



BASIC SAFETY IMPERATIVES
of NPP operation

1. Control the reactor power in all possible situations.
2. Cool the fuel in all possible situations.
3. Confine the radioactive material within the appropriate barriers.

SAFETY OBJECTIVES
AND STANDARDS

1. What should they cover? How the are applicable to old reactors?
   - long term safety goals;
   - medium term objectives for specific action plans;
   - formal standards and regulations - the means to achieve goals and objectives.

2. HOW TO IMPLEMENT THEM TO REACTORS BUILT TO OLD STANDARDS?
   1. Confirm the original safety intentions are still met.
   -if not , backfitting,upgrading or reconstruction is obligatory.
   2. Identify future life limiting features.
   3. Review safety level with respect to new criterea. Identify necessary and justified safety improvement measures.

INTERNATIONAL COOPERATION
IN NUCLEAR SAFETY AT KOZLODUY

1. INCREASING OPERATIONAL SAFETY.
   WANO ASSISTANCE:
   - HOUSEKEEPING
   - TWINING the operators with western utility.
   - GENERAL ASSISTANCE in MANAGEMENT
   - 3-years PROGRAMME for BACKFITTING and UPGRADING the OPERATION of the NPP.
   - INVESTIGATING THE GENERIC DEFICIENCIES.

2. STRENGTHENING THE REGULATORY AUTHORITY.
   - assistance in the creation of internationally accepted regulatory process.
   - technical support in reviewing the safety of backfitting and upgarding measures.

/CEC sponsored programme/

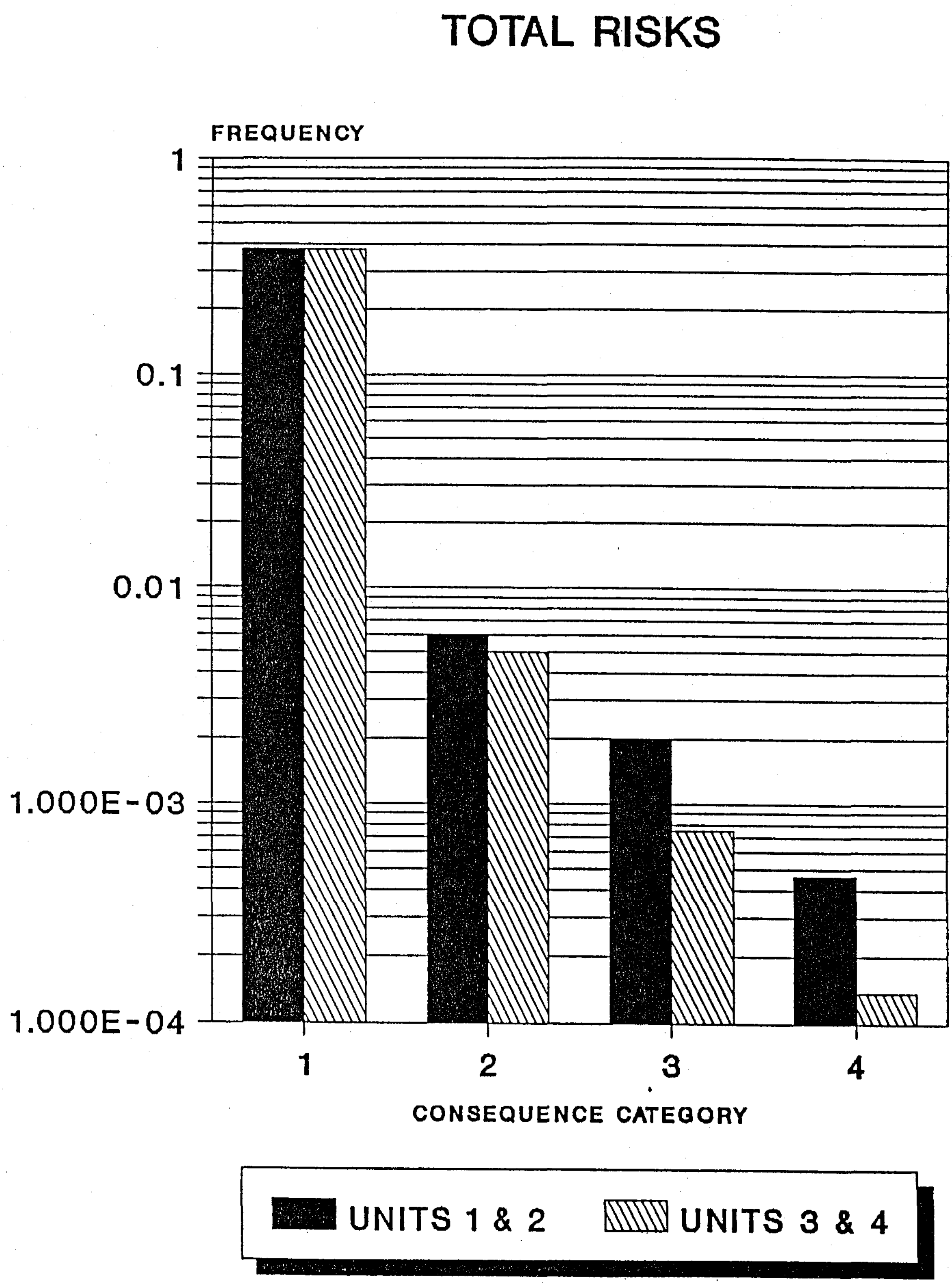
NUCLEAR SAFETY
AND PUBLIC UNDERSTANDING

1. WHAT SOCIETY REQUESTS IS:
- protect individuals and environment
- create economical opportunities for cheap and clean energy production.

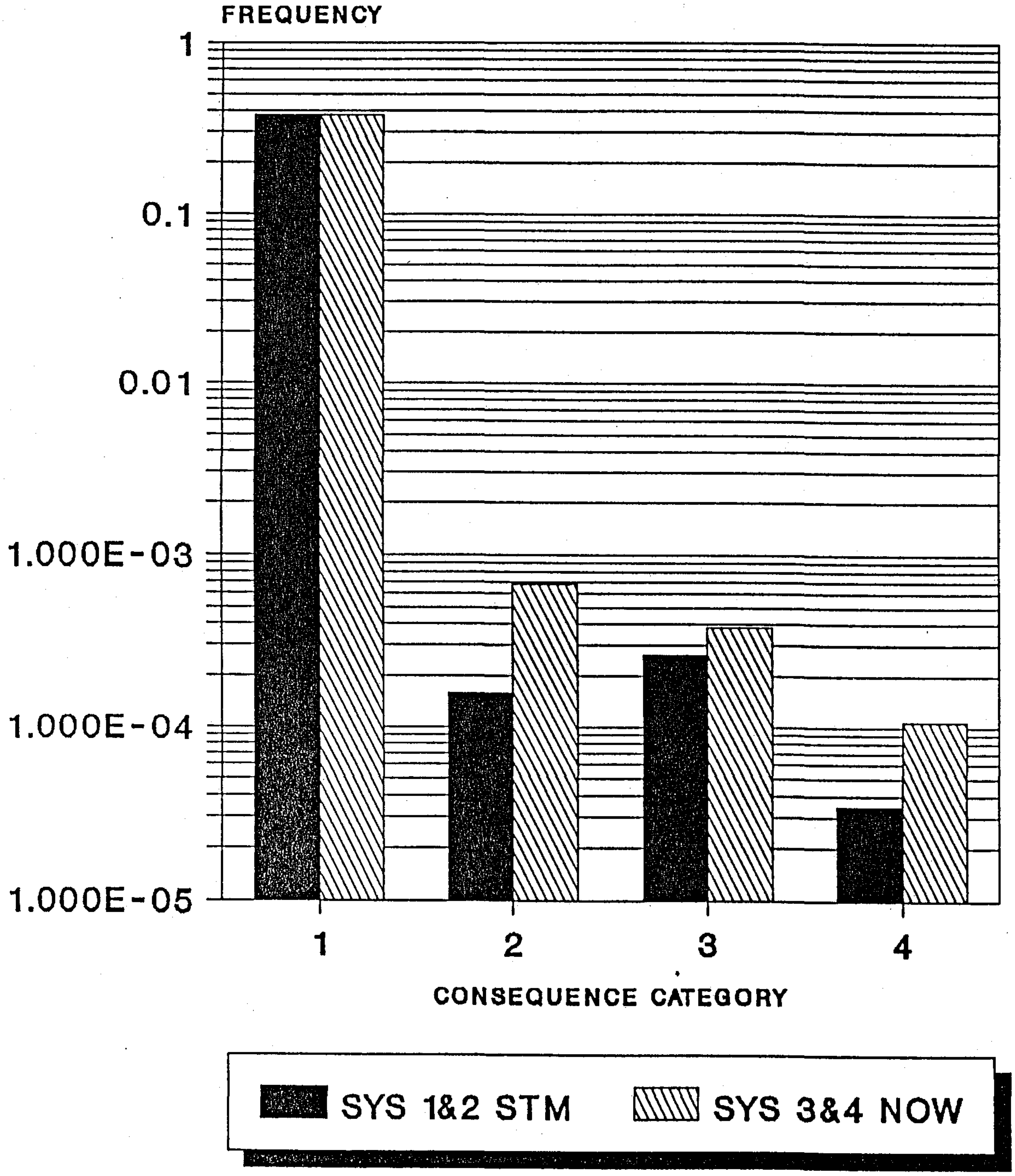
2. HOW NUCLEAR POWER MEETS THESE REQUIREMENTS?
   - SAFETY CULTURE in NPP operation.
   - RELIABLE SAFETY STANDARDS.
   - JUSTIFIED SAFETY OBJECTIVES.
   - PROVEN PRACTICE.
   - CREDIBLE REGULATORY ORGANIZATION!

PUBLIC OPINION
IN BULGARIA

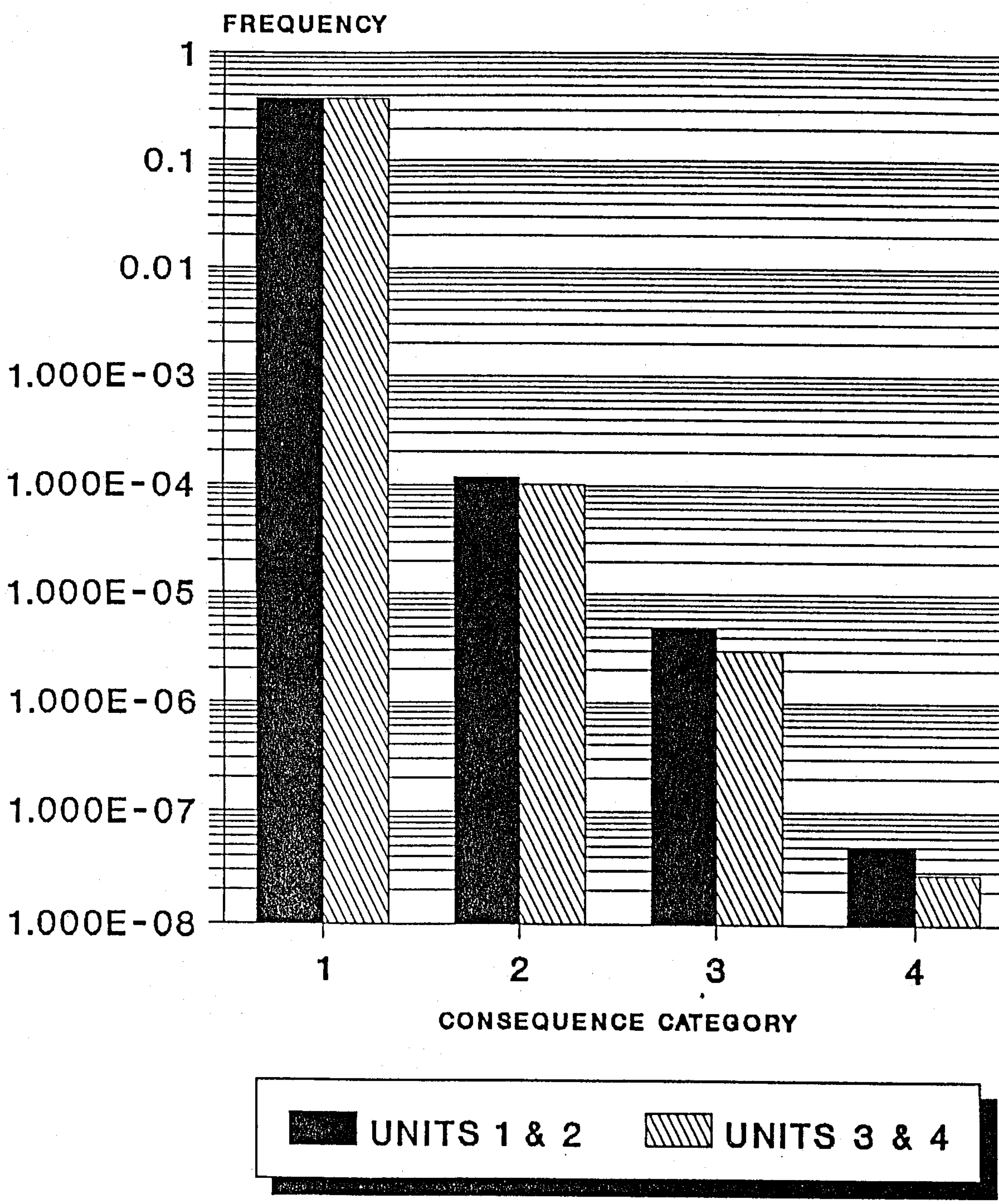
1. Within the old system of centrally planned economy:
-before Chernobil accident - positive or none.
-after Chernobil accident - both positive and negative
2. At present people realize that:
- Nuclear power has stabilizing effect in the transition to new political and economical sysytem.
- Safety has to be upgraded and internationally accepted.
- There also exists a strong economic justification for using nuclear power.


TOTAL RISKS
FREQUENCY
1
0.1
0.01
1.000E-03
1.000E-04
1
2
3
4
CONSEQUENCE CATEGORY
UNITS 1 & 2
UNITS 3 & 4

UNITS 1 & 2 SYSTEM RISKS WITH SHORT TERM MODS



TOTAL RISKS WITH LTM AND FVC



セッション３
原子力平和利用の促進と国際核不拡散体制の新しい考え方

〈パネル討論〉

ブラジル原子力委員会（ＣＮＥＮ）委員長
Ｊ．カルバリョ

フランス原子力庁（ＣＥＡ）国際局長
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国際原子力機関（ＩＡＥＡ）事務局次長
Ｗ．ダークス

前在ウィーン国際機関日本政府代表部特命全権大使
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ほ　か

FRANCE'S POSITION ON NON PROLIFERATION

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In announcing in June, 1991 **that it had decided in principle to join the NPT,** France intended to formalize its commitment to the non proliferation of nuclear weapons. That commitment had been made as early as 1968 at the United Nations Tribune, when France declared that it intended to act, in the future, in the same way as those nations which would decide to join the Treaty.

One year after deciding to appoint, for the first time, an observer to the NPT review conference in August, 1990, formal adhesion was judged to be desirable. To oppose the proliferation of mass-destruction weapons, now emerging as a clear threat to world peace and security, requires a strengthening of international cohesion. This was formally restated early this year by the Security Council.

From the French standpoint, cohesion should first prevail at the European level. Following Spain's adhesion in 1988, France remained the only European Community member which had note joined the Treaty. By now, all twelve Community members will have signed the NPT, which is certain to reinforce the Community's foreign nuclear policy. As announced by the French President in a January, 1992, statement in New York, the ratification process is now in the last stages of completion.

With China becoming a NPT signatory, the five permanent members of the Security Council will also be parties to the Treaty. This will enhance their capacity to work together in discharging their statutory responsibilities as worldwide peace-keepers.

With the same intent, France adopted in September, 1991, **the principle of full scope safeguards** as a requirement for its nuclear exports. It is only fair that those nations which have renounced the nuclear military option, and given proof of this by subjecting all their nuclear undertakings to international inspection, should be the first to benefit from peaceful nuclear energy application.

This decision was implemented without delay on a national basis, and without waiting for the emergence of a consensus within the nuclear suppliers' group. An identical decision was announced at the same time by Great Britain, and later by Belgium. All members of the European Community have now adopted that principle.

As regards France, the institution of full inspection as early as late 1991 was notified to India and Pakistan, which have not so far accepted the principle of such inspections on their territories. France makes the acceptance, by those countries, of inspection of all their nuclear activities a requirement for any commercial project.

Last, it has been decided to **ratify Additional Protocol No. 1 to the Tlatelolco Treaty** for making Latin America a nuclear-free zone. This decision was made just before the 25th anniversary of the Treaty, acknowledging its role as an effective instrument in preventing nuclear proliferation.

This decision attests to France's wish to support the full implementation of the Treaty at a time when several Latin American nations have taken steps to ban mass-destruction weapons from their area.

The institution of specific, mutual trust provisions, designed to suit the requirements of each individual area, should be increasingly effective in restraining, if not in ending, the development of underground programs in mass-destruction weaponry. Such is the case in Latin America, in Southeast Asia and in the Korean peninsula. This type of regional agreement, although no substitute for international inspection, is often a prerequisite for the restoration of trust.

As a major supplier, a nuclear power and a permanent member of the Security Council, France feels it has a special responsibility to oppose proliferation, and intends to fully discharge that responsibility. This intent is attested by the decision to join the NPT, the adoption of full inspection and the ratification of Protocol No 1 to the Tlatelolco Treaty.

Equally meaningful **is the desire of France to help strengthen export control policies and the international safeguards system, in constantly improved cooperation with its main partners.**

A most important factor in determining the French position has definitely been **the progress of political cooperation in the security area** (since the adoption of the Single Act in December, 1985) **and in that of non-proliferation** within the European Community. As early as November, 1984, the Community member states had already made a joint statement on the role which they assigned to non-proliferation in the implementation of their foreign policies. That document also formalized their collective adhesion to the London Guidelines.

It was however in 1988 that the Twelve drafted a joint document covering the underlying principles of their nuclear policy, and an analysis of the situation on a regional basis. Since then, cooperation has made a great deal of progress, as attested by the Dublin Declaration in 1990 and by the joint proposal of practical steps to strengthen international safeguards, presented at the IAEA General Conference last September.

Experience has shown the existence of many problems with the safeguards system as it was enforced. The credibility of the entire institution rests on its ability to find remedies. Formerly, the system was bases entirely on trust. There is now proof that NPT signatories may commit serious breaches of their obligations, and that more intrusive inspections may be required. Such is the purpose of special inspections, one of the most necessary and urgent steps among the proposals put before the IAEA.

Also in 1991, France accepted for the first time to participate in the **revision of the London Guidelines**, together with the twenty-five nations which have agreed to follow the guidelines, to adjust the texts to a situation which has changed much since 1976 due to technological as well as strategic developments.

The desire to curb the proliferation risk at a time of superpower rapprochement has led major suppliers to seek an improvment of export control systems to make them more effective.

Present efforts to strenghten the various non-proliferation systems are consistent with the interests of all nations, Northern and Southern. Their purpose is not, as some fear, to impose new restrictions on developing countries, or to hinder technological exchanges.

The aim of such efforts is, instead, **to fill the need for security** of which we are all aware after the dramatic reconciliation of the super powers. Efforts spent to make the world a safer place should not be jeopardize by regional instability and by a new arms in other area.

Another goal is to create an environment which is safe enough for international nuclear trade and technology transfers to flourish. What we have to strive for is a balance between stricter non-proliferation controls, which are necessary, and improved cooperation with those countries which honour their commitments.

The non-proliferation and disarmament issues are now becoming more closely inter-related. This is reflected in the arms control and disarmament plan presented in June, 1991. France has expressed satisfaction at the fact that both major nuclear powers are beginning to move towards minimum deterrence. The time will come when the cuts in the two main arsenals appear sufficients ; France will then honour its commitment, made as early as 1983, to participate in the nuclear disarmament process.

Anti-proliferation actions, technology transfers, disarmament inspections, as well as trust and transparency measures are now mutually dependant.

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КОНЦЕПЦИЯ РАЗВИТИЯ АТОМНОЙ ЭНЕРГЕТИКИ
В РОССИЙСКОЙ ФЕДЕРАЦИИ.

Введение.

Проводимая руководством России программа экономических реформ не может быть выполнена, если в ее фундамент не будет заложено дальнейшее развитие энергетики. При этом необходимо учитывать, что инвестиционый цикл в области электроэнергетики составляет 8-12 лет.

Отсутствие обоснованных цен на энергоресурсы и обьективной стоимости энергоисточников, отражающих реальные трудозатраты, препятствуют разработке оптимальной структуры энергетики.

Экономические и политические реформы, осуществляемые сегодня в стране, неизбежно приведут к соответствию трудовых затрат и цен которые будут, видимо, сопоставимы с соответствующими ценами на мировом рынке. По этой причине определяя стратегию развития топливно-энергетического комплекса России целесообразно обратиться к опыту промышленно развитых стран.

За последние 10-15 лет стоимость выработки электроэнергии на АС в большинстве стран, развивающих атомную энергетику, была заметно ниже, чем для ТЭС на угле. Только в США и Канаде есть районы, где угольные ТЭС более экономичны, чем АС. При этом следует отметить, что ЭС на мазуте и природном газе во всех развитых странах менее экономичны, чем угольные.

Наличие крупных месторождений природного газа ставит Россию в уникальные условия по отношению к промышленно развитым странам мира. По-видимому, в ближайшие 30-40 лет только электростанции и котельные на природном газе могут реально рассматриваться как альтернатива АС и АСТ в европейской части страны.

Однако следует иметь ввиду, что средняя дальность передачи газа увеличилась с 530 км. в 1956-60 годах до 2400 км. в настоящее время, а затраты на прокладку новых магистралей составят от десятков до сотен млрд. рублей.

Необходимо также помнить, что запасы ядерного топлива в России велики, а нефть и газ являются ценными продуктами,использующимися в различных сферах народного хозяйства.

1.НАЛИЧИЕ УСЛОВИЙ РАЗВИТИЯ АТОМНОЙ ЭНЕРГЕТИКИ

Созданный в России в целях обеспечения обороноспособности страны замкнутый научно-производственный комплекс технологически связанных предприятий охватывает все сферы, необходимые для функционирования атомной энергетики, включая геологию, добычу и переработку руды, металлургию, химию и радиохимию, машино- и приборостроение, базы строительной индустрии. Уникальным является созданный в стране научный и инженерно-технический потенциал, равный по своим возможностям или превосходящий в отдельных элементах подобный потенциал западных стран. Около 80% промышленного и 90% научно- технического потенциала комплекса (включая практически все ключевые позиции) сосредоточено в России.

Промышленно-сырьевой потенциал России позволяет уже в настоящее время обеспечить работу АЭС общей установленной мощности 100 000 МВт (с учетом сложившейся в СНГ кооперации). Кроме того планируются работы по вовлечению в топливный цикл накопленного оружейного урана и плутония.

Возможности комплекса позволяют не только полностью удовлетворять потребности России и СНГ в ядерном топливе, но и экспортировать природный и обогащенный уран на мировой рынок. При этом уровень технологии, добычи и переработки урана по ряду направлений превосходит мировой, что позволяет в условиях конкуренции удерживать позиции на мировом урановом рынке.

Таким образом Российская Федерация имеет все необходимые условия для развития атомной энергетики, включая топливную и промышленные базы, научный потенциал и систему подготовки кадров.

2. ОБЕСПЕЧЕНИЕ БЕЗОПАСНОСТИ АТОМНОЙ ЭНЕРГЕТИКИ

Дальнейшее развитие атомной энергетики без возврата к ней доверия общественности практически невозможно. Необходимо формировать позитивное общественное мнение на базе открытости, обьективной информации и возможности контроля общественностью.

Для этого необходимо обеспечить и обосновать возможность безопасного функционирования атомных станций и предприятий на основе объективного анализа структуры и содержания реальной опасности конкретных элементов ядерно-энергетического комплекса.

Следует обеспечить возможность эксплуатации действующих АЭС до исчерпания проектного ресурса основного оборудования при постоянной оценке их безопасности, последовательном поэтапном выполнении мероприятий по повышению безопасности и поддержанию ее на приемлемом уровне.

Разрабатываемая программа развития атомной энергетики ориентирована на создание в первую очередь современных атомных энергоблоков, замещающих в электроэнергетической системе устаревшие энергоблоки, которые должны быть выведены из эксплуатации.

С этой точки зрения элементами повышенного риска являются энергоблоки атомных станций первых поколений, в наименьшей мере отвечающие современным принципам обеспечения безопасности.

К таким блокам относятся четыре энергоблока с водяными реакторами корпусного типа мощностью 440 мвт и четыре энергоблока с графитовыми реакторами канального типа мощностью 1000 мвт.

АЭС первого поколения находятся в особом режиме эксплуатации, включающем ежегодный выпуск отчетов по реальному состоянию безопасности с анализом и выдачей разрешений на дальнейшую эксплуатацию. При невозможности обеспечения признаваемого приемлемого уровня безопасности такие блоки плановым образом могут выводиться из эксплуатации не ожидая исчерпания проектного ресурса.

Уровень безопасности энергоблоков нового поколения должен удовлетворять в полной мере рекомендациям МАГАТЭ и требованиям основных нормативных документов по безопасности, введенных в действие с 1990 года и определивших следующие целевые ориентиры:

- вероятность тяжелой аварии с расплавлением активной зоны- 10^{-5} на один реактор в год;

- вероятность выхода радиоактивных продуктов из-под защитной оболочки реактора при расплавлении активной зоны реактора - 10^{-7} на один реактор в год.

3. НАПРАВЛЕНИЯ РАЗВИТИЯ АТОМНОЙ ЭНЕРГЕТИКИ

Учитывая реальное состояние экономики целесообразно выделить в дальнейшем развитии атомной энергетики два этапа:

ЭТАП 1990-2000 гг. , можно рассматривать, как " реновационный" , на котором должна происходить модернизация энергомощностей с повышением безопасности и незначительным ростом мощности АЭС за счет начатого строительства. На этом этапе разрабатываются и строятся головные энергоблоки нового поколения;

ЭТАП 2000-2010 гг.,который должен характеризоваться ростом мощностей, переходом к блокам АС новых поколений, уровень безопасности и экономические показатели которых обеспечат устойчивое развитие атомной энергетики на перспективу.

При этом основной стратегической задачей являются реальная демонстрация возможности внодрения в энергетику страны новых безопасных и экономических энергоисточников на ядерном топливе.

В рамках задачи создания АС нового поколения на этих этапах, в связи со сложившейся неблагоприятной экономической обстановкой , необходима концентрация сил на одном (водо-водяном) направлении, с максимальным использованием имеющегося отечественного задела, международного опыта и кооперации.

Основными проектами по этому направлению являются:

- проект энергоблока большой мощности ВВЭР-1000 и проекты энергоблоков средней мощности ВВЭР-500-600 и ВПБЭР-600 предназначенные для решения задач электроснабжения крупных регионов с вводом головных блоков начиная с 1998 года;

- проект АСТ-500 (окончание сооружения и пуск), предназначенный для решения вопросов теплоснабжения.

До 2000 года должны быть также сооружены головные блоки малой единичной мощности, предназначенные для энергообеспечения отдаленных и труднодоступных регионов.

Одновременно должны продолжаться работы по разработке проекта конкурентноспособного реактора-наработчика топлива на базе реактора типа БН (сооружение с 2010 г.) с целью замыкания топливного цикла (включая сжигание оружейного плутония) и самообеспечения атомной энерготики топливом на сверхдлительную перспективу.

Вклад ресурсов в развитие других направлений ядерной энергетики (в частности в развитие развернутых работ по высокотемпературным газовым реакторам) должен осуществляться в соответствии с изменением общей экономической ситуации.

Несмотря на это необходимо поддержание поисковых работ по АС с качественно более высокими показателями по безопасности и экономике. Дальнейшее развитие таких исследований и разработок должно определяться получаемыми результатами и улучшением экономической ситуации для обеспечения возможности их внедрения за пределами 2010 года.

Реальный успех в развитии принципиально новых направлений на настоящей стадии развития атомной энергетики возможен только путем обьединения усилий всего мирового ядерного сообщества при общем подтверждении перспективности таких разработок. Поскольку атомная энергетика стала предметом международного общественного внимания, любое новое направление ее развития требует международного признания.

С учетом завершения начатого строительства, вывода из эксплуатации устаревших блоков первых поколений и сооружения замещающих энергоблоков можно ожидать общей установленной мощности атомных электростанций в Российской Федерации к 2000 году до 25 мвт и к 2010 году до 43 мвт.

4. ТОПЛИВНЫЙ ЦИКЛ АТОМНОЙ ЭНЕРГЕТИКИ И КОНВЕРСИЯ ОРУЖЕЙНОГО ПЛУТОНИЯ

Необходимо реализовать принятую концепцию замкнутого топливного цикла то есть обеспечить возврат в систему атомной энергетики всего регенерированного из отработавшего ядерного топлива урана и плутония.

Для обеспечения экологически безопасного обращения с отработавшим ядерным топливом (ОЯТ) необходимо завершить строительство завода по переработке ОЯТ к 2000-2002 гг, и производственного комплекса для изготовления смешанного уран-плутониевого топлива для реакторов на быстрых нейтронах и для изготовления смешанного уран-плутониевого топлива для реакторов типа ВВЭР, в том числе с использованием оружейного плутония.

При радиохимической переработке ОЯТ решаются также основные задачи, связанные с проблемой переработки и локализации радиоактивных отходов всех уровней активности.

Для этой цели используются отработанные в опытно-промышленном и промышленном масштабах методы отверждения жидких радиоактивных отходов путем остекловывания, битумирования и цементирования.

Отвержденные РАО радиохимических заводов и АС, а также ОЯТ реакторов РБМК, переработка которого до 2010 года признана экономически нецелесообразной, должны направляться в региональные могильники на вечное захоронение или длительное хранение (ОЯТ РБМК).

Проблема переработки и захоронения радиоактивных отходов в атомной энергетике будет решаться совместно с переработкой и захоронением значительных обьемов отходов военного комплекса.

Дополнительные возможности может дать развитие принципиально новых методов обезвреживания радиоактивных отходов с использованием глубокого фракционирования и ядерной трансмутации.

5. КОНВЕРСИЯ ОРУЖЕЙНОГО ПЛУТОНИЯ

Должны быть развернуты работы по формированию наиболее эффективного процесса вовлечения оружейного плутония в топливный цикл атомной энергетики. Эта проблема по существу является частью проблемы эффективного повторного использования ядерного топлива.

Придание плутонию свойств, определяющих невозможность его использования в военных целях, относительно легко достижимо - смешением , например, с энергетическим плутонием; запасы последнего в России , образовавшиеся в форме очищенного диоксида при регенерации отработавшего топлива АЭС, составляют около 30 тонн, а ежегодная наработка около 2 тонн.

Повторное использование плутония,перешедшего в категорию "высокофонового",энергетического,целесообразно в реакторах на нейтронах.

Быстрые реакторы позволяют выжигать не только плутоний практически любого состава, но и другие тяжелые элементы, накопленные в результате работы реакторов в уран-плутониевом цикле. Один серийный реактор БН-800 Южно-Уральской АЭС расчитан на использование 2,3 т плутония для начальной загрузки и 1,6 т для ежегодной подпитки. Однако, в связи с отложенным до 2000 г. широким развитием ядерной энергетики с реакторами на быстрых нейтронах, сфера использования уран-плутониевого топлива в быстрых реакторах ограничивается сегодня только реакторами БН-350 и БН-600. Эти реакторы способны потенциально потреблять, по предварительным оценкам, по 0,6 т плутония ежегодно (полная загрузка активной зоны БН-350 и 50% -ная - БН-600). Эти оценки исходят из условий сохранения отработанных конструкций твэлов и ТВС и соответствия современным требованиям безопасности (обеспечение неположительного натриевого пустотного эффекта реактивности).

Наличие в СНГ в эксплуатации 16 реакторов ВВЭР-1000 обуславливает сегодня существенно большие потенциальные возможности потребления плутония тепловыми реакторами в сравнении с быстрыми. При загрузке одной трети активной зоны смешанным топливом годовое потребление плутония для одного реактора составит около 0,35 т, или 7 т для всех реакторов этого типа.

Накоплен определенный опыт экспериментального использования плутония оружейного состава в реакторах. В реакторе БН-350 прошли испытания и исследования (с химической переработкой) изготовленные на ПО "Маяк" 10 опытных ТВС (350 кг оксидного топлива) с плутонием оружейного качества.

Значительный научный задел имеет комплекс работ, связанный с получением уран-плутониевого топлива. Он включает ряд альтернативных технологий , что позволило выйти на опытно-промышленный уровень для некоторых из них. На опытно-промышленных установках ПО " Маяк" к настоящему времени обработано свыше 400 кг смешанного топлива и изготовлено более 2000 твэлов для реакторных испытаний в БН-350 и БН-600. Ни один из испытанных на сегодня твэлов указанного происхождения не потерял герметичности при выгорании до 10% тяжелых атомов, теплонапряженности 490 Вт/см и температуре оболочки до 690 С. Создан проект завода (комплекс 300 ПО " Маяк"), и с 1984 г. начато его строительство. Первая очередь этого производства рассчитана на обработку 5-6 т плутония ежегодно. Однако, в связи с корректировкой программы развития энергетики с быстрыми реакторами строительство топливного комплекса прекращено на стадии примерно 50% -ной готовности.

Работы по введению в серийные реакторы ВВЭР-1000 топливного цикла на основе оружейного плутония находятся на начальной стадии.

Для обеспечения достаточно интенсивного вовлечения оружейного плутония в энергетику требуется строительство новых промышленных узлов.

Для ликвидации ядерных боезарядов необходимо строительство хранилищ .

Быстрой реализации проблемы конверсии оружейного плутония будет способствовать привлечение зарубежных инвестиций. Эти инвестиции целесообразны прежде всего в форме поставок оборудования для намечаемых производств.

При высвобождении в военном секторе значительных количеств плутония и высоко обогащенного урана актуальными становятся два вопроса: как организовать контроль за передачей этих материалов из военного в мирный сектор в самих ядерных державах и смогут ли (в какой форме) эти материалы передаваться для использования в мирных целях в страны, не обладающие ядерным оружием.

Что касается первого вопроса, в сферу мирной ядерной деятельности нельзя передавать материал, полученный непосредственно после демонтажа ядерных боеголовок, но лишь материал в форме, непозволяющей достаточно легко использовать его вновь для изготовления оружия. К тому же и контроль МАГАТЭ может лишь начинаться на стадии, когда материал уже не приспособлен для использования в оружии.

В отношении второго вопроса надо попытаться выработать рекомендации, в каком виде предпочтительнее передать в неядерные страны эти материалы. Наиболее безопасным с точки зрения режима нераспространения ядерного оружия было бы переведение этих материалов в форму, трудно используемую для создания ядерных взрывных устройств. Например, высоко обогащенный уран, возможно, следует в основном передавать лишь в форме уже изготовленного реакторного топлива, предпочтительно обогащения не выше 20-30% по урану-235, а плутоний - в виде смеси окислов урана и плутония.

6. МЕЖДУНАРОДНОЕ СОТРУДНИЧЕСТВО И УЧАСТИЕ В МИРОВОМ РЫНКЕ ЯДЕРНОЙ ТЕХНОЛОГИИ И ЯДЕРНЫХ МАТЕРИАЛОВ

Техническая сложность, специфическая ядерная опасность и большая ресурсоемкость ядерной энергетики и ядерной технологии требуют тесной международной кооперации и взаимной поддержки в развитии национальных программ. Практически не реально успешное развитие изолированных направлений, не использующих мировой задел и международный потенциал атомной техники. Международный характер атомной энергетики приобретает на новом этапе ее развития принципиальное значение, требуя международного признания прежде всего безопасности развития конкретной (и в особенности новой) ядерной технологии;

Развитие атомной энергетики в Российской Федерации должно обеспечить не только сохранение имевшегося, но и расширение межгосударственного (в пределах СНГ) и международного рынка. Возможность развития имеется. Принят ряд принципиальных решений о сооружении атомных энергоисточников в Казахстане. В различной стадии подготовки находятся международные соглашения по сооружению на базе отечественной технологии атомных станций в Индии, Иране, Китае, Финляндии. Эффективная реализация этих проектов требует рациональной международной кооперации разработчиков и поставщиков оборудования.

Успешное существование и развитие отечественной атомной энергетики требует расширения участия Российской Федерации на рынке ядерных материалов. Это участие стабилизирует топливообеспечивающую отрасль, улучшает экономичность ядерного топливного цикла и через валютные поступления способствует международной интеграции в дальнейшем развитии ядерной энергетики.

7. УКРЕПЛЕНИЕ СИСТЕМЫ ГАРАНТИЙ

В 1995 году исполняется 25 лет действия Договора о нераспространении ядерного оружия. Россия, продолжающая участие в Договоре за бывший СССР, видит в нем один из главных элементов режима нераспространения ядерного оружия. Эффективность этого режима в настоящий период должна опираться на укрепление системы гарантий МАГАТЭ, усиление контроля за ядерным экспортом и за обращением с ядерными материалами, высвобождаемыми в военной сфере в ходе ядерного разоружения.

Обнаружение в 1991 году тайной, не поставленной под контроль Агентства ядерной деятельности в Ираке, где " полноохватное" соглашение о гарантиях в рамках Договора действовало с 1972 года, еще раз показало, что меры контроля МАГАТЭ должны быть расширены, чтобы позволять проверку отсутствия в странах с "полноохватными" гарантиями незаявленных ядерных установок. Без принятия таких мер уровень проверки Агентством выполнения государствами своих обязательств по Договору не будет уже восприниматься как адекватный.

В последнее время Агентством были разработаны предложения по использованию так называемых специальных инспекций для проверки отсутствия в стране незаявленных установок. Имеется в виду использовать право МАГАТЭ провести инспекцию в любом месте , в отношении которого у Агентства имеется информация (в том числе полученная от государств-членов) о возможном наличии там незаявленных ядерных материалов и установок. Россия поддерживает эти предложения , исходя из того, что использование для этой цели специальных инспекций должно предполагать совместное согласование МАГАТЭ и государством процедур их проведения. Не менее важно, чтобы в случае согласия государства на введение режима таких инспекций, Агентство учитывало результаты проверки отсутствия незаявленных установок в подходе к применениию гарантий в этом государстве.

Как известно, в 1978 году были согласованы Руководящие принципы для ядерного экспорта, включая Исходный список предметов, экспорт которых мог осуществляться лишь при условии применения к ним контроля МАГАТЭ в стране-получателе. В то время не удалось согласовать, чтобы контроль МАГАТЭ в странах-получателях был "полноохватным", т.е. распространялся на всю их ядерную деятельность , а не только на поставляемые предметы. Ряд стран, включая Советский Союз, заявили тогда о своей решимости добиваться согласования между странами - ядерными поставщиками принципа принятия получателями полноохватных гарантий МАГАТЭ в качестве условия получения ими любых предметов, упомянутых в Исходном списке.

Подход, требующий принятия "полноохватных" гарантий , позволяет обеспечить, чтобы ядерный экспорт в страны, не обладающие ядерным оружием, не содействовал повышению их ядерного потенциала, не поставленного под контроль МАГАТЭ. В настоящее время имеются реальные предпосылки того, чтобы этот принцип неукоснительно претворялся в жизнь при заключении любых новых контрактов и соглашений в области ядерного экспорта.

セッション4
わが国のリサイクル路線の国際的な位置づけ－わが国の責務と諸外国の見解

〈基調講演〉

わが国における核燃料サイクル政策について
科学技術庁原子力局長
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核燃料リサイクリング－ＩＡＥＡの見解
国際原子力機関（ＩＡＥＡ）事務局次長
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我が国における核燃料サイクル政策について

科学技術庁原子力局長　石田　寛人

1．はじめに

我が国は、1950年代半ばに原子力の開発利用に着手し、現在、原子力は、我が国の全発電電力量の３割近くを賄う基軸エネルギーの一つとして、我が国のエネルギー供給上重要な役割を果たすに至っている。

我が国の原子力政策においては、その開発利用に着手した段階から、使用済核燃料を再処理し、回収されたプルトニウム及びウランをリサイクルし、核燃料として利用することを目指す核燃料サイクル政策を一貫して堅持してきた。こうした政策は、原子力開発利用の基本的な推進方策を明らかにするため策定され、逐次改定されている原子力開発利用長期計画（現行の計画：昭和62年度６月）に示されているが、その具体的方策のあり方については原子力委員会核燃料リサイクル専門部会の報告（平成３年８月）にとりまとめられている。

2．核燃料サイクル政策の基本的考え方

我が国の核燃料サイクル政策の基本的考え方は、次のとおりである。

①資源と環境を大切にし、リサイクル社会の形成に貢献する。

核燃料のリサイクルとは、リサイクルしなければ、すべてが廃棄物となってしまう使用済燃料の中から、有用なものを資源として再利用するということであり、資源の保護に貢献するとともに環境への影響を低減することを可能とする。このような資源の節約と再利用の努力は、我が国のような技術の力をもってエネルギー確保に努め大きなエネルギー需要に対応しようとしている国が率先して取り組むべき重要な課題である。

②原子力を長期的に経済的かつ安定なエネルギー源とする。

エネルギー資源の殆どを輸入に頼っている我が国において、原子力によるエネルギー供給を今後も長期にわたって行っていくためには、ウラン資源の有する潜在力を最大限に発揮させることによってその有効利用を図り、原子力のエネルギー源としての供給安定性を高めることが必要である。さらに、核燃料のリサイクルを行うことによってウラン市場の需給を安定化させ、結果的に核燃料の価格を長期的に安定化させることは国際的に重要である。

③我が国における放射性廃棄物の管理をより適切なものとする。

核燃料のリサイクルによって、有用資源たる減損ウラン、プルトニウムと放射性廃棄物を分離すれば、放射能レベルの高い放射性廃棄物を量を少なく、安定な状態に固化しやすくなり、我が国の放射性廃棄物管理を一層適切なものにすることができる。このような放射性廃棄物の管理のあり方は、我が国においては、環境保護の観点からも適切なものである。

④核不拡散問題について国際的な懸念が生じないよう核燃料リサイクル計画の透明性に配慮する。

我が国は、原子力基本法に基づき、厳に平和目的に限って、原子力開発利用を進めてきたところであり、今後、プルトニウムの利用を前提とする核燃料のリサイクルを推進していく上で、核不拡散に対し、引き続き厳格に取り組んでいく決意である。即ち、我が国の核燃料のリサイクル計画に関して、核不拡散の観点から国際的に懸念を生ずることのないよう、計画の透明性を確保するとともに、計画推進のために必要な量以上のプルトニウムを持たないことを原則としている。原子力委員会核燃料リサイクル専門部会は、昨年８月、現時点において最も妥当と考えられるプルトニウム利用の長期的な考え方を提示しており、これによれば、今後のプルトニウムの需要と供給はバランスのとれたものとなっている。

⑥保障措置の健全な発展と世界の核不拡散体制の強化に貢献する。

核燃料のリサイクル利用の本格化、即ちプルトニウム利用を実用規模で進めて行くに当たっては、これまでに我が国に蓄積されてきた技術及び経験を基に適切な保障措置の適用を図るだけでなく、その高度化にも積極的に取り組むなど、国際的に更に理解を得て、計画が進められるよう引き続き努力し、これを通じて、今後ともＩＡＥＡ保障措置の健全な発展と世界の核不拡散体制の強化に貢献していくことが重要である。これは、プルトニウムの平和利用を進めようとする我が国の責務でもある。

3．長期的な観点に立った計画的な政策の推進

以上のような基本的考え方にも示されるように、核燃料のリサイクルに対する取り組みにおいては、長期的な観点に立脚することと計画の整合性を絶えず認識することが極めて重要である。これは、原子力の分野において、一つのシステムを確立するには、研究開発をとっても、施設整備の建設をとっても、極めて長い期間にわたる継続的な努力を要するからである。また、動力炉開発（軽水炉ー新型転換炉ー高速増殖炉）と核燃料サイクル開発（ウラン資源開発ー濃縮ー燃料加工（含むＭＯＸ加工）ー再処理ー廃棄物処理）とが整合性をもって推進されて初めて、核燃料のリサイクルのための総合的なシステムが完成するからである。

我が国において、プルトニウムは、ＦＢＲ、軽水炉及び新型転換炉のいずれにおいても用いることになっている。将来における我が国のプルトニウム利用の主力であると位置づけているＦＢＲについては、引き続き、その実用化を目指し、現在、総合機能試験中の原型炉「もんじゅ」を運転し、その成果を踏まえた実証炉の建設、運転を経て、来世紀におけるＦＢＲの実用化につなげることにしている。また、我が国の原子力発電計画において当面の主流である軽水炉において、段階的、計画的にプルトニウム利用を進め、当面のエネルギー供給面で一定の役

割を果たすとともに、将来のＦＢＲの実用化に向けて、実用規模の核燃料のリサイクル体系の整備を進めることにしている。

また、核燃料利用面で融通性に富む新型転換炉によるリサイクル利用も重要な課題である。

プルトニウムの供給について、我が国は、現在、東海再処理工場と海外再処理委託により対応しているが、六カ所再処理工場の建設を進めることにより、来世紀の初めには、我が国の核燃料のリサイクル計画に必要なプルトニウムの国内供給を達成する計画である。

以上のほか、ウラン濃縮については、我が国が独自に開発した遠心分離法による事業化が進みつつあり、放射性廃棄物処分についても、低レベル廃棄物の埋設センターの建設が進められている。高レベル廃棄物の処分については、関連研究開発の推進とともに、将来の処分に向けたより具体的手順等につき、原子力委員会で政策検討が進められている。

４．第２の”ＡＴＯＭＳ　ＦＯＲ　ＰＥＡＣＥ”

さて、現在、旧ソ連邦の崩壊に伴い、核兵器の解体により発生する核物質及び核兵器関連技術の拡散が世界的に懸念されている状況にある。これについては，一義的には、ロシア連邦等旧ソ連邦構成諸国が厳格な管理を行うことを強く期待するものであるが、核軍縮を原子力平和利用の観点から意義あるものとするため、原子力平和利用技術の応用により解体核物質の処理を行う、いわば「第２の”ＡＴＯＭＳ　ＦＯＲ　ＰＥＡＣＥ”」ともいうべき構想を原子力先進国が協力し、国際的に進めていくべきではないかと考える。特に、従来より、厳に平和利用に限り、原子力開発利用を進めるとともに、核不拡散に対し国際的な努力を重ねてきた我が国としても、「世界の平和と安全」を守るという見地に立った適切な対応が重要であり、現在、このための技術的な検討を体系的に行っているところである。

核兵器の解体から生じる核物質については、一定期間の安全な貯蔵・管理が必要となろうが、そのままでは核不拡散上恒久的な解決策とはならないので、しかるべき時期に再び核兵器に使用されないように処理する必要があると考える。このための方途としては技術的にはいろいろなオプションがあるが、原子炉の燃料として利用し、燃焼による発電を行うことが核不拡散上の要件も満たす最も建設的かつ効果的な望ましい方策と考えられる。

解体核兵器から生じる核物質のうち高濃縮ウランは転換等のプロセスを経て低濃縮化すれば、世界中の既存の原子力発電所の燃料として使用しうるが、問題は現在の世界のウラン市場に著しい混乱が生じないよう、その市場放出の時期や規模に配慮することが必要である。

一方、プルトニウムについては、核不拡散上の配慮等から、原子炉での燃焼は現地主義を基本とすることが適切である。このプルトニウムの原子炉での燃焼方法としては、既存のＦＢＲや軽水炉での利用、あるいは新しい概念の専焼炉での利用が考えられる。例えば、ロシア連邦には、２基のＦＢＲが運転中であり、また、20基以上の軽水炉も運転されている。これらの炉の中には一定の条件さえ満たせられればプルトニウム利用が可能なものもあろうかと推察される。また、現在、科学技術庁においては、関係方面と密接な連携を保ちつつ、ＦＢＲ技術を活用したプルトニウム専焼炉について、技術的な検討を進めているところである。この専焼炉の計画は、資源の有効利用という長期的観点からのＦＢＲの増殖の意義、すなわち核分裂性物質確保の重要性をいささかも減じさせるものではなく、むしろ、「もんじゅ」の臨界が迫りＦＢＲによる増殖の技術的見通しがたちつつあるからこそ、核兵器からのプルトニウムを処理するための専焼炉という構想の検討が可能となったのである。更に、我が国は、解体核物質の原子炉利用及びそのための燃料加工の分野とともに、その前段階の貯蔵や輸送における核物質管理技術の分野についても、封じ込め技術、遠隔監視技術等を蓄積し、保有しており、このような技術を国際的な枠組みの下に活用するための検討を進めている。

我が国としては、今後、この解体核物質の厳格な管理とその安全、かつ、有効な処理について国際的な努力に積極的に参加していくべきであると考える。その際、関係各国、ＩＡＥＡ、ＯＥＣＤ／ＮＥＡとの連携は重要である。もとより、このような努力は極めて息の長い、長期にわたるものとなろう。また、各国間の密接な協力関係の形成と維持には、相当の努力を求められようが、我が国がこのような国際的枠組みへ参画するに当たっては、国内の核燃料リサイクル計画とは明確に切り離し、世界の平和と安全の一層の促進に貢献するとの立場で、対処していくべきものと認識している。本件について関係各国と関係国際機関において十分な検討が行われることを強く望むものである。

Nuclear Fuel Recycling
- The IAEA Perspective

by

William J. Dircks, Deputy Director General
International Atomic Energy Agency
Vienna, Austria

I am extremely pleased to be able to speak today before this distinguished group of nuclear industry leaders. In a way, it is a kind of homecoming for me: I have not had the privilege of addressing such a group since my term as last President of the US Atomic Industrial Forum, which ended in 1987.

It is very timely that this group address the subject of nuclear fuel recycling, because there is an urgent need to review once again our policies regarding plutonium and its use.

(Slide 1)

Until the early 1970s, the nuclear fuel cycle was pictured as an orderly sequence of processes which extended from uranium mining through milling, conversion, UF_6 production, fuel enrichment, fuel fabrication, power generation, reprocessing and nuclear material recycling to final disposal of the waste streams from the reprocessing plant.

This picture was based on a projected dramatic growth in electric energy demand. In the United States, the demand was expected to increase by 7% per annum, resulting in a need to double the country's installed electricity generating capacity every 10 years. It was estimated that 700 nuclear power plants would be operating by the year 2000.

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Seven hundred light-water reactors operating with a once-through fuel cycle would have placed very severe demands on the available uranium supplies. Consequently, it was felt that the deployment of breeder reactors would be necessary - and that, to ensure supplies of plutonium-based fuel for the breeder reactors, the rapid development of nuclear fuel reprocessing would also be necessary. In addition, it was felt that it would be necessary to recycle the uranium and plutonium in the spent fuel removed from light-water reactors - in the case of the plutonium, by using it as mixed-oxide fuel.

Plutonium was expected gradually to take the place of enriched uranium as the primary nuclear fuel. In fact, 21 years ago, speculating about the future role of plutonium, Nobel Prizewinner Professor Glenn Seaborg wrote "By the year 2000, US water reactors will have been partially displaced by fast breeder reactors. Plutonium will be in short supply as the need to start up new fast breeders sharpens .... we can foresee that the value of annual plutonium production in the United States alone will exceed the value of the world's annual gold production around the year 2000. Some have surmised that plutonium could even replace gold as the international monetary standard - at least it has real intrinsic value."

Only two short years after those words were written, the first oil shock occurred and entirely changed the demand for energy in general and for nuclear power in particular. The increase in the price of oil resulted in drastic reductions in electricity demand. Instead of 7% per annum increases, the United States - for example - experienced growth of only 1-2%, or even negative growth. Reactor orders were cancelled and plant construction was delayed or, in several cases, abandoned. There have been no new plant orders since 1978, and none are foreseen for at least another five years. In Europe, with the exception of France, not only economics but also a tide of anti-nuclear political sentiment, which intensified after the Chernobyl accident, stopped virtually all growth of nuclear power. Uranium prices dropped drastically and have stayed low.

The economic justification for the use of recycled plutonium was severely eroded. In 1976, for example, in the United States "the Generic Environmental Impact Statement on the Uses of Recycled Plutonium in Mixed-Oxide Fuel in Light Water Reactors", or - as it was called, "GESMO" - based the justification for a mixed-oxide (MOX) fuel licensing action on a reference cost of $ 28 per pound of U_3O_x with a range between $ 15 to $ 56 per pound at 1976 prices. The study stated that "... it is judged highly unlikely that the price of uranium will be significantly reduced from $ 28". The price of uranium today is in the range of $ 8 to $ 10 per pound.

There are justifications other than economic ones for the reprocessing option - for example, the energy independence justification. Another justification is that the disposition of reprocessed waste is simpler and more environmentally acceptable than the spent fuel disposal method associated with the once-through fuel cycle. These justifications affect the decisions taken by governments in trying to meet their countries' energy and environmental objectives. Here in Japan, they are certainly involved in the decision of the Japanese Government to pursue a program of recycling and eventually of breeder reactor deployment.

Whatever the non-economic justifications for the recycling option, erosion of the economic justification for using isolated plutonium in MOX fuel has led to a rapid curtailment of investment in new MOX fuel fabrication plants and to long delays in the commissioning of those plants which were under construction. This situation is expected to continue at least until there is major turn-around in nuclear power plant orders and construction.

The isolation of plutonium from reprocessing and the scarcity of MOX fuel fabrication capacity are together resulting in an increasing amount of isolated plutonium - a plutonium stockpile that will exist well into the next century.

(Slide 2)

Let me illustrate this point. The IAEA recently put the total capacity of the world's nuclear power plants in 1990 and in the years 2000, 2010 at 325, 387 and 456 Gigawatt (electric) respectively and the quantities of spent fuel arising in those years from electricity generation by those plants at 9700, 10 600 and 12 000 tons (heavy metal) respectively.

The fissile plutonium in those quantities of spent fuel amounts to 46, 50 and 58 tons respectively.

(Slide 3)

In 1990 the spent fuel reprocessing capacity available in the world was 4100 tons (heavy metal), and the amount of fissile plutonium isolated by reprocessing in that year was roughly 14 tons. The reprocessing capacity available worldwide in the year 2000 is expected to be 6900 tons (heavy metal), and the amount of fissile plutonium isolated by reprocessing in that year is expected to be roughly 25 tons.

(Slide 4)

There are at present MOX fuel fabrication plants at six locations in the world. In 1990 they had an annual fabrication capacity of 95 tons and required about 4 tons of fissile plutonium per annum.

(Slide 5)

It is expected that in the year 2000 they will have an annual fabrication capacity of 430 tons and require about 19 tons of fissile plutonium per annum.

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In 1990, less than 30% of the amount of fissile plutonium isolated by reprocessing was incorporated into reactor fuel. In the year 2000, the figure will probably be around 75%. It is expected that this imbalance between fissile plutonium production on one hand and the demand for fissile plutonium for fuel fabrication on the other will, during the period 1990 to 2000, result in the stockpiling of 110 tonnes of fissile plutonium. In addition, the news media are carrying reports about 150 tons of fissile plutonium already stockpiled in Europe.

We should note that these forecasts are based on the optimistic assumption that the currently planned MOX fuel fabrication plants - for which construction dates have not yet been decided - will actually be built. If the plants are not built or if construction schedules are stretched out, the problem of stockpiled plutonium will be exacerbated. Because of the need for security, safety and radiation protection measures, the capital requirements of MOX fuel fabrication plants are much higher than those of fuel fabrication plants processing non-irradiated uranium. Moreover, decisions to invest in MOX fuel fabrication plants are extremely dependent on expectations about the development of nuclear power and the supply of and demand for uranium and enrichment services - and, as already indicated, there is little likelihood of significant increases in these areas over the next 15-20 years.

In addition to this excess of civil plutonium, attention is now focussing on the large amounts of fissile material that may be isolated if nuclear warheads are dismantled in the former Soviet Union and in the United States. For the United States, the Uranium Institute has given an estimate of 100-110 tons of plutonium and 500-550 tons of highly enriched uranium; the corresponding estimate for the former Soviet Union is 100 tons of plutonium and 400-500 tons of highly enriched uranium.

For many reasons, it has been long-standing policy to keep military and civilian nuclear materials separate. However, the options being discussed for disposing of nuclear warhead material include burning it in reactors. Again according to the Uranium Institute, the material in question would correspond (in terms of natural uranium equivalent) to about five years' reactor requirements of the Western World.

There are many obstacles to using such material for civilian purposes, and it would certainly be years before it is used in this way. However, material released from military stockpiles should be regarded as a potential source of fuel for civil reactors and as a factor influencing the economics of the nuclear fuel cycle.

Even if one disregards the fissile material from nuclear warheads, the excess of isolated fissile plutonium from civilian nuclear programmes poses a major political and security problem worldwide. Although plutonium from power reactors tends to be impure - containing significant amounts of non-fissile isotopes - and not ideal for nuclear weapons fabrication, it can nevertheless be used for this purpose. Accordingly, it will have to be stored under conditions of strict security and safeguards accountability.

The accumulation of isolated plutonium could, of course, be avoided either by increasing its use in reactor fuel (for example, in MOX fuel) or by reducing its recovery in reprocessing. In this context, it may be noted that in a document entitled "Nuclear Fuel Recycling in Japan" the Japanese Advisory Committee on Nuclear Fuel Recycling has stated that "it is a national principle that Japan will not possess plutonium beyond the amount required to implement nuclear fuel recycling programmes". We should all welcome this statement, for it is consistent with the IAEA's statutory position regarding the avoidance of excess fissile material.

From a security point of view, isolated plutonium is best kept in reactors - in the reactor fuel. Given the current availability of very low-cost uranium for reactor fuel, there would appear to be little incentive to invest in additional facilities for the use of plutonium in commercial power generation. As we have already seen, the adverse economics of MOX fuel utilization compared to the utilization of fresh, low-enriched uranium fuel will probably persist well into the next century. Thus, there is little help to be expected here in dealing with surplus plutonium.

There are other options for using or disposing of excess plutonium. For example, special "once-only fast-burn" reactors would not only dispose of excess plutonium but also help in increasing energy supplies. The Japanese Science and Technology Agency has proposed such a reactor as a means of dealing with plutonium resulting from the dismantling of nuclear warheads. This option is a long-term one and as yet untested. However, it deserves further serious study.

There is no doubt that the process of finding ways to deal with the growing stockpile of plutonium and to achieve its safe and secure use in power generation will be a long one. Certainly, major breakthroughs are not to be expected before the first decade of the next century. We must accordingly face up to the question of the long-term storage of plutonium - or rather the question of the desired extent of international involvement in long-term plutonium storage. The IAEA carried out an intensive International Plutonium Storage (IPS) study during the period 1978-1984. However, the IPS study did not lead to a consensus among the participating Member States. Perhaps the time has come to revisit this concept.

Under Article IX of the IAEA Statute, Member States may make special fissionable materials available to the IAEA, which is responsible for storing and protecting them. The materials may be stored by the Member State concerned or, with the agreement of the IAEA, in an IAEA depot.

In 1989, in a communication addressed to Soviet Foreign Minister Eduard Shevardnadze, and more recently, in a letter addressed to Russian President Boris Yeltsin, the IAEA'S Director General, Dr. Hans Blix, offered the services of the IAEA in safeguarding plutonium and highly enriched uranium discharged from dismantled Soviet weapons. In January 1992 the Director General wrote to the Foreign Ministers of China, France, Russia, the United Kingdom and the United States referring to Article IX and reiterated the IAEA's offer "to verify the continued peaceful storage or use of this nuclear material" - provided, of course, resources were made available to the IAEA.

The situation regarding plutonium has changed drastically since the IPS study, but many findings of the IPS study are still useful. Placing the plutonium in a given country under an IPS regime, thus creating greater transparency, might lead to greater understanding in neighbouring countries for the uses to which the plutonium is ultimately to be put.

Interestingly, in a paper prepared for the 1988 JAIF Conference, Dr. Wolf Häfele, former Chairman of the Board of the Jülich Nuclear Research Establishment in Germany, commenting on the desirability of moving forward with liquid-metal fast breeder reactors, noted the need to deal with plutonium build-up. He said "The approach of having an International Plutonium Storage handled by the IAEA appears in a new light - So far all these negotiations started from the viewpoints of plutonium storage, disposability, and sovereignty. Environmental compatibility of thousands of tonnes of plutonium could be a new element. The idea of Regional Fuel Cycle Centers that was considered by the IAEA in the seventies should be reevaluated in such a context." .

Summarizing briefly, decisions are urgently needed regarding the future use and/or disposition of plutonium. As a result of nuclear fuel reprocessing, and potentially as a result of nuclear weapons dismantling, in the foreseeable future the supply of plutonium will far exceed the industrial capacity to absorb plutonium into peaceful, commercial nuclear industrial activities.

The uncertainty surrounding the future size and shape of nuclear power makes it highly unlikely that new investment decisions to alleviate this mismatch will be made in the near term. It is thus imperative that decisions be taken now regarding plutonium storage that meets rigorous safety and security requirements.

(Slide 6)

The IAEA is ready to

(a) offer an international forum for the exchange of information on this important subject; and

(b) participate in organizing the international storage or disposition of plutonium at the request of Member States - including Member States wishing to place their plutonium under "international supervision".

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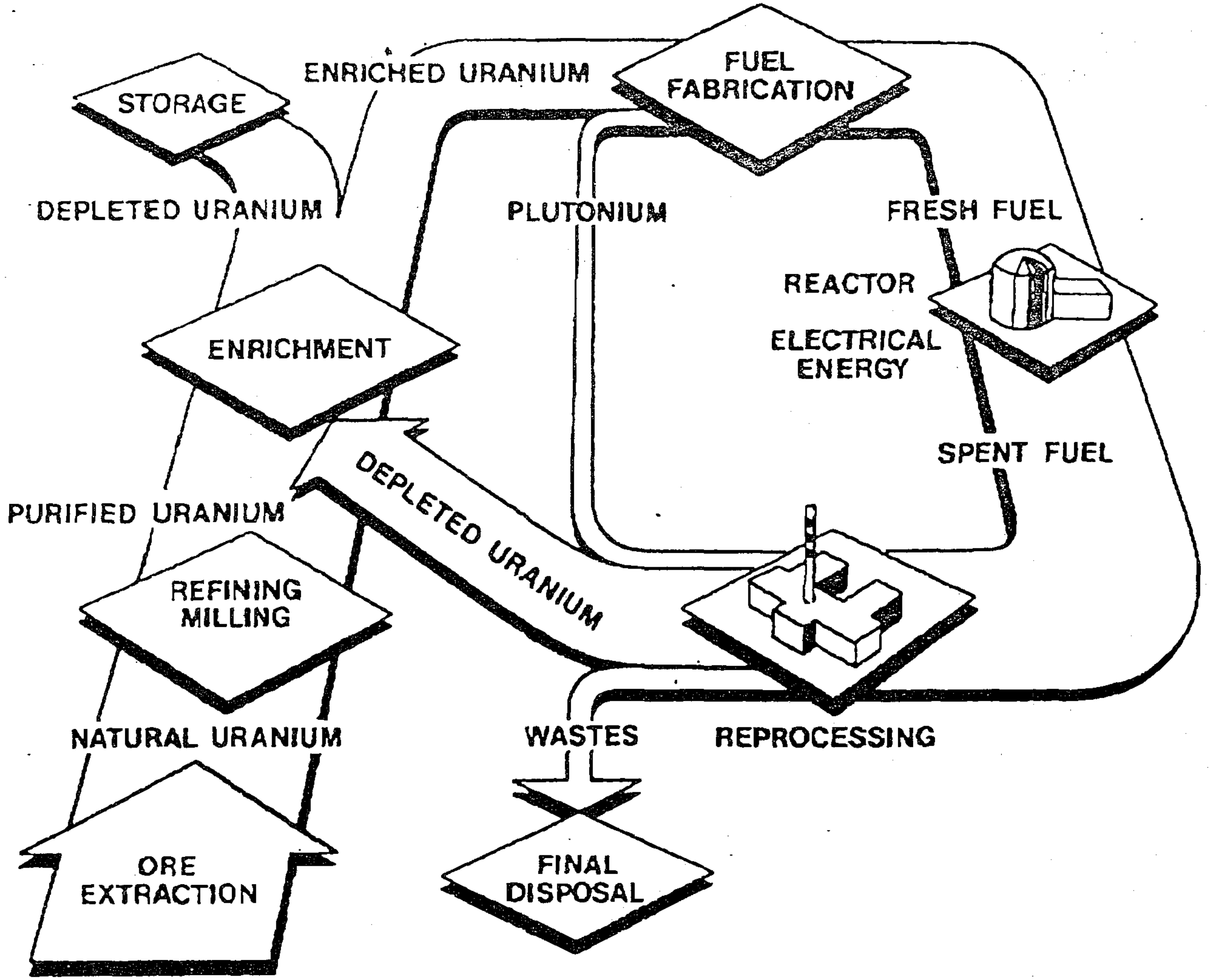
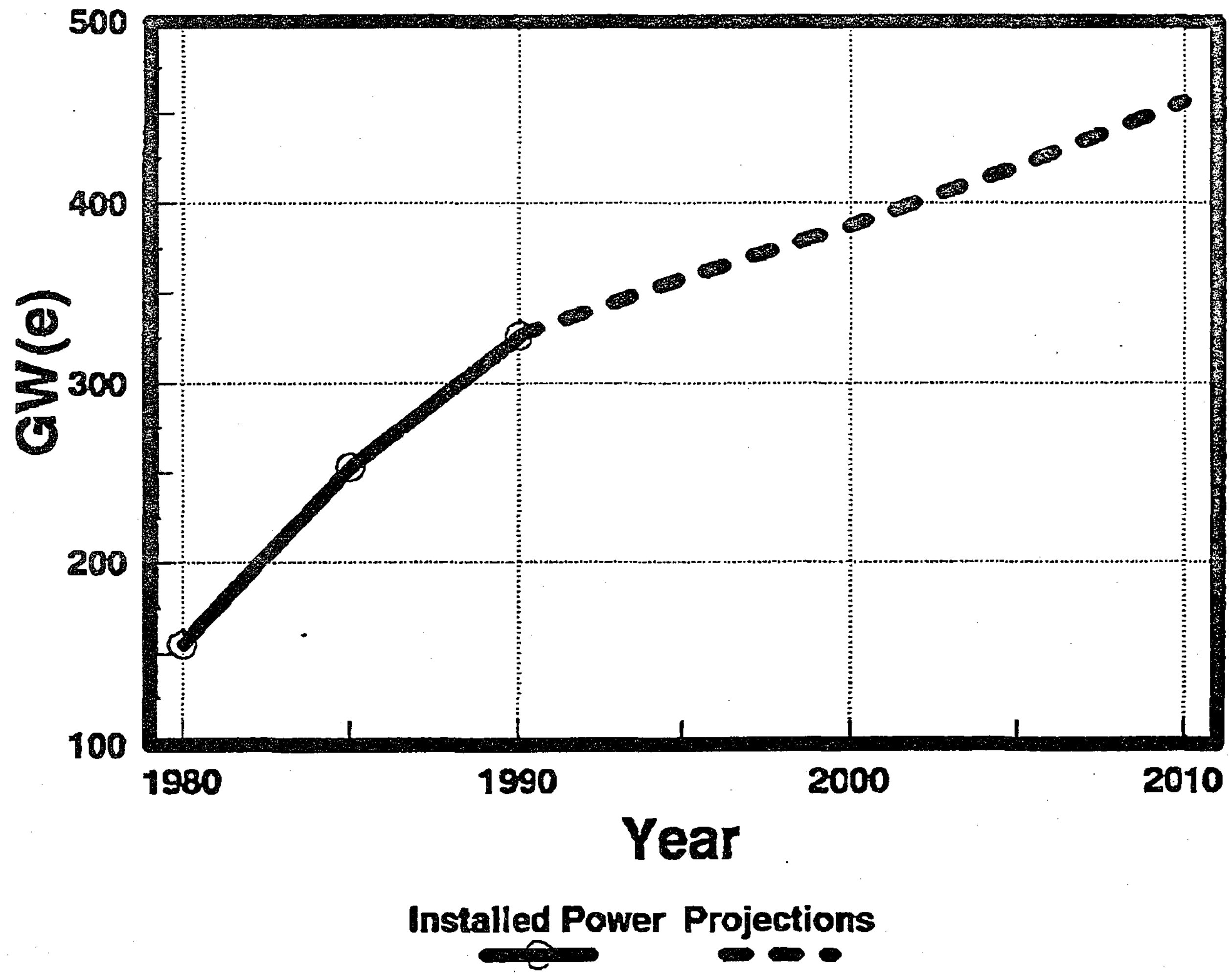
THE NUCLEAR FUEL CYCLE

(1)



(2)

Installed Power and Projection of World Nuclear Generating Capacity Low Projection



IAEA Yearbook

Projected R eprocessing Capacities in the World (t HM/a) (3)

	Fuel type	1991	1995	2000	2005
France	GCR	600	600	0	0
	LWR	1200	1600	1600	1600
	FBR	5	5	5	5
India	PHWR	200	400	1150	1150
Japan	LWR	100	100	900	900
USSR	LWR	400[a]	400[a]	400[a]	400[a]
UK	GCR	1500	1500	1500	1500
	LWR	-	1200	1200	1200
	FBR	1	1	1	1
Total		4006	5806	6756	6756

[a] The completion of a reprocessing plant at Krasnoyarsk of 1500 HM/a capacity has been posponed indefinitely

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(4)

MOX LWR Fabrication Capacity in the World

Country	Supplier	Capacity (t HM/a)	Status
Belgium	Belgonucleaire	35	In operation
	Belgonucleaire	35	Planned
France	Cogema-CEA	15	In operation
	Framatome, Cogema	120	Under construction [a]
Germany	Siemens	35	In operation
	Siemens	120	Completed [b]
Japan	PNC (Tokai)	10	In operation
	PNC (Tokai)	40	Planned
UK	BNFL	8	Under construction [c]
	BNFL	42	Planned

[a] The MELOX plant at Marcoule is expected to reach its capacity of 120 t HM/a in 1997

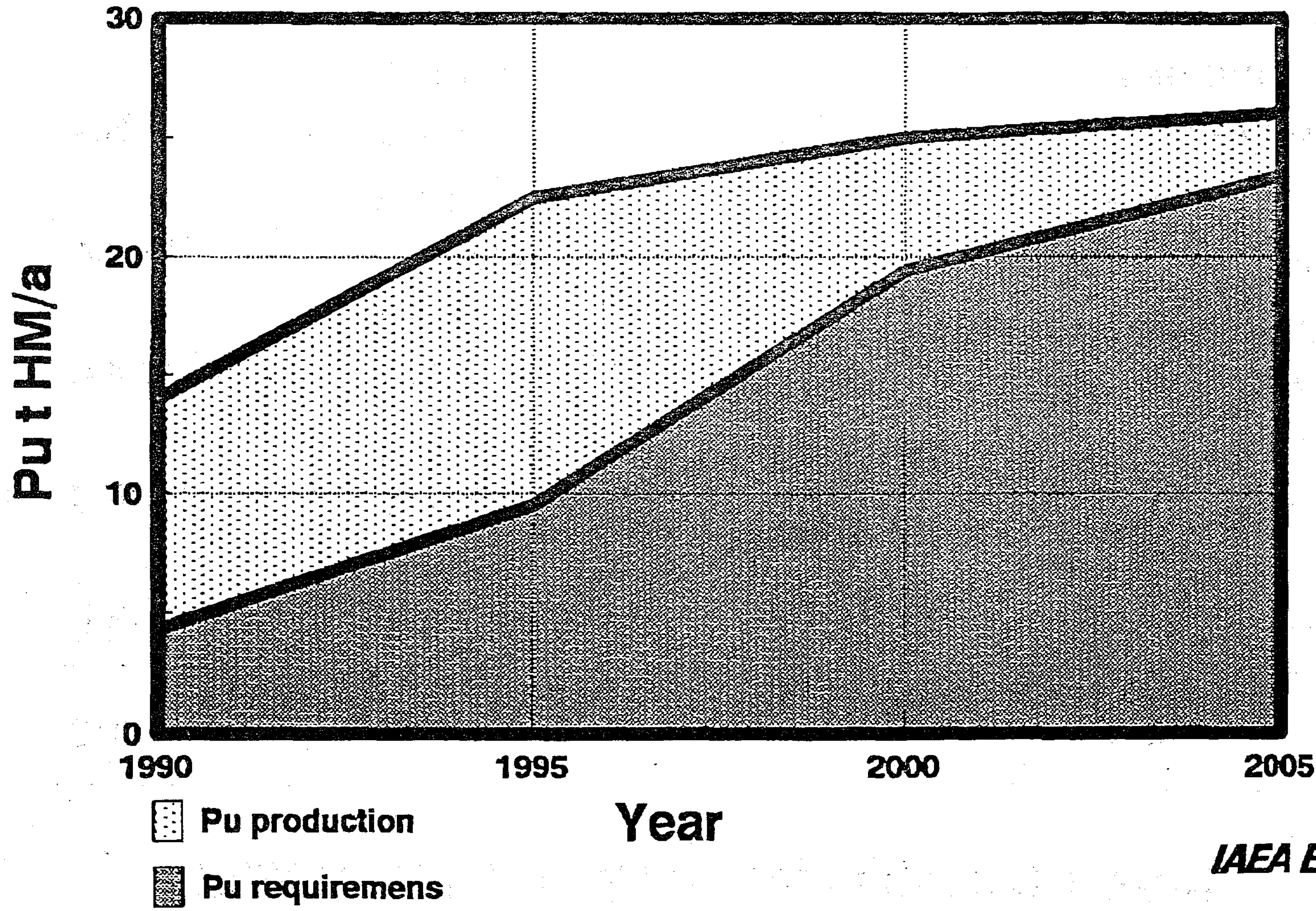
[b] A new MOX Fabrication planmt at Hanau is expected to start production in 1992

[c] Will be operational in 1993

IAEA Yearbook

(5)

Projected Pu production and Pu requirement for the MOX fuel in the World



IAEA Estimate (1992)

(6)

CONCLUSION

The IAEA is ready to

(a) offer an International Forum for the Excange of Information on this Important Subject; and

(b) Participate in Organizing the International Storage or Disposition of Pu at the Request of Member States - including Member States Wishing to Place their PU under "International Supervision"

JAPAN ATOMIC INDUSTRIAL FORUM, INC.

25th Annual Conference, Yokohama,
April 8-10, 1992

BNFL VIEW

by L. N. Chamberlain

I start from a belief that nuclear power will make - indeed must make - a growing contribution towards meeting the world's energy needs. It will do so alongside growing emphasis on energy conservation and renewable forms of energy.

An important argument in favour of nuclear power is that it is environmentally friendly. It is an argument that is increasingly being accepted by environmental activists themselves. As we all know, great care has to be taken in design and operation of nuclear facilities. There must be well thought out and effective routes for management of wastes, and responsible and efficient use of the natural resource that is the raw material of nuclear power: natural uranium. This is where recycling comes in.

The use of recycled uranium and of plutonium extracted from spent nuclear fuel is an important expression of the conservation of an earth resource. It is the duty of the nuclear industry to provide this cycle safely and efficiently. Without it we could and should be accused by environmentalists of being profligate with the resources entrusted to us. With it we can legitimately claim that nuclear power is a virtually renewable energy source it its own right.

The reprocessing of spent nuclear fuel not only permits the recycling of the uranium and the use of the plutonium. It also provides for effective management of the fission product waste.

We cannot afford to throw reusable uranium or the plutonium away: they are too valuable as energy resources. Nor can we afford to carelessly discard the waste fission products. Reprocessing gives us access to the unused energy resource in irradiated fuel. It also puts fission products in a form that makes them accessible for a stage by stage programme of waste management, leading to ultimate disposal.

I am proud to be able to say that over 60% of the fuel in our AGR power stations in the UK has been made from recycled re-enriched uranium.

Reprocessing, waste treatment, reprocessed U conversion, re-enrichment and MOX fuel fabrication - these technologies are all available and in use. It is up to my side of the industry to provide them cost effectively and safely. It is up to the regulators to provide the necessary framework to enable us to do so and up to utility fuel managers to plan for their use.

I hope that other nuclear programmes will follow the example of the UK and Japan and adopt the full fuel cycle with reprocessing and effective waste management, reuse of the recycled uranium and the burning of the plutonium in MOX fuel.

Any other philosophy is economically, environmentally and morally flawed.

SUMMARY OF PERSPECTIVES

Thomas L. Neff

The issue of nuclear fuel recycling, which was an essential part of the nuclear vision of the 1960s, has become increasingly difficult over the past thirty years. Arguments have involved questions about (1) the practical value of reprocessing and recycle, and (2) the relationship of reprocessing and plutonium shipment and domestic civilian use to international non-proliferation concerns.

These issues have been greatly complicated by several recent developments: the breakup of Soviet Union and the reversal of the super-power arms race; the success or near success of clandestine nuclear weapons programs even among signatories to the Non-Proliferation Treaty; and, the slowdown of plutonium utilization in Western Europe on economic, technical, environmental, and waste management grounds.

While Japan's program is primarily its own concern, and while Japan has excellent non-proliferation credentials under the existing non-proliferation regime, international nuclear regimes have been shaken and challenged by events in Iraq, North Korea, and the breakup of the Soviet Union. It is likely that approaches to non-proliferation will have to be changed.

Effective changes may require fundamentally new approaches and not just incremental modifications of the NPT and IAEA systems. The effort to achieve this will require close cooperation and tradeoffs--perhaps even with domestic programs--among leading nations. If this cooperation fails, there is likely to be increased conflict over national and international policies, including use of plutonium.

- **Practical Value Issues** Internationally, the value of plutonium reprocessing and recycle--for economic, technical, waste management, and energy security objectives--has been increasingly questioned. These are obviously matters for national decisions, but decisions increasingly take place in an international context and can have international implications.

  Most economic studies now show that the cost of MOX fabrication makes LWR recycle uneconomic, compared to conventional uranium fuel, even if the cost of the plutonium is taken to be zero; if reprocessing cost is included, there is a substantial economic penalty.

  There are new questions about whether it is technically possible to obtain high burnups from MOX fuels; this raises questions about the economic and technical performance of MOX fuels compared to conventional uranium fuels.

  There has long been a debate about whether reprocessing and recycle makes waste management and disposal cheaper, safer or more environmentally attractive, compared to disposal of conventional spent fuel. There have been recent shifts away from the view that reprocessing is necessary or desirable: Germany and Scotland, for example, have now changed policies to allow storage and disposal of spent fuel, without reprocessing. In principle, there may be advantages to separating all actinides from spent fuel and burning them in reactors. However, under all current European and Japanese reprocessing plans, actinides will remain in vitrified wastes and must be disposed of. It would be nearly impossible to recover them later for burning.

The debate over reprocessing obscures the fact that the fundamental problem that has not been solved by *any* country is the ultimate *disposal* of nuclear waste in any form. Reprocessing and recycle may have relatively little effect on disposal, except perhaps to delay public and political attention to the ultimate disposal problem.

Energy security is a matter for individual nations to decide. However, the cost of conventional reactor fuel has declined greatly since reprocessing decisions were made and the rate of recovery of plutonium seems to be greater than can be utilized. The glut of both uranium and plutonium has been increased by events in the former Soviet Union, and by the release of large amounts of uranium and plutonium from weapons programs. This will keep prices for fuel from rising for many years.

There does not seem to be any way to *use* all of the civil and weapons plutonium in the next few decades. Weapons plutonium alone would be more than enough for research and reactor use for several decades, even if there were no more reprocessing. From a practical and public perception perspective, it may thus be better to focus on solving the surplus plutonium storage problem (either in spent fuel or in separated form) than to seek incremental ways to use plutonium.

o **Soviet Breakup and Reversal of the Arms Race** The breakup of the Soviet Union is leading to fundamental changes in international security regimes, including that relating to non-proliferation. For more than four decades, East-West tension was the dominant factor in international security, with the U.S. leading the Western alliance. Non-proliferation policy was usually of lower priority and something to be overlooked if it got in the way of unity against the Soviet threat.

Today, the U.S. is cutting back not just its nuclear arsenal but also its conventional forces. Future security concerns are likely to be regional in nature, requiring regional solutions. Proliferation will undoubtedly be a central issue, and thus come to have higher relative priority, in Japan and other nations, as well as in the U.S. This has a number of implications for the use of plutonium.

With the end of the Cold War, and the increase in the number of de facto nuclear states, there is a fundamental question about the assumptions underlying the NPT and the distinction between peaceful and non-peaceful uses of the atom. The NPT was based on a division between weapons and non-weapons states, with non-weapons nations assumed to be able to pursue all possible nuclear technologies without concern about undermining the basic principle of the security regime. That basic principle is now obsolete.

The barrier between peaceful and non-peaceful uses was thus geopolitical and not technical in nature. Today, this barrier needs to be reconstructed to reflect new regional and international realities. The central problem is now more technical than geopolitical: access to weapons-usable material is now the primary barrier to weapons acquisition. Even domestic actions on use of such fissile material--with plutonium the most difficult issue--may affect regional and international nuclear security regimes.

Political control over the vast nuclear enterprises of the former Soviet Union is still uncertain; much appears still to be in the hands of newly entrepreneurial managers and former officials, many of whom are seeking alliances with Western companies. Great caution is necessary in dealing with these situations, since unexpected environmental, non-proliferation or other consequences could shake public confidence and harm Western nuclear programs.

The health and environmental consequences of decades of weapons programs--most of which are associated with plutonium production and handling--are only beginning to emerge, especially as the veil of secrecy is pulled back in the former Soviet Union. Despite differences, there is danger of a "spillover" effect on public perceptions of nuclear activities, and especially those involving plutonium. It would be unfortunate if such spillover effects undermined the basic acceptance of conventional nuclear power.

Weapons dismantlement in the U.S. and the FSU will result in the release of a minimum of 10 to 15 tonnes of weapons-grade plutonium a year, probably greater than the flow from projected civil reprocessing. Because of its purity, weapons-plutonium has higher energy value and lower handling costs than civil plutonium. Unlike the plutonium in spent fuel, weapons plutonium is already separated and must be made secure. This will increase the scrutiny given to civil reprocessing and plutonium shipment and use, increasing the attention given to linkages to security issues.

Even if a domestic cost/benefit analysis appears to favor reprocessing and recycle, changes in the regional and international political context, and spillover from concerns about weapons plutonium activities, may suggest that near-term "industrialization" of plutonium use results in more problems for both nuclear power and international security than it is worth.

o **Perspectives on Japan's Role** Japan now has the leading role in the world in encouraging reprocessing and recycle and will be a very visible player in many issues involving plutonium separation, storage, shipment and use. There is a possibility that Japan could--in the long-term--play a constructive role in solving the problems associated with huge inventories of weapons plutonium, emerging environmental disasters associated with prior plutonium activities, and proliferation activities.

However, it is also possible that these problems could severely damage not just Japan's own reprocessing and recycle programs, but also its conventional nuclear power program. If failures to control plutonium and its environmental and proliferation impacts--which are unfortunately likely--become associated in the public mind with Japan's own plutonium-related activities, those activities may be harmed. To the extent that recycle is publicly seen as an essential part of conventional nuclear power (for fuel or waste management purposes), utility use of conventional nuclear power may also be hurt.

This problem is partly one of timing: Japan's major initiatives--symbolized by the first sea shipment--are coming at a time of intense concern over activities in Iraq, North Korea and other nations, failures of the non-proliferation regime, and growing attention by the U.S. and other nations to proliferation as the primary regional and international security threat. They also coincide with the emergence of major new problems associated with large volumes of weapons plutonium and revelations about environmental impacts of plutonium-related activities.

Efforts to deal with weapons plutonium problems are highly sensitive and initiatives that link weapons plutonium to civil uses appear both premature and potentially dangerous to civil programs. The situation in the former Soviet Union is extremely complex and until political integration and control is clearly demonstrated, alliances with subgroups promoting commercial conversion of weapons activities carry many risks.

セッション5
社会は原子力情報に何を求めているか

〈パネル討論〉

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