THE 24TH JAIF
ANNUAL CONFERENCE
第24回原産年次大会

APRIL 8～10, 1991

JAPAN ATOMIC INDUSTRIAL FORUM
日本原子力産業会議

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	E. キーナー	
	P. オーセル	
	P. ヘーレン	
	茅 陽一	
	依田 直	

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菅原　努
中村政雄
野口邦和

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木元教子
広瀬弘忠
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聴　弘
永末栄一

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Y. Kaya
S. Yoda
K-A. Edin

E. Kiener

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E. Nagasue

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第２４回原産年次大会総括プログラム

	第　１　日 ４　月　８　日　（　月　）	第　２　日 ４　月　９　日　（　火　）	第　３　日 ４月１０日（水）
午前	<u>開会セッション</u> (9:30～12:00) 準備委員長大会基調 原産会長所信表明 原子力委員長所感 ＜特別講演＞	<u>セッション２</u> (9:00～12:00) 「脱原子力政策のゆくえ」 ［講演とパネル討論］	<u>セッション４</u> (9:00～12:00) 「原子力の安全と理解 ― 何が必要か」 ［講演とパネル討論］
午後	（昼休み）	<u>午餐会</u>　(12:30～14:30) 於：ホテルオークラ ＜特別講演＞ …………………………………… 原子力映画上映 (12:45～14:00)	（昼休み）
	<u>セッション１</u> (13:30～18:00) 「激動する世界情勢とエネルギー・原子力」 ［講演と討論］	<u>セッション３</u> (15:00～18:00) 「チェルノブイリ事故後の放射線影響」 ［講演とパネル討論］	<u>セッション５</u> (13:30～17:00) 「エネルギー・原子力政策に何が求められるか」 ［パネル討論］
			閉会：大会のまとめ
	<u>レセプション</u> (18:30～20:00) 於：東京プリンスホテル		

4月8日（月）

開会セッション（9：30～12：00）

議長：那　須　　翔　　東京電力㈱社長

大会のねらい

生　田　豊　朗　　大会準備委員長
（財）日本エネルギー経済研究所理事長

原産会長所信表明

圓城寺　次　郎　　（社）日本原子力産業会議会長

原子力委員長所感

山　東　昭　子　　原子力委員会委員長、科学技術庁長官

＜特別講演＞

「９０年代のエネルギー政策：ＥＣの見解」

Ａ．ｶﾙﾄﾞﾘ･ｲ･ｸｰﾆｬ　　欧州共同体（ＥＣ）エネルギー委員

「新しい国際秩序とエネルギー」

Ｍ．ラニヨン　　米国テネシー峡谷開発公社（ＴＶＡ）総裁

セッション１（13：30～18：00）
激動する世界情勢とエネルギー・原子力

議長：綿　森　　力　　（社）日本原子力産業会議副会長

「世界のエネルギーバランスにおける将来の原子力の役割」

Ｂ．セミョーノフ　　国際原子力機関（ＩＡＥＡ）事務局次長

「ソ連における原子力産業の現状と将来」

Ｖ．コノワロフ　　ソ連原子力発電・産業大臣

「２１世紀へ向けてのエネルギー戦略」

Ｔ．ヘンドリクソン　　米国エネルギー省原子力担当首席次官補代理

「我が国の長期エネルギー需給展望と原子力開発の考え方」

緒　方　謙二郎　　通商産業省資源エネルギー庁長官

＜休　憩＞

議長：渡　辺　文　夫　　（社）日本原子力産業会議副会長

「イギリスにおけるエネルギー部門の民営化と原子力発電の将来」

Ｔ．ウォーカー　　イギリス・エネルギー省次官

「チェコスロバキアにおけるエネルギー確保への努力と国際協力の必要性」

Ｊ．イーハ　　チェコスロバキア経済省次官

「新たな国際連携へ向けて」

Ｒ．カール　　フランス電力庁副総裁

＜討　論＞

『新しい国際連携の方向と課題』

上記講演者のほかの討論参加者

遠　藤　哲　也　　在ウィーン国際機関日本政府代表部特命全権大使

Ｒ．ロング　　米国原子力学会次期会長

Ｉ．スブキ　　インドネシア原子力庁次官

レセプション（18：30～20：00）

於　東京プリンスホテル「プロビデンスホール」

4月9日（火）

セッション2（9：00～12：00）
脱原子力政策のゆくえ

議長：佐　和　隆　光　　　京都大学教授

「スウェーデンにおける原子力発電早期廃止政策の変更」

K.-A. エディン　　　スウェーデン・クラフトサム（電気事業連合）理事長

「スイスのエネルギー政策と原子力の将来」

E．キーナー　　　スイス連邦エネルギー局長

＜パネル討論＞

パネリスト：

P．オーセル	スウェーデン産業大臣エネルギー顧問
P．ヘーレン	スイス原子力協会事務局長
茅　　陽　一	東京大学教授
依　田　　直	東京電力㈱副社長
K.-A. エディン	同　前
E．キーナー	同　前

＜参加者との討論＞

午餐会（12:30 ～14:30）　　　於　ホテルオークラ「平安の間」

通商産業大臣所感

中　尾　栄　一　　　通商産業大臣

特別講演「日本の美」

平　山　郁　夫　　　東京芸術大学学長

映画上映(12:45～14:00)　　　於　メルパルクホール

- ●検証・原子力発電の安全規制はいま
- ●巨大地震に耐える
- ●ある日の藤城さん親子━原子炉の暴走は防げるか
- ●地球にやさしく・安全に━低レベル放射性廃棄物の埋設

セッション3（15：00～18：00）
チェルノブイリ事故後の放射線影響

議長：田　島　英　三　　　原子力安全研究協会理事長

「チェルノブイリ事故による放射線影響」

熊　取　敏　之　　　（財）放射線影響協会理事長

＜パネル討論＞

熊　取　敏　之	同　前
小　藤　博　子	生活研究家、主婦
菅　原　　努	京都大学名誉教授
中　村　政　雄	読売新聞社論説委員
野　口　邦　和	日本大学助手

＜参加者との討論＞

4月10日（水）

セッション4（9：00～12：00）
原子力の安全と理解－何が必要か

議長：勝　部　領　樹　　　㈱ＮＨＫエンタープライズキャスター
「原子力開発利用とパブリック・アクセプタンス」
山　本　貞　一　　　科学技術庁原子力局長
「原子力安全と社会的認識」
近　藤　駿　介　　　東京大学教授

＜パネル討論＞

パネリスト：

上　坂　冬　子	評論家
木　元　教　子	評論家
広　瀬　弘　忠	東京女子大学教授
松　井　義　雄	読売新聞社編集局次長
桝　本　晃　章	電気事業連合会広報部長

コメンテーター：
アン・ビスコンティ　　米国エネルギー啓発協議会（ＵＳＣＥＡ）副理事長

＜参加者との討論＞

セッション5（13：30～17：00）
エネルギー・原子力政策に何が求められるか

議長：田　原　総一朗　　　評論家

＜パネル討論＞

パネリスト：

与謝野　　　馨	自由民主党衆議院議員
伊　藤　　　茂	日本社会党衆議院議員
近　江　巳記夫	公明党衆議院議員
聴　濤　　　弘	日本共産党政策宣伝委員会責任者
永　末　英　一	民社党衆議院議員

＜参加者との討論＞

閉会：大会のまとめ

生　田　豊　朗　　　大会準備委員長

The 24th
JAIF ANNUAL CONFERENCE
Program

(As of April 3, 1991)

April 8 - 10, 1991
Mielparque Hall
Tokyo, Japan

Japan Atomic Industrial Forum, Inc.

The 24th JAIF Annual Conference

Basic Theme:
ENERGY IN THE 1990'S: EXPECTATIONS FOR NUCLEAR POWER

Monday, April 8

§ OPENING SESSION 9:30 - 12:00

Chairman: Sho Nasu
President
Tokyo Electric Power Co.

Remarks by Chairman of Program Committee
Toyoaki Ikuta
President
Institute of Energy Economics, Japan

JAIF Chairman's Address
Jiro Enjoji
Chairman
Japan Atomic Industrial Forum

Remarks by Chairman of Atomic Energy Commission
Akiko Santo
Chairman
Atomic Energy Commission
Minister for Science and Technology

Special Lectures:

"Energy Policy for the Nineties: An EC Viewpoint"
Antonio Cardoso e Cunha
Energy Commissioner
European Communities

"The Importance of International Cooperation in World Energy Policy"
Marvin Runyon
Chairman
Tennessee Valley Authority
U.S.A.

§ SESSION 1 13:30 - 18:00
WORLD SITUATION IN FLUX: ENERGY AND NUCLEAR POWER

Chairman: Tsutomu Watamori
Vice Chairman
Japan Atomic Industrial Forum

"The Future Role of Nuclear Energy in the Global Energy Balance"
Boris A. Semenov
Deputy Director General
International Atomic Energy Agency

"Expectations for International Cooperation in the Nuclear Power Development"
Vitaly F. Konovalov
Minister for Nuclear Power and Industry
U.S.S.R.

"Energy Strategy towards the 21st Century"
Tom A. Hendrickson
Principal Deputy Assistant Secretary for Nuclear Energy
Department of Energy
U.S.A.

"Long-term Prospects for Energy Demand and Supply and the Concept of Nuclear Development in Japan"
Kenjiro Ogata
Director General
Agency of Natural Resources and Energy
Ministry of International Trade and Industry

[Intermission]

Chairman: Fumio Watanabe
Vice Chairman
Japan Atomic Industrial Forum

"Energy Privatisation and Future of Nuclear Power in UK"
Timothy Walker
Permanent Under-Secretary
Department of Energy
United Kingdom

"Efforts for Energy Security and International Cooperation"
Jan Jicha
Deputy Minister
Federal Ministry of Economy
Czech and Slovak Federal Republic

"Towards the New Global Cooperation"
Remy L. Carle
Deputy Director General
Electricite de France
France

Discussion
-- Direction of the New Global Cooperation

Participants:
Lecturers in this Session and;

Tetsuya Endo
Ambassador, Permanent Mission of Japan to the International Organizations in Vienna

Robert L. Long
President Elect
American Nuclear Society
U.S.A.

Iyos Subki
Deputy Director General
National Atomic Energy Agency
Indonesia

JAIF CHAIRMAN'S RECEPTION 18:30 - 20:00
Providence Hall, Tokyo Prince Hotel

Note: In this year's Conference much time is appropriated for discussions between speakers and Japanese/overseas participants. Participants are invited to exchange views and make comments in each discussion.

Tuesday, April 9

§ SESSION 2 9:00 - 12:00
PHASE-OUT POLICY OF NUCLEAR POWER: WHERE IT WILL GO

Chairman: Takamitsu Sawa
Director, Insitute of Economic Research
Kyoto University

"Early Phase of Nuclear Abolished in Sweden"
Karl-Axel Edin
Managing Director
KRAFTSAM
Sweden

"Swiss Energy Policy and the Future of Nuclear Power"
Edward Kiener
Director
Federal Office of Energy
Switzerland

Panel Discussion
Panelists:
Peter Åsell
Energy Advisor to the Minsiter of Industry
Sweden

Peter Hählen
Secretary General
Swiss Association for Atomic Energy
Switzerland

Yoichi Kaya
Professor
University of Tokyo

Susumu Yoda
Executive Vice President
Tokyo Electric Power Co.

Karl-Axel Edin
Eduard Kiener

Discussion with the floor

LUNCHEON 12:30 - 14:30 (Bus service available to and from
Room Heian, Hotel Okura Hotel Okura)

Remarks by Minister of International Trade and Industry
Eiichi Nakao
Minister of International Trade and Industry

Special Cultural Lecture
Ikuo Hirayama
President
Tokyo National University of Fine Arts and Music

FILMS 12:45 - 14:00
Mielparque Hall

Films will be shown on the following topics;
- Safety regulation on nuclear power
- Aseismicity of a nuclear power plant
- Nuclear safety
- Radioactive waste management

§ SESSION 3 15:00 - 18:00
THE RADIOLOGICAL EFFECTS OF CHERNOBYL ACCIDENT

Chairman: Eizo Tajima
President
Nuclear Safety Research Association

"Radiological Effects of Chernobyl Accident"
Toshiyuki Kumatori
President
Association of Radiation Effects

Panel Discussion
Panelists:

Hiroko Kofuji
Consumer Consultant; Housewife

Tsutomu Sugawara
Professor Emeritus
Kyoto University

Masao Nakamura
Editorial Writer
The Yomiuri Shimbun

Kunikazu Noguchi
Assistant
Hihon University

Toshiyuki Kumatori

Discussion with the floor

Wednesday, April 10

§ SESSION 4 9:00 - 12:00
NUCLEAR SAFETY AND PUBLIC UNDERSTANDING: WHAT IS NECESSARY

Chairman: Ryoju Katsube
TV Caster
NHK Enterprises Co.

"Issues of Nuclear Development and Public Acceptance"
Teiichi Yamamoto
Director General
Atomic Energy Bureau
Science and Technology Agency

"Nuclear Safety and Public Recognition"
Shunsuke Kondo
Professor
University of Tokyo

Panel discussion
Panelists:

Fuyuko Kamisaka
Social Critic

Noriko Kimoto
Social Critic

Hirotada Hirose
Professor
Tokyo Woman's Christian University

Yoshio Matsui
Deputy Managing Editor
The Yomiuri Shimbun

Teruaki Masumoto
General Administration Manager
Public Relations & Information Dept.
Federation of Electric Power Companies

Commentator:
Ann S. Bisconti
Vice President
US Council for Energy Awareness
U.S.A.

Discussion with the floor

§ SESSION 5 13:30 - 17:00

REQUIREMENTS FOR ENERGY AND NUCLEAR POLICY

Chairman: Soichiro Tahara
Social Critic

Panel discussion
Panelists:

Kaoru Yosano
Member, House of the Representatives
Liberal Democtatic Party

Shigeru Ito
Member, House of the Representatives
Social Democratic Party of Japan

Mikio Oomi
Member, House of the Representatives
Komeito

Hiroshi Kikunami
Chairman of the Policy & Propaganda Commission
Japanese Communist Party

Eiichi Nagasue
Member, House of the Representatives
Japan Democratic Socialist Party

Discussion with the floor

CLOSING

Toyoaki Ikuta
Chairman
Program Committee

開会セッション

大会のねらい
年次大会準備委員長，（財）日本エネルギー経済研究所理事長
生　田　豊　朗

原産会長所信表明
（社）日本原子力産業会議会長
圓城寺　次　郎

原子力委員長所感
原子力委員会委員長，科学技術庁長官
山　東　昭　子

〈特別講演〉
９０年代のエネルギー政策：ＥＣの見解
欧州共同体（ＥＣ）エネルギー委員
Ａ．カルドゾ・イ・クーニャ

新しい国際秩序とエネルギー
米国テネシー峡谷開発公社（ＴＶＡ）総裁
Ｍ．ラニヨン

第２４回原産年次大会　会長所信表明

平成３年４月８日
メルパルクホール

議長、御臨席の皆様、原産年次大会の開催に当たり、主催者を代表いたしまして、一言御挨拶を申し上げます。

湾岸戦争の早期終結は、大変喜ばしいことであります。

しかし、湾岸戦争がこのように早期に終結しても、例えば、昨年と同様に、予想されるこの夏の大幅な電力消費や、ここ数年来の民生部門を中心とするエネルギー需要の著しい伸びが、わが国のエネルギー情勢を一段と厳しいものにしつつあります。

この情勢に対応できる単一のエネルギー源はなく、石油代替エネルギー、新エネルギー、未利用熱の利用、そしてエネルギーの節約に至るまで、すべての方策を活用しなくてはなりません。特にその中でも、原子力発電は、環境保護に適し、大量で安定した供給が可能な、現実的なエネルギー源であります。

原子力発電をはじめとする、今後のエネルギーの安定供給については、エネルギー需給見通しを、単なる数字合わせに終わらせるのではなく、政府自らが、その現実的姿を国民にありのまま提示し、協力を訴えていかなくては、将来に禍根を残すことになります。

私ども原子力関係者としましても、エネルギーの安定供給のために、最大限の努力を行う所存ですが、それには、深刻な状況になりつつあるエネルギーに対する国民の認識並びに、原子力発電に対する理解と支援が必要であります。そのため私どもは、生活レベルからグローバルな世界のエネルギーに係わる情勢について、種々の場を通して国民の皆さまに説明し、原子力発電所の建設についての理解を得る努力をしなくてはなりません。

わが国の原子力開発のみならず、世界各国の原子力開発についても、積極的な協力を進めなくてはなりません。特にこれから原子力発電を導入しようと計画しているアジア諸国につきましては、わが国の経験も活かし、安全かつ着実に導入ができるよう、共に協力し合う必要があります。

またソ連、東ヨーロッパ諸国につきましても、原子力発電の実状が明らかになるにつれ、これらの国々には、安全性などの問題を含めて、今まで以上に協力することが必要であると思われます。私ども民間としましても、然るべき枠組みのもとに、積極的な役割を果たしていく所存であります。

原子力発電の推進のための第１条件は、安全の確保です。今回の美浜発電所の事故は、わが国の原子力発電技術の水準が、世界でもトップクラスにあると言われていますだけに、私ども原子力関係者ばかりでなく、多くの方々に大きなショックを与えました。また、原子力発電の安全性そのものに対する不安も、与えたのではないかと、懸念しております。

事故に対しては、最新の技術を駆使して、その再発を無くすよう努力するのは当然ですが、同時に、関係者が、原子力の安全とは何かを整理し直して、それを基に、国民の皆さまに理解を求めていかなくてはなりません。

わたくしどもは、原子力発電の建設、運転、管理に携わる関係者と共に、何にもまして、大前提である安全性について再確認し、今後の原子力開発を進めることにいたします。

世界の原子力平和利用の推進にとって、憂慮されますことは、核兵器の拡散問題です。原子力発電を推進し、特に燃料サイクルの実用化にチャレンジしておりますわが国にとりましては、世界の核不拡散体制の確立とその維持、並びに、核軍縮の一層の実現が、国民の悲願であり、平和利用推進の国民合意の基盤であります。私どもは、そのような立場から、核不拡散条約（ＮＰＴ）の、１９９５年以降の延長はもちろん、核兵器保有国間の核軍縮努力、ＮＰＴ批准国への平和利用のための協力を、強く望みます。

現在、わが国と北朝鮮（朝鮮民主主義人民共和国）の間で、話し合いが行われておりますＮＰＴ批准に伴う保障措置問題には、私どもは、わが国政府の姿勢を全面的に支持するものであります。

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。

以上

JAIF Chairman's Address
24th JAIF Annual Conference
Mielparque Hall, Tokyo
April 8, 1991

Mr. Chairman, ladies and gentlemen, I am honored to be able to greet you today at the opening of the JAIF annual conference, on behalf of the Japan Atomic Industrial Forum.

I am very glad that the Gulf War came to an early end. However, notwithstanding this fact the energy situation in Japan still faces such severe realities as an expected sharp increase in electric power consumption this summer, similar to that of last year, and growing demand especially in public welfare activities.

No single existing energy source can relieve this critical condition. We have to resort to all available means, including alternatives to oil, new energies, using previously unused heat, and conserving energy. It is a matter of course that nuclear power, in particular, is the energy source best suited to the requirements for environmental protection, that is both capable of a large volume of constant supply and realistic.

It will be recessary to formulate proper perspectives on future steady energy supplies, including nuclear and all other available means, and the Japanese Government should take initiative to appeal to the people of the nation for cooperation by showing the real status of energy in the country. Without such efforts, we will experience trouble in the near future.

In the nuclear energy sector, we must strive our utmost to assure a constant supply of energy for the future. For that purpose, it is essential to make the Japanese people aware of the energy situation at present and to obtain their understanding and support for nuclear power.

We must take every opportunity available to promote a knowledge of energy at all levels, from household affairs to global policy, so that better public understanding will be obtained for the construction of nuclear power plants.

The efforts on the energy issue should not be restricted to the development of nuclear energy in Japan, but should be extended to cooperation with other nuclear-energy countries around the world.

Asian countries planning to introduce nuclear power for future use, in particular, should be allowed access to the Japanese experience in ensuring the safe and steady operation of nuclear power plants. In this way we can cooperate each other.

The soviet Union and Eastern European countries that are pushing ahead with nuclear power projects stand in need of more of the same kind of cooperation that they have so far received in the matter of nuclear safety. The Japan Atomic Industrial Forum is fully prepared to do its part.

The primary condition for the promotion of nuclear power is to assure safety.

The recent accident that occurred at the Mihama nuclear plant was a big blow to the image of nuclear safety held by the Japanese people, as well as to the nuclear energy sector, because safe nuclear technology in Japan had been believed to be the most reliable in the world. The accident made a serious impact on the Japanese people in terms of the safety issue of nuclear power stations, and it is certainly of great concern to us.

While it is necessary to ensure that such accidents will never be repeated again, the persons concerned have been requested to scrutinize again the problems related to the nuclear safety and to seek greater understanding on the part of the people by showing their sincerity about the accident's outcome.

We are prepared, as are all other interests involved in the construction, operation and management of nuclear power plants, to reaffirm safety as the major premise for the development of nuclear energy in the future.

Our major concern for the future in the area of the peaceful uses of nuclear energy in the world is to prevent the proliferation of nuclear weapons. Japan is further promoting nuclear power and is challenging the commercialization of nuclear fuel cycle. Securing accomplishment of these programs, it is essential to establish the non-proliferation regime as well as nuclear disarmament all over the world, which is our nation's earnest wish and also the basis for consensus in the peaceful uses of nuclear energy.

The Nuclear Non-Proliferation Treaty (NPT), which is set to expire in 1995, should naturally be extended beyond that time. To achieve the goal of non-proliferation, however, it is necessary for the nuclear-weapons states to make further efforts toward nuclear disarmament and to extend peaceful cooperation to the countries that have already ratified the NPT and agreed to have their nuclear facilities inspected.

The inspection of the International Atomic Energy Agency (IAEA) is an outstanding issue in the ongoing negotiations between Japan and North Korea (the Democratic People's Republic of Korea). This is a matter of grave concern to all Japanese involved as far as the peaceful uses of nuclear energy is concerned.

The Japanese government is requested, acting as a nation committed to the peaceful uses of nuclear energy, to continue its vigorous efforts to persuade North Korea.

Before closing my address, I must express my heartfelt gratitude to the chairman and members of the organizing committee for this annual conference, to the chairmen of all sessions, to the foreign and Japanese visitors with papers for presentation, and to all other participants in this conference.

Thank you.

第二十四回原産年次大会

原子力委員会委員長　所感

本日、第24回原産年次大会が、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ましたことは誠に喜ばしく存じます。
圓城寺会長、生田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、大変喜ばしく思っております。

世界のエネルギー需要は、過去2回の石油危機の後、比較的低い伸びで推移していましたが、近年は伸び率が増大しており、さらに、開発途上国のエネルギー需要の急速な増加等により、将来的には、全世界のエネルギー需要は着実に増大することが予測されております。

こうした状況のもと、今回、中東の湾岸危機の発生に伴い、原油供給について世界が心配したことは記憶に新しいところですが、このように供給に不安定な要因を内包している石油への依存度を低減し、世界のエネルギー供給の安定化を図るためには、エネルギー消費大国である我が国を始めとする先進各国が、石油代替エネルギー、とりわけ供給安定性、経済性に優れる原子力の開発を積極的に推進し、世界のエネルギー問題の解決に貢献していくことが重要と考えております。また、エネルギー以外の多様な用途がある化石燃料の消費を抑制する上でも、非化石燃料である原子力を始めとする石油代替エネルギーの開発が重要です。

さらに、近年、地球温暖化、酸性雨等の地球環境問題が大きくクローズアップされてきております。石油、石炭等の化石燃料は、その燃焼に伴い、温室効果や酸性雨の原因となる二酸化炭素等を発生させることから、これらに過度に依存することは好ましくありません。原子力に関しては、二酸化炭素等を発生させないという優れた特長を有しております。このため、ヒューストンサミット等の国際会議の場においても、地球規模の環境問題の解決に重要な役割を果たすことが確認されており、この点からも原子力の開発利用は大きな意義をもっております。

このようにエネルギー源として優れた特長を有している原子力については、現在、

世界全体で４２６基、約３億４千万キロワットの原子力発電所が運転中であり、世界全体の総発電電力量に対し、原子力が１７パーセントを占め、電力供給の主要な担い手としての地位を築いております。

この原子力の開発利用を推進するに当たっては、安全確保を第一として、国民の理解と協力を得ることが重要です。

こうした観点から、今回の関西電力美浜発電所で起こった蒸気発生器伝熱管損傷につきましては、環境に影響を与えることはなかったものの、地元を始めとして国民の皆様に心配をおかけする結果となり、誠に遺憾に思います。十分な原因究明を行った上で、今後、このようなことが再発しないよう、万全の安全対策をとることが重要と考えております。

また、国民の皆様の原子力に対する理解の増進に当たっては、従来のような新聞、テレビ等のマスメディアを活用した、広く国民に問いかけていく広報だけではなく、全国各地で開催される勉強会への講師の派遣、国民の皆様の疑問や不安に懇切丁寧に答えていく対話形式の活動、あるいは身の回りの放射線を測定する簡易放射線測定器を貸し出して実際に計ってもらうなど、分かりやすい体験型広報等を行い、適時的確に、草の根的な広報活動を進めているところです。加えて、パブリックアクセプタンス対策の推進に当たっては、国際的な連携も重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いくこととしております。

次に原子力政策の推進状況についてですが、原子力発電を着実に推進する一方、ウラン資源を有効に活用し、原子力発電の供給安定性を高めるため、現在、青森県六ヶ所村において、核燃料サイクル施設計画が進展しております。政府としても、安全確保対策の一層の充実強化を図り、かつ本計画についての理解と協力の増進を図るため広報活動を強化するともに、我が国の研究開発の成果を最大限に活用するべく技術的支援を行っております。

また、将来の原子力発電の主流となる高速増殖炉については、２１世紀の実用化を目指して原型炉「もんじゅ」の建設を行っているところですが、現在、工事はほぼ終了し、今後、総合機能試験を行うこととしており、来年１０月の臨界を目指して着実に計画を進めているところです。

この「もんじゅ」の燃料製造等に必要なプルトニウムについては、平成４年には国内のプルトニウムに不足が生じる見通しであり、英仏において回収されるプルトニウムの返還輸送を平成４年秋頃までに行うこととしております。これについては、関係機関の緊密な協力の下、輸送に万全を期すこととしております。

一方、今後の原子力の研究開発については、技術革新の牽引車としての先導的な役割を果たすことが期待される領域を重視しております。

人類の恒久的エネルギー源である核融合については、日本原子力研究所の臨界プラズマ試験装置（ＪＴ－６０）が、高性能化のための改造を終了し、この程、運転を開始致しました。今年度は、いよいよ重水素を用いた実験を行うこととしており、研究開発に一層の進展がみられることを期待しております。また、日本、米国、ＥＣ、ソ連の四極により進められている国際熱核融合実験炉（ＩＴＥＲ）計画につきましては、昨年末、概念設計活動が成功裡に終了し、今年度からは、工学設計活動に移行することとなっておりますが、我が国としては、本計画に主体的かつ積極的に参加していくこととしております。

放射線利用については、医療、工業、農業等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高度化を図ることが必要です。特に、難治性がんの治療を可能とする重粒子線がん治療装置の建設が、平成５年度の完成を目指し着実に進められております。また、物理、化学等幅広い分野での応用が期待されている大型放射光施設についても、その建設が進められているところです。

また、原子力船の研究開発につきましては、原子力船「むつ」が、本年２月、原子力船として完成し、第一次実験航海を実施したところですが、今後、概ね１年間にわたり、舶用炉の研究開発に必要な実験データ、知見等を得るため、実験航海を行うこととしております。

次に、原子力分野における我が国の国際貢献についてですが、まず我が国及び世界の原子力開発利用を一層円滑に推進するためには、今後とも、核兵器の不拡散に関する条約、及び国際原子力機関の保障措置体制が健全に維持・強化されることが重要であると考えており、我が国の国際協力は、核不拡散との両立を図りつつ展開している

ところです。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、技術基盤の整備に重点を置き、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地域と我が国とを含めた、地域として一体の協力が有効であり、本地域全体の原子力技術水準の向上に貢献してまいります。具体的には、昨年に続き、先月、第２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るなど、積極的な対応を行っているところです。さらに、先進諸国との間においても、核融合、高レベル放射性廃棄物の処理処分等の協力を積極的に進めております。

これらの原子力の開発利用を進めるに当たっては、安全の確保が大前提であり、私としても全力を尽くしてこれに当たる所存ですので、皆様方におかれましても、宜しくかかる趣旨をご理解頂き、一層の御支援、御協力をお願いする次第です。

以上、私の所感を申し述べましたが、本日から３日間、「９０年代のエネルギー　原子力に何を期待するか」という基調テーマのもと、内外の多数の有識者・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致しまして、私の挨拶とさせていただきます。

Draft speech for M. Cardoso e Cunha
at the Japan Atomic Industrial Forum
Tokyo, April 8, 1991

ENERGY POLICY FOR THE NINETIES: AN EC VIEW-POINT

Chairman, ladies and gentlemen,

Introduction

I am pleased to share some views with you on the approach the European Community has adopted to a number of energy issues.

I would like to take the opportunity in Opening this morning's session to set out some broad strands of energy policy in the european Community with particular attention to the single european market, recent developments in eastern Europe including the European Energy Charter, nuclear policy, energy technology and some of the oil policy issues.

In a time of significant changes worldwide and rising uncertainties due to political events, the importance of energy must be clear to everyone.

In contradiction to the relative calm that has been reigning in the past years on the energy markets, and which has tempted some to lapse into passivity, today's situation reminds us again that energy is of vital importance in all areas of our economy and for our wellbeing.

The interlinkage of economies or the fact that the environment knows no frontiers, requires global thinking in order to meet the challenges that arise.

The European Community has an unique chance to play a pivotal role in a process such as this. Owing to its history, culture and traditions it may prove to be the meeting point between the east and west, north and south.

Alongside the events taking place internationally, the key concept, in energy-policy terms, governing european activities today is the achievement of the internal market by end 1992 and the improvement of security of energy supply.

In the past, the Community approached energy matters largely in playing the role of coordinator of national energy policies of the individual member states. There have been a few common programmes, most notably in the field of energy technology.

Whilst this approach was appropriate to the circumstances of the past it has proved increasingly more difficult to sustain in a rapidly changing world, and moreover, it is no longer good enough for the single, integrated energy market of the 1990s and beyond.

The final quest for the European single market was launched by the Commission in 1985 when the actions necessary for its achievement were spelt out. Energy took its place on the internal market train in 1988 with the publication of a white paper - "the internal energy market " - setting out the strategy for a single market in the energy sector.

There are now many complex issues and future consideration to be borne in mind which demand an energy policy to be decided for the Community as a whole. The objectives are now much wider, more ambitious - and urgent - than before, and that is why the Commission is working towards the presentation of a new perspective for the European Community's energy policy for the coming years.

This perspective will suggest how to meet demand, economic growth, environmental protection and development within the context of the internal energy market, in order to create a more favourable framework for stimulating enterprise, competition and trade.

Such a new approach should result in a common energy policy which will most probably be embodied in the EEC treaty.

It is only by taking full advantage of the Community dimension, through economies of scale, optimisation of resource allocation, its opportunities for increased trade, that the Community's energy supply can provide the right basis for the increasingly intense struggle for markets which is taking place at the global level. Only a truly common energy policy can fully exploit this Community dimension.

1993 is approaching fast, and the question arises of how far down the road the Commission is in terms of its programme. In fact, steady progress is being made.

Firstly, a directive was adopted on transparency of prices, which is fundamental to the operation of an open energy market.

A twice yearly publication of prices paid by consommers - small and large - should guarantee that they will be better able to make the best choice for a rational, economic use of energy from the various fuels available to them.

The second proposal which was adopted, concerns Community trade in electricity. A directive proposes that there should be a system under which electricity companies would be able to use transport networks of other such companies for trade across national frontiers when the capacity is available.

Before the summer, a positive decision should also be reached with regard to natural gas, which pursues the same goal as for electricity: increased trade between existing suppliers through better implementation of transit and more competition.

These specific directives will be followed by other proposals, all designed to introduce greater competition in the Community's energy sector and to remove restrictive national barriers. By increasing competition and exploiting the advantages of a large single market, energy costs should be reduced to the benefit of all energy consumers.

Meantime, the Commission has set up consultative committees, with the purpose of examining the case for the introduction of third party access to gas and electricity networks in the Community.

The main considerations which will govern the Commission's choice are two. The first is that security of supply must not be adversely affected. The second is that the principle of subsidiarity will be respected. This means that authority of local and regional entities cannot be overshadowed by unnecessary central discipline.

Apart from the question of third party access, there are other areas in which the Commission is acting or may act so as to introduce greater competition in the networked energies.

These include principally the liberalisation of independent electricity production and transparency of costs. By transparency of costs we mean, first of all, the "unbundling" of the different functions of integrated companies at an accounting level so that customer knows the price of the product, (gas and electricity) as well as the price of its transport.

Another area of the Commission's concern is normalisation in the energy field , with particular reference to environmental standards. We are convinced that norms, where appropriate, have a vital part to play in opening up the market.

Before I change the subject I want to report progress on two more subjects of the internal market: fiscality and the oil sector.

On taxation the Commission's aim is to harmonise, so far in the area of indirect taxation, the fiscal conditions under which energy products are traded in the Community from country to country.

On oil itself, the present thinking in the Commission is to ensure greater transparency and less discrimination in the granting of licenses for oil exploration and production.

We are also conscious of the need for policies to flank the internal market. These range from general strengthening of energy infrastructures in the framework of transeuropean networks, to more specific items like energy in cities, on peripheral islands or in rural environment.

It is clearly my intention to avoid exclusive reference to developments inside the Community. Clearly, Community energy policy has an international dimension. What happens inside the Community in completing the internal energy market, has repercussions beyond the Community's borders.

The Commission devotes considerable attention to strenghten energy relations with the neighbouring countries of Efta, the mediterranean and, of course, eastern Europe.

Much before the beginning of the gulf crisis, that international side of the Community energy policy was strongly stressed by the events in the east and by the political and economic reforms undertaken there.

The sincere will to express our solidarity with the populations in the USSR and in the countries of central and eastern Europe, the need to include the energy infrastructures development and their liberalization inside the whole economic process, and as well our concern with the serious deterioration of the energy situation led us to build and organize a systematic approach of energy cooperation with those states.

As a starting point I lead a mission in Moscow last september which was followed by another one, of technical nature. Contacts with the soviet authorities were pursued later in the year.

As a result of the fact finding mission, two types of cooperation projects were identified: first technical type projects involving the transfer of technology and the sharing of expertise in such fields as nuclear safety, energy efficiency, environmental protection etc... and secondly large investment projects in areas such as oil, electricity and gas development and transport, upgrading and modernising refineries.

The Community can contribute financially for the first type of projects but its contribution in the second domain will be limited to the role of facilitator for western industry to make the necessary investment. That is why, in my view, cooperation in the field of the legal and administrative framework has absolute priority.

All this is in the line of the Houston economic declaration of July 90 which expressed the belief that technical assistance should be provided now to help the soviet union move to a market-oriented economy and to mobilize its own resources.

Following this impulsion at the last European Community Rome summit of December 90, a technical assistance programme for the USSR was agreed which would target, among others, the energy sector.

As you are certainly aware, that programme has been subjected to some political reservations following events in the baltic republics. But since the 4th of march, the Community decided to relaunch the programme and preparation of the technical cooperation has started again to match the priorities as soon as possible . We shall pursuing additional contacts with the soviet authorities in the coming months.

On the side of energy cooperation with the countries of central and eastern EUROPE, the Community has two roles to play.

First, the Commission is responsible for the coordination of the complex cooperation of the 24 countries which decided in October 90 that energy was a priority for cooperation with eastern EUROPE.

Secondly the EC programme PHARE includes as well an energy sector. As you probably know, PHARE, originally considered for Poland and Hungary, has been extended to Bulgaria, Romania, Czechoslovakia and Yugoslavia. An amount of approximately 5 mecus per country has been allowed for 1991 in the energy cooperation field.

It is all right, for administrative cooperation!
But who is going to explore, produce, distribute and sell the energy goods if not the industry?

If we expand this view to the East and consider USSR as well, we shall all agree that an overall approach is absolutely necessary, an approach which will stress the need to bring together soviet energy resources and western capital, technology and markets to benefit Europe as a whole, in order to match the complementarities existing in the reality, by creating a large european energy cooperation.

And I am very happy to tell you that the Community took the initiative in that field, following the political impulsion from the Dutch prime minister Lubbers at the last Dublin summit in June 90.

The iniciative was further developed by the European Commission at the CSCE (Conference on the Security and the Cooperation in Europe) summit in Paris in last November. An european energy charter should create the climate of confidence necessary for the exploitation and marketing of energy resources in both east and west.

In the Commission view, the charter should be a political declaration of interest by which the signatories would agree on the overall aims, principles and objectives for energy markets and cooperation.

The definition of what this cooperation would involve and the measures necessary for its implementation should be the subject of an International Conference in which all interested parties would participate.

Our Communication to the Council and the indicative draft Charter sent with it are based on a two-tier approach : the Charter itself and the specific agreements which will be associated downstream.

At the first level, the European Energy Charter is a type of code of conduct or solemn declaration on broad economic, energy and environmental principles which the signatories undertake to respect. Such a declaration of intent would by its nature be non-binding.

However, the value of such a text would be to establish for the first time a consensus on the bonds of solidarity and complementary relationships in the field of energy in Europe.

However, the value of such a text would be to establish for the first time a consensus on the bonds of solidarity and complementary in the field of energy in Europe.

Such a code of conduct establishes general operational rules for activities in the field of energy in order to meet the great challenges of the security and diversification of supplies.

With this aim in mind, the indicative draft Charter proposed by the Commission sets itself three clear objectives: first the development of trade, second cooperation, coordination and technology transfer, and third optimum use of energy and protection of the environment.

It emphasizes the importance of market economy mechanisms to attain these objectives.

The second level involves the practical application of the Charter's principles. It is anticipated that this will be done by concluding specific implementing agreements. These would be legally binding international multilateral instruments, the signing of which would impose binding obligations. The indicative Charter contains a non-exhaustive list of priority subjects for the conclusion of such agreements. They must serve as a reference and legal framework for European enterprises in order that they may cooperate with east european countries and their enterprises in a safe, predictable environment.

Obviously, nuclear power, will be in the context of an implementation of the Charter a priority issue for trans-european cooperation.

This source of energy, which plays a very important role in the electricity production balance within the European Community and also in Eastern Europe and the USSR, should be evaluated on its own merits and compared to other sources of energy in terms of respect for the environment safety and in terms of costs, both direct and indirect, of electricity production .

At the present, only six out of the twelve member States of the European Community are producing nuclear energy. This production satisfies however more than one third of the electricity needs of the Community as a whole. Nuclear energy represents around 14% of the primary energy consumption and 35% of the total electricity production within the European Community.

The Commission of the European Communities itself is neutral in relation to the use of nuclear energy in the sense that we do not consider our competence to interfere with this type of choice of our member states. Once a choice has been made in favour of nuclear power, however, it is our duty to ensure at the highest level, the respect of the Euratom

Treaty, for the well being of all europeans and for the best assimilation of this type of energy source into society as a whole.

Everybody recognizes that an accident or even an incident occuring in the nuclear power industry of a specific country has, in fact, a strong worldwide impact - it is enough to look at the consequences of the accidents at Three Mile Island and, especially, Chernobyl.

With this in mind, I have been promoting, since one year ago, a linking operation - a twinning - amongst nuclear stations in the whole of Europe. We aim to maximise for the common benefit, the irreplaceable accumulation of experience represented by the design and operation of over 200 nuclear plants. It is encouraging to see that industrialists - in particular electricity producers - are willing to proceed that way.

Some concrete initiatives have already taken off with the financial aid of the Community, including programmes to evaluate the safety of the Soviet VVER reactors, to set in motion action to increase their safety levels and to intensify the training of their personnel. This is only a start, we shall be prepared to go much further.

Against this background, nuclear energy is, in fact, beginning a new phase in its evolution. It will be necessary to rationalise the approaches taken by those who promote nuclear energy , first of all to allow it to make its own case, against competing sources of energy mainly in the field of costs.

We must recognise that, in fact, the energy situation, is not exactly the same in Japan and in the European Community. The existance of oil ressources in the North Sea and coal ressources in several of our Member States could be seen as a factor of security. However, the oil is not much, and the coal is very expensive. As a result both of our regions European Community and Japan are largely dependent from outside energy supplies and, so, nuclear power can play a very important role.

We must emphasize the very good relationships between Japanese and european industries in the nuclear field, particularly in the area of nuclear fuel reprocessing.

You may be interested to know that, recently, a Joint Statement on Fuel Cycle Costs was signed in Washington by the US Department of Energy and the European Community.

The purpose of the DOE/EC Study of Fuel Cycle Analysis is to develop a commonly acceptable range of estimates for the full costs of fuels production, I mean transformation, transportation and use. The fuels under consideration include coal, oil ,. natural gas, uranium, and renewable resources, such as solar, biomass, and hydropower. Conservation technologies will also be considered. It is necessary to have a scientific consensus on the total costs of fuels so that valid comparative judgements can be made on energy investment decisions.

This study is the first of its kind undertaken on an international basis and could have a significant impact on the future energy policies of many nations. Other countries have expressed an interest in participating in the Fuel Cycle Study. As far as I know, Japan will join this study very soon. Other nations may join the Study later.

In Europe, nuclear power should become the subject of a common industrial strategy, worked together by the interested parties, promoters and users, in order to ensure the viability of a european product.

Until now, quite naturally , each european promoter (state or enterprise) has tried to differentiate its product by boasting of its qualities, mainly in the safety field. From now,it will be necessary to incorporate into all the new reactors the same standards of safety and environmental protection.

To be in a position to create an industrial strategy of such a scale, an acceptable answer must be given to the questions raised by the wider public opinion. Public opinion has to be convinced that nuclear energy is safe, clean and economical as long as certain preconditions are satisfied.

In particular, the public has the right to know if certain aspects of the industry, which have not as yet been fully developed commercially on a large scale, such as the storage of highly radioactive waste and the decommissioning of nuclear facilities, are well mastered by our scientists and engineers. Without openness there is no democracy.

We can note some clear signs in the field of public opinion about nuclear power as the case of the postponement of the phase-out of the nuclear reactors in Sweden. But we must keep paying a very special attention to the public acceptance of nuclear power. With that in mind, we, the EUR community, we think that the existance of a common product with similar safety features and rules, is a project of the biggest importance.

Such a project needs to be organised around three points to achieve its objective of public acceptability:

1 the European States, within their own sovereignty, should adopt the same regulations in relation to the safety of nuclear power stations ;

2 the producers of nuclear electricity should reach an understanding and define the technical specifications of future reactors ;

3 the main European nuclear constructors should get together to outline any proposal for a common product to offer the international market of nuclear reactors. French and German companies are already walking down this road.

Summing up, this would mean conceiving and building a <u>common European reference reactor</u>. Drawing from plans already in use in France and

Germany, this european project could be a joint undertaking with the Community producers of nuclear electricity, and should they wish, those of the member states of EFTA, those of central and eastern european countries as well as those of USSR.

In this way, all interested European countries would have taken part in the conception of the reactor with the possibility of adopting identical regulations of nuclear safety and observing the same codes of construction.

Europe would then have regulations assuring irreprochable levels of safety and of quality control. The european economic space will be homogeneous and will allow for free competition amongst all suppliers of nuclear equipments, systems and services.

In this direction, the Community producers of nuclear electricity have already started to make progress. They have established a so-called "European Economic Interest Grouping" which is intended to become an essential agent at the disposal of the Commission to perform the Community assistance to Eastern European countries for the upgrading of their Nuclear Power Systems.

They have also agreed on some form of cooperation with the view of defining common requirements for the Pressurized Water Reactor they would wish to operate from the year 2000 on. This cooperation may envolve, I hope, to lead to the first consistant outline of the European reference reactor I mentioned before.

Further progresses on the utility and industry side are expected during the next few years, as well as in the harmonization of national safety rules.

In this way, the objectives of safety and economic viability will be attained freely and independantly rather than by regulation. For the next century, the nuclear option cannot exclude this development. With strong demographic growth, coupled with economic development world-wide and its consequent need for energy, nuclear can be presented as the obvious energy source, at the same time clean and safe to supply. The main condition is that this energy source gains public acceptance and credibility.

I have mentioned the place of safety and respect for the environment in the acceptance and use of nuclear power, but there is another vital aspect, that of nuclear non-proliferation.

In June 1990, the European Council made a Declaration on Nuclear Non-Proliferation in which it stated, inter alia, that it attaches the greatest importance to the maintenance of an effective international nuclear non-proliferation regime and will make every effort to contribute to strengthening non-proliferation and encouraging the participation of further countries in the system. The European Council recognized that International Atomic Energy Agency safeguards are the cornerstone of an effective non-proliferation regime and recalled the important contribution of Euratom safeguards.

The Community is a party to the Safeguards Agreements between member States and the I.A.E.A. and the Commission participated, in the 4th Review Conference of the Treaty on the Non-Proliferation of Nuclear Weapons, which carried out a thorough review of the implementation of that Treaty. The work done by this Review Conference was clearly of major importance.

Additionaly, as you may know, the twelve member States of the European Community have collectively adhered to the Nuclear Suppliers Group Guidelines. The Commission welcomed the fact that an informal meeting of the 26 States that adhere to these Guidelines took place in the Hague last month with a view to reinforcing the nuclear non-proliferation regime.

Chairman, Ladies and Gentlemen

Broader international cooperation in the field of energy technology - and not only nuclear - should become a central element of energy strategies to be developed by the industrialised countries.

The development and commercial implementation of new, more effective energy technologies is a vital part of meeting the environmental and security of supply challenges which face both Japan and the European Community.

The Community has recently embarked on a new 5-year programme, to promote energy technologies in the fields of rational use of energy, renewable energy sources, solid fuels and hydrocarbons. This programme, with a budget size of 125 billion Yen, will build on our work over the previous decade and will draw together and coordinate the energy technology programmes of the 12 member states.

A major new feature is a set of associated measures to promote the commercial implementation of innovative energy technologies, using a network of 33 Organisations for the Promotion of Energy Technology throughout the Community. Our intention now is to extend this network outside the Community. In particular, we are trying to identify a suitable agency in Japan, to encourage a two-way flow of information on innovative energy technologies. Officials of mine have been exploring this during a recent visit to Japan.

It is clear that the problems which we face in this area are often very similar, and that cooperation together in energy technology would be mutually beneficial. It would also be in line with the agreement to cooperate reached at the EC-Japan High Level Consultations on 25-26 October 1990 in Tokyo. I therefore hope that we can take further steps to encourage this energy technology cooperation together. The development of new and renewable energies is a promising area. But clean coal technologies should also be looked at very closely.

The concept of an energy policy implies, indeed, that one takes into account the place of each fuel, including coal in a balanced energy mix, taking also into account the need to better protect the environment.

Coal has played and will play in the future an important role within the Community's energy policy provided a reasonable solution is found to the environmental problem. In the context of the world energy situation, geographical diversification of supply and substitution between different energy sources are of paramount importance. Coal will therefore continue to play an important role as a "regulator" of the energy markets and I am referring here both to imported coal and Community coal which have proved to be complementary.

An objective which is very important with respect to Community coal, is the development of the energy resources under satisfactory economic conditions, and hence the pursuit of efforts to improve their competitiveness.

It is however important to add that the concept of economic viability cannot be left completely to the short term free market forces. Community coal has to be part of a long term concept bearing in mind security of supply.

The efforts the Commission is undertaking with regard to the security of supply issue, should be seen in the perspective of achieving the single energy market, which will indeed contribute positively to the Community's security of supply, also for coal.

I could not finish my intervention today without having some words about the future of oil after the gulf crisis.

The end of the war should have brought into question whether it is desirable and possible to favour a greater stability in the international oil market and in particular in the oil price evolution.

This concern has not been a recent one. It had preoccupied many minds throughout the 1970s, engendered the concept of the "minimum safeguard price" and encouraged the search for an indexation formula by the producing countries.

The Gulf war has shown for the first time that a natural convergence of interests can exist between the three protagonists in the oil game (producing countries, consuming countries and oil companies).

The producing countries, with OPEC's blessing, have quickly increased their production to make up for the iraki/kuwaiti deficit. The consuming countries have proven the credibility of the crisis mechanisms by exhibiting genuine solidarity and a common analysis of the situation. The oil operators finally have shown a remarkable ability to adapt to new market conditions.

Today, the result is evident and seems very positive. Oil prices are relatively stable and are situated at levels close to those observed prior to the crisis, that is to say in the regions of 19-20 $/barrel.

I believe that improved market stability is desirable for producing countries as well as the consuming countries and oil operators.

The challenge that lays ahead for the 1990s will therefore be to reach a pragmatic approach to the stability of the oil markets which can stand the test of time.

Our policies should give the main players in the oil game clear indications of our future objectives. They concern above all three levels: the political level, the industrial level and the market level.

On the political level the Community would contribute to reinforcing the international solidarity, developing new forms of dialogue between consumers and producers.

As far as the Commission is concerned it should step up the negotiation of the free exchange agreement between EEC/GCC and also the membership of the Community to the International Energy Agency.

On the industrial level there should be a support to the investments in oil producing countries, in order to better contribute towards the functioning of the oil market. It would so develop a favourable climate for investments in the oil and gas industry in the upstream and downstream markets. In this respect, the framework of the energy charter could be of great interest for the development of better industrial relations with all suppliers, including the mediterranean countries.

On the market level, the EEC shall emphazise its responsabilities of major importer of oil, reinforcing the level and operationality of strategic oil stocks. We support free market practices, but it is high time to balance the flexibility and margin of manoevre of both suppliers and consumers.

The diversification of sources of supply namely the cooperation with Soviet Union is in the top of our priorities.

Chairman,
Ladies and Gentlemen

Energy discussions are never easy, objective and complete. The matter is highly political and is naturally subjected to peculiar approaches and interlinked interests.

There is, however, ample room for international solidarity and common appraisal of specific situations. The EEC and Japan can find, in the energy sector, many points of identity of interests. It is our common duty to take this departure point on a basis for pragmatic cooperation.

Draft speech for M. Cardoso e Cunha
at the Japan Atomic Industrial Forum
Tokyo, April 8, 1991

ENERGY POLICY FOR THE NINETIES: AN EC VIEW-POINT

Chairman, ladies and gentlemen,

Introduction

I am pleased to share some views with you on the approach the European Community has adopted to a number of energy issues.

I would like to take the opportunity in Opening this morning's session to set out some broad strands of energy policy in the european Community with particular attention to the single european market, recent developments in eastern Europe including the European Energy Charter, nuclear policy, energy technology and some of the oil policy issues.

In a time of significant changes worldwide and rising uncertainties due to political events, the importance of energy must be clear to everyone.

In contradiction to the relative calm that has been reigning in the past years on the energy markets, and which has tempted some to lapse into passivity, today's situation reminds us again that energy is of vital importance in all areas of our economy and for our wellbeing.

The interlinkage of economies or the fact that the environment knows no frontiers, requires global thinking in order to meet the challenges that arise.

The Community must play a pivotal role in a process such as this. Owing to its history, culture and traditions it may prove to be the meeting point between the east and west, north and south.

Having said that, alongside the events taking place internationally, the key concepts, in energy-policy terms, governing our activities today is in the achievement of the internal energy market by end 1992 and the improvement of security of energy supply.

Policy orientations

In the past, the Community approached energy matters largely in playing the role of coordinator of national energy policies of the individual member states. There have been a few common programmes, most notably in the field of energy technology.

Whilst this approach was appropriate to the circumstances of the past it has proved increasingly more difficult to sustain in a rapidly changing world, and moreover, it is no longer good enough for the single, integrated energy market of the 1990s and beyond.

The single market was launched by the Commission in its white paper of 1985 in which the actions necessary for its achievement were spelt out. Energy took its place on the internal market train in 1988 with the publication of a white paper - "the internal energy market " - setting out the strategy for a single market in the energy sector.

There are now many complex issues and future consideration to be borne in mind which demand an energy policy to be decided for the Community as a whole. The objectives are now much wider and more ambitious - and urgent - than before, and that is why the Commission is working towards the presentation of a new perspective for the Community's energy policy for the coming years.

This perspective will suggest how to meet demand, economic growth, environmental protection and development within the context of the internal energy market, in order to create a more favourable framework for stimulating enterprise, competition and trade.

Such a new approach should result in a common energy policy which will most probably be embodied in the EEC treaty.

It is only by taking full advantage of the Community dimension, through economies of scale, optimisation of resource allocation, its opportunities for increased trade, that the Community's energy supply can provide the right basis for the increasingly intense struggle for markets which is taking place at the global level. Only a truly common energy policy can fully exploit this Community dimension.

Internal Market for Energy

1992 is approaching fast, and the question arises of how far down the road the Commission is in terms of its programme. In fact steady progress is being made.

Firstly, a directive was adopted on transparency of prices, which is fundamental to the operation of an open energy market.

A twice yearly publication of prices paid by consommers - small and larger ones - should guarantee that they will be better able to make the best choice for a rational, economic use of energy from the various suppliers or fuels available to them.

The second proposal which was adopted, concerns Community trade in electricity. A directive proposes that there should be a system under which electricity companies would be able to use transport networks of other such companies for trade across national frontiers when the capacity is available.

Before the summer, a positive decision should also be reached with regard to natural gas, which pursues the same goal as for electricity: increased trade between existing suppliers through better implementation of transit and more competition.

These specific directives will be followed by other proposals, all designed to introduce greater competition in the Community's energy sector and to remove restrictive national barriers. By increasing competition and exploiting the advantages of a large single market, energy costs should be reduced to the benefit of all energy consumers.

Meantime, the Commission has set up consultative committees, with the purpose of examining the case for the introduction of third party access to gas and electricity networks in the Community.

The main considerations which will govern the Commission's choice are two. The first is that security of supply must not be adversely affected. The second is that the principle of subsidiarity will be respected.

Apart from the question of third party access, there are other areas in which the Commission is acting or may act so as to introduce greater competition in the networked energies.

These include principally the liberalisation of independent electricity production and transparency of costs, including the "unbundling" of the different functions of integrated companies at an accounting level so that the customer knows the price of the product , i.e. gas and electricity; and of the service, i.e. their transport.

Another area of the Commission's concern is normalisation in the energy field , with particular reference to environmental standards where appropriate. We are convinced that norms have a vital part to play in opening up the market in energy.

Closely connected with the subject of normalisation is that of public procurement in the energy industries.

Before I leave the subject of the internal market I would like to report progress on two more subjects - fiscality and the oil sector.

On the first of these, the Commission's aim is to harmonise, so far only in the area of indirect taxation, the fiscal conditions under which energy products are traded in the Community from country to country.

On oil itself, I would like to refer to present thinking in the Commission to ensure greater transparency and less discrimination in the granting of licenses for oil exploration and production.

Finally, I should add that we are also conscious of the need for policies to flank or accompany the internal market. These range from general strengthening of energy infrastructures in the framework of transeuropean networks, to more specific items like energy in cities, on peripheral islands or in rural areas.

International dimension

So far, I have dealt with the developments inside the Community. But clearly Community energy policy has an international dimension. What happens inside the Community for example, in completing the internal energy market, has repercussions beyond the Community's border.

The Commission devoted recently considerable attention to strenghten energy relations with the neighbouring countries of efta, the mediterranean and, of course, eastern Europe.

Much before the beginning of the gulf crisis, that international side of the Community energy policy was strongly stressed by the events in the east and by the political and economic reforms undertaken there.

The sincere will to express our solidarity with the populations in the USSR and in the countries of central and eastern Europe, the need to include the energy infrastructures development and their liberalization inside the whole economic process and as well our concern with the serious deterioration of the energy situation there led us to build and organize a systematic approach of energy cooperation with those states.

EC - USSR bilateral cooperation

As a starting point I lead a mission in Moscow last september which was followed by another one, more technical, by my services. They also had contacts with the soviet authorities later in the year.

As a result of the fact finding mission, two types of cooperation projects were identified: first technical type projects involving the transfer of technology and the sharing of expertise in such fields as nuclear safety, energy efficiency, environmental protection etc... and secondly large investment projects in areas such as oil, electricity and gas development and transport, upgrading and modernising refineries.

I must say that the Community could contribute financially in the first category but its contribution in the second domain would be limited to the role of facilitator for western industry to make the necessary investment. That is why cooperation in the field of the legal and administrative framework is essential in my view.

All this is in the line of the Houston economic declaration of July 90 which expressed the belief that technical assistance should be provided now to help the soviet union move to a market-oriented economy and to mobilize its own resources.

And indeed, at the last EC Rome summit of December 90, a technical assistance programme for the USSR was agreed which would target, among others, the energy sector.

As you are well aware, that programme has been the subject of some political reservations following events in the baltic republics. But since the 4th of march, the Community decided to relaunch the programme and preparation of the technical cooperation has started again to match as soon as possible the priorities. We shall pursuing additional contacts with the soviet authorities in the coming months.

Energy cooperation with the PECO

On the side of energy cooperation with the countries of central and eastern EUROPE, the Community has two roles to play.

First we have to coordinate the works of the 24 group which decided in October 90 that energy was a priority for cooperation with eastern EUROPE.

Secondly the EC programme PHARE includes as well an energy sector. As you know, PHARE, originally considered for Poland and Hungary, has been extended to Bulgaria, Romania, Czechoslovakia and Yugoslavia. An amount of approximately 5 mecus per country could be allowed for 1991 in the energy field.

But who is going to explore, produce, distribute and sell the energy goods if not the industry!

That is why an overall approach was absolutely necessary, an approach which would stress the need to bring together soviet energy resources and western capital, technology and markets to benefit Europe as a whole, in order to match the complementarities existing in the reality, by creating a large european energy cooperation.

And I am very happy to tell you that the Community took the initiative in that field. The first idea came from the Dutch prime minister Lubbers at the last Dublin summit in June 90.

It was further developed by the Commission at the CSCE (Conference on the Security and the Cooperation in Europe) summit in Paris in November. A european energy charter should create the climate of confidence necessary for the exploitation and marketing of energy resources in both east and west.

A European Energy Charter

In the Commission view, the charter should be a political declaration of interest by which the signatories would agree on the overall aims, principles and objectives for energy markets and cooperation.

The definition of what this cooperation would involve and the measures necessary for its implementation should be the subject of an International Conference in which all interested parties would participate.

The Communication and the indicative draft Charter accompanying it are based on a two-tier approach : the Charter itself and the specific agreements which will be associated with it.

At the first level, the European Energy Charter is a type of code of conduct or solemn declaration on broad economic, energy and environmental principles which the signatories undertake to respect. Such a declaration of intent would by its nature be non-binding.
However, the value of such a text would be to establish for the first time a consensus on the bonds of solidarity and complementary relationships in the field of energy in Europe.

This code of conduct establishes general operational rules for activities in the field of energy in order to meet the great challenges of the security and diversification of supplies.

With this aim in mind, the indicative draft Charter proposed by the Commission sets itself three clear objectives: the development of trade, cooperation, coordination and technology transfer, and optimum use of energy and protection of the environment.

It emphasizes the importance of market economy mechanisms to attain these objectives.

Finally, it takes the Community's possible initiative and contribution in this area into account.

The second level involves the practical application of the Charter's principles. It is anticipated that this will be done by concluding specific implementing agreements. These would be legally binding international multilateral agreements, the signing of which would impose binding obligations. The indicative Charter contains a non-exhaustive list of priority subjects for the conclusion of such agreements. These agreements must serve as a reference and legal framework for European enterprises in order that they may cooperate with these countries and their enterprises in a safe, predictable environment.

Nuclear energy

Nuclear power, will be in the context of an implementation of the Charter a priority issue for trans-european cooperation.

This source of energy, which plays a very important role at the moment in the electricity production balance within the European Community but also in Eastern Europe and the USSR, should be evaluated on its own merits and compared to other sources of energy in terms of: respect for the environment safety and costs, both direct and indirect, of electricity production.

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Everybody recognizes that an accident or even an incident occuring in the nuclear power industry of a specific country has, in fact, a strong worldwide impact - it is enough to look at the consequences of the accidents at Three Mile Island and, especially, Chernobyl.

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Some concrete initiatives have already taken off with the financial aid of the Community, including programmes to evaluate the safety of the Soviet VVER reactors, to set in motion action to increase their safety levels and to intensify the training of their personnel. We should start with this approach, but be prepared to go much further.

Against this background, nuclear energy is, in fact, beginning a new phase in its evolution. It will be necessary to rationalise the approaches taken by those who promote nuclear energy , first of all to allow it to make its own case, when being compared with competing sources of energy mainly in the field of costs.

At this point, we must recognise that, in fact, the energy situation, not being exactly the same in Japan and in the European Community (existance of oil ressources in the North Sea and coal ressources, though expensive), both of our regions are largely dependent from outside energy supplies and, so, where nuclear power can play a very important role.

And we must emphasize the very good relationships between Japanese and european industries in the nuclear field, mainly in the area of nuclear fuel reprocessing.

I must point out that, recently, a Joint Statement on Fuel Cycle Costs was signed in Washington by the US Department of Energy and the European Community.

The purpose of the DOE/EC Study of Fuel Cycle Analysis is to develop a commonly acceptable range of estimates for the full costs of fuels production, transformation, transportation and use. The fuels under consideration include coal, oil , natural gas, uranium, and renewable resources, such as solar, biomass, and hydropower. Conservation technologies will also be considered. It is necessary to have a scientific consensus on the total costs of fuels so that valid comparative judgements can be made on energy investment decisions.

This study is the first of its kind undertaken on an international basis and could have a significant impact on the future energy policies of many nations. Other countries have expressed an interest in participating in the Fuel Cycle Study. As far as I know, Japan will join this study very soon. Other nations may join the Study later.

In Europe, nuclear power should become the subject of a common industrial strategy, worked together by the interested parties, i.e. promoters and users, in order to ensure the viability of a european product.

Until now, quite naturally , each european promoter (state or enterprise) has tried to differentiate its product by boasting of its qualities, mainly in the safety field. From now,it will be necessary to incorporate into all the new reactors the same standards of safety and environmental protection.

To be in a position to create an industrial strategy of such a scale, an acceptable answer must be given to the questions raised by the wider public. Public opinion has to be convinced that nuclear energy is a source of power which is safe, clean and economical as long as certain preconditions are satisfied .

In particular, the public has the right to know if certain aspects of the industry, which have not as yet been fully developed commercially on a large scale, such as the storage of highly radioactive waste and the decommissioning of nuclear facilities, are well mastered by our scientists and engineers. This is a request on behalf of the openness without which there is no democracy.

Even, if we can note some good signs in the field of public opinion about nuclear power - the case of the postponement of the phase-out of the nuclear reactors in Sweden (not an European Community country but in the same geographical location) is a very positive sign - we must keep paying a very special attention to the problem of public acceptance of nuclear power in Europe and we think that the existance of a common product with similar safety features and rules, is a project of the biggest importance.

The project needs to be organised around the following three points to achieve its objective of public acceptability:

- the European States, within their own sovereignty, should adopt the same regulations in relation to the safety of nuclear power stations ;

- the producers of nuclear electricity should reach an understanding and define together the technical specifications of future reactors ;

- the main European nuclear constructors should get together to outline any proposal for a common product to offer the international market of nuclear reactors. French and German companies have already started down this road.

Summing up, it would mean conceiving and building a common European reference reactor. Drawing from plans already in use in France and Germany, this european project could be a joint undertaking with the Community producers of nuclear electricity, and should they wish, those of the member states of EFTA, those of central and eastern countries as well as the USSR, could take part.

In this way, all interested European countries would have taken part in the conception of the reactor with the possibility of adopting identical regulations of nuclear safety and observing the same codes of construction.

Europe would then have regulations assuring irreprochable levels of safety and of quality control and only then, the european economic space , being homogeneous , will allow for free competition amongst all the suppliers of nuclear equipments (or systems) and of services.

In this direction, the Community producers of nuclear electricity have already started to make progress. They, first, established a so-called "European Economic Interest Grouping" which is intended to become an essential agent at the disposal of the Commission to perform the Community assistance to Eastern European countries for the upgrading of their Nuclear Power Systems.

The have also agreed on some form of cooperation with the view of defining common requirements for the Pressurized Water Reactor they would wish to operate from the year 2000 on. This cooperation may evolve in such a direction so that to lead to the first consistant outline of the European reference reactor wich I mentioned a little time ago.

Further progresses on the utility and industry side are expected during the next few years, as well as in the harmonization of national safety rules.

In this way, the objectives of safety and economic viability will be attainened,freely and independantly rather than by regulation. For the next century, the nuclear option will remain one option impossible to do without. With strong demographic growth predicted, coupled with economic development world-wide and its consequent need for energy, nuclear can be presented as the ideal energy source which is at the same time clean and safe to supply. The main condition is that this energy source gains public acceptance and credibility.

I have mentioned the place of safety and respect for the environment in the acceptance and use of nuclear power, but there is another vital aspect, that of nuclear non-proliferation.

In June 1990, the European Council made a Declaration on Nuclear Non-Proliferation in which it stated, inter alia, that it attaches the greatest importance to the maintenance of an effective international nuclear non-proliferation regime and will make every effort to contribute to strengthening non-proliferation and encouraging the participation of further countries in the regime. The European Council recognized that I.A.E.A. safeguards are the cornerstone of an effective non-proliferation regime and recalled the important contribution of Euratom safeguards.

The Community is a party to the Safeguards Agreements between member States and the I.A.E.A. and the Commission participated, as an Observer, in the 4th Review Conference of the Treaty on the Non-Proliferation of Nuclear Weapons, which carried out a thorough review of the implementation of that Treaty. The work done by this Review Conference was clearly of great importance.

Additionaly, as you will know, the twelve member States of the European Community have collectively adhered to the Nuclear Suppliers Group Guidelines. The Commission welcomed the fact that an informal meeting of the 26 States that adhere to these Guidelines took place in the Hague in March 1991 with a view to reinforcing the nuclear non-proliferation regime.

Energy technology cooperation

Broader international cooperation in the field of energy technology - and not only nuclear - should become a central element of energy strategies to be developed by the industrialised countries.

The development and commercial implementation of new, more effective energy technologies is a vital part of meeting the environmental and security of supply challenges which face both Japan and the European Community.

The Community has recently embarked on a new 5-year programme, to promote energy technologies in the fields of rational use of energy, renewable energy sources, solid fuels and hydrocarbons. This programme, which has an estimated financial envelope of 700 million ECUs (that is 125 billion Yen), will build on our programmes carried out over the previous decade and will draw together and coordinate the energy technology programmes of our member states.

A major new feature is a programme of associated measures to promote the commercial implementation of innovative energy technologies, using a network of 33 designated Organisations for the Promotion of Energy Technology throughout the Community. Our intention now is to extend this network outside the Community. In particular, we are trying to identify a suitable agency in Japan, to encourage a two-way flow of information on innovative energy technologies. Officials of mine have been exploring this during a recent visit to Japan.

It is clear that the problems which we face in this area are often very similar, and that cooperation together in energy technology would be mutually beneficial. It would also be in line with the agreement to cooperate reached at the EC-Japan High Level Consultations on 25-26 October 1990 in Tokyo. I therefore hope that we can take further steps to encourage this energy technology cooperation together. The development of new and renewable energies is a promising area. But clean coal technologies should also be looked at very closely.

The place of coal

The concept of an energy policy implies, indeed, that one takes into account the place of each fuel, including coal in a balanced energy mix, taking also into account the need to better protect the environment.

Coal has played and will play in the future an important role within the Community's energy policy provided a reasonable solution is found to the environmental problem. In the context of the world energy situation, geographical diversification of supply and substitution between different energy sources are of paramount importance. Coal will therefore continue to play an important role as a "regulator" of the energy markets and I am referring here both to imported coal and Community coal which have proved to be complementary.

An objective which is very important with respect to Community coal, is the development of the energy resources under satisfactory economic conditions, and hence the pursuit of efforts to improve their competitiveness.

Having said that, it is however important to add that the concept of economic viability must not be left completely to the free market. Community coal has to be part of a long term concept bearing in mind security of supply.

The efforts the Commission is undertaking with regard to the security of supply issue, should be seen in the perspective of achieving the single energy market, which will indeed contribute positively to the Community's security of supply, also for coal.

Oil policy

I have touched upon the main issues in the Community's energy policy. But i could not finish my intervention today without having some words about the future of oil after the gulf crisis.

The end of the gulf war should have brought into question whether it is desirable and possible to favour a greater stability in the international oil market and in particular in the oil price evolution.

This concern has not been a recent one. It had preoccupied many minds throughout the 1970s, and had engendered the concept of the "minimum safeguard price" by the consumer countries and had encouraged the search for an indexation formula by the producing countries.

During the 1980s, the quest for this stability which as we know had little success, brought about a recourse to the production quota formula for OPEC, whilst the consuming countries endured this defenseless against the market forces, pushing oil prices down in 1986, reaching unimaginable low levels (below 10 $/bbl).

The Gulf war has shown for the first time that a real convergence of interests can exist between the three protagonists in the oil game (producing countries, consuming countries and oil companies).

The producing countries, with OPEC's blessing, have quickly increased their production to make up for the iraki/kuwaiti deficit. The consuming countries have proven the credibility of the mechanisms for the crisis of the Community and of the IEA by exhibiting genuine solidarity and a common analysis of the situation, the oil operators finally have shown a remarkable ability to adapt to the new market conditions.

Today, the result appears in the figures. Oil prices are relatively stable and are situated at levels close to those observed prior to the crisis, that is to say in the regions of 19-20 $/bbl.

I believe that improved market stability is desirable for producing countries as well as the consuming countries and oil operators.

The challenge that lays ahead for the 1990s will therefore be to reach a greater understanding between the three main players in the oil market and to find a pragmatic approach to the stability of the oil markets which can stand the test of time.

The policies, which should be implemented after the gulf crisis by the Community, should give the main players in the oil game clear indications of our future objectives. They concern above all three levels: the political level, the market level and energy policy as such.

On the political level the Community would contribute to reinforcing dialogue between consumers and producers.

As far as the Commission is concerned it should step up the negotiation of the free exchange agreement between EEC/GCC and also the membership of the Community to the IEA.

On the industrial and market level there should be a support to the investments in upstream oil producing countries, in order to better contribute towards the functioning of the oil market. It would so develop a favourable climate for investments in the oil and gas industry in the upstream and downstream markets. In this respect, the framework of the energy charter could be of great interest for the development of better industrial relations with all the mediterranean countries.

Finaly, on the energy policies level, like the other industrialised countries, the Community should consider how to develop a coherent approach of improving security of supply and environment protection, especially concerning CO_2 through the use of fiscal instruments.

We should study maybe in the framework of the IEA, the level of emergency stocks and their possible increase and more flexible utilization.

Furthermore, the Community and the other industrialised countries should develop technical cooperation and particularly the diffusion of european technologies in the area of supply and demand in energy.

All these actions are presently being considered or already committed by the Community.

I thank you for your attention and i am at your disposal for questions you want to raise.

REMARKS BY MARVIN RUNYON, CHAIRMAN
TENNESSEE VALLEY AUTHORITY
BEFORE THE JAPANESE ATOMIC INDUSTRIAL FORUM
APRIL 8, 1991 TOKYO, JAPAN

"THE IMPORTANCE OF INTERNATIONAL COOPERATION IN WORLD ENERGY POLICY"

Thank you for that kind introduction. I'm honored to have this opportunity to address such a prestigious gathering of world experts on energy.

Since 1980 when I became president of Nissan Motor Manufacturing Corporation USA, I've been a frequent visitor to Japan. And I've continued to visit Japan during my tenure as Chairman of TVA. My most recent visits have introduced me to your electric utilities and their vendors, and I've seen for myself the impressive accomplishments of your nuclear industry.

Among the people I met during my last trip which was just last month, was Mr. Nasu, President of Tokyo Electric Power Company (TEPCO), and I feel privileged to be part of his session at today's meeting. I certainly appreciated his hospitality and his willingness to share his time and expertise with me.

Over the years, I've observed how much my countrymen have learned from your experiences, as well as how you have benefited from ours. I'm here to advocate continuing that tradition of learning from one another because I firmly believe that learning from one another is an important key in maintaining a vital mix of energy options. Our world energy future depends on having a mix of energy options, coal, nuclear, petroleum, natural gas, conservation and so on, that are readily available for individual utilities and nations to choose from, based on what most effectively meets their energy needs.

I'm a businessman, and my discussion today will provide a businessman's perspective on the practical implications of energy policy, and the importance of international cooperation in keeping our energy options open, especially the option of nuclear power.

In the next three years, TVA will have to decide how to meet a growing demand for electricity in our region. We will want to choose among a variety of energy supply options and choose the best one that meets the needs of our customers. For nuclear power to continue to be a viable option for U.S. electric utilities, including TVA, it will have to pass several tests which I will talk about later in my speech. Its chances of passing those tests are greatly improved through international cooperation and the cooperative transfer of energy-related technologies among nations.

My central point is this. Individuals and nations can learn from one another's experiences. This international learning can help us keep alive a vital mix of energy options and advance technologies for each option, so that individual nations, as well as individual utilities, can be free to choose particular energy supply approaches that make the most sense to them. Cooperation and choice are linked as key ingredients in this approach toward energy policy.

You've already heard about my background, so let me tell you a little about the organization I represent, the Tennessee Valley Authority. The Tennessee Valley Authority was created by the U.S. Congress in 1933 as part of a historic sweep of legislation known as "The New Deal" which established a number of experiments in progressive government. TVA was intended to be a federal corporation that combines the flexibility and innovation of a private company with the responsiveness and authority of a government agency. TVA has embodied this philosophy throughout its history, and as a result of its flexibility and willingness to change, TVA is now one of the few New Deal corporations still in existence.

TVA has become one of America's largest electric utilities and continues to serve a large portion of the southern United States as a regional development agency. TVA's responsibilities include the management of the 1,050-kilometer Tennessee River and its tributaries which is America's fifth-largest river system. TVA also operates the National Fertilizer & Environmental Research Laboratory which has developed 75 percent of America's fertilizer technology.

TVA's power system has a generating capacity of nearly 32,000 megawatts, making us comparable in capacity to Japan's second-largest utility, Kansai Electric Power Company. In comparison to Japanese utilities, we serve fewer people but a much larger territory. To be specific, we serve a population of about seven million people, less than one-third the number of people served by Kansai, but provide electricity for a geographic area of about 200,000 square kilometers, about half the size of Japan. Our revenues of nearly 750 billion yen a year are about one-fifth those of Japan's largest utility, TEPCO.

Like any private utility, TVA's power system is financially self-supporting and is not in any way subsidized by the federal government. One hundred percent of our revenues come from the electric rates that our customers pay.

TVA's generating facilities include 11 coal-fired, 29 hydroelectric, and four nuclear power plants with a total of nine reactor units. Two of those units are now operating, and we're loading fuel at a third.

When all of TVA's nuclear units are brought online by the end of this decade, they'll produce about 30 percent of TVA's total generating capacity. But by the year 2002, TVA projections indicate that we'll need even more capacity. That means that within the next three years, TVA will have to make one of those important choices that I talked about earlier. TVA will have to choose how to best supply its customers' future energy needs.

Adding significant new hydroelectric capacity is no longer an option because the Tennessee River system is now fully utilized. And environmental considerations may lessen the attractiveness of another coal-burning plant. As a result, TVA may be the only utility in North America to actively look at new nuclear construction as an option for meeting future energy demands.

An important consideration in TVA's decision to build a new power plant will be the competitive environment in which we operate. Competition is a new issue for TVA and for most other U.S. electric utilities. It's part of the energy policy environment in the U.S. that affects every decision a utility makes. Although TVA is a corporation owned by the U.S. government, our government status doesn't protect us from competitors. Our competitors can and do come into our service area and try to steal our customers. In this competitive environment, our customers are free to shop around for the best power deal. And last year, TVA's largest customer announced it was going to do just that.

The city of Memphis, which accounts for about 10 percent of TVA's total power sales, told us it might not renew its contract with TVA. Even though Memphis ultimately concluded that TVA was still its best choice for power, the situation reinforced the fact that we can't take our customers for granted.

And to remain competitive, TVA will have to choose its future power sources on the basis of least-cost planning. That means we will choose the energy supply option that provides the needed capacity, the least cost to our customers. For nuclear power to be competitive in a least-cost planning approach and remain a viable energy option in the United States, the costs of nuclear plant construction, as well as the costs of operation and maintenance, have to come down.

During my recent visits to Japan, I've been impressed with the efficiency and innovative approaches you've demonstrated and especially your progress in getting new units on line quickly and operating them safely. It's that kind of innovation that is needed in our country. When I was here 18 months ago, I toured TEPCO's Kashiwazaki power station where one unit was operating, four were under construction, and two more were planned. Today, three units are operating, two are under construction, and the two units planned will go under construction in August. Nothing in my country can compare to that kind of efficiency.

In the U.S., the average construction time for a new nuclear unit has been steadily increasing. The last three U.S. nuclear plants to begin commercial operation took about 15 years to build. In contrast, it takes the Japanese nuclear industry as little as four years to bring a new unit on line.

The innovative construction approaches and technologies demonstrated in this country could and should be shared with others through cooperative agreements. Such cooperative agreements and technological exchanges could help preserve nuclear power as an important option in a world-wide mix of energy sources.

The recently established World Association of Nuclear Operators (WANO) provides one avenue for sharing information and encouraging technological exchanges among electric utilities with nuclear power plants. I attended the inaugural meeting of WANO in Moscow nearly two years ago, and I know several of the people in this audience also attended. At that meeting we were all reminded just how important nuclear power is for a brighter future in nations around the world.

Many of us also traveled to Chernobyl which increased our personal awareness of our tremendous responsibility to operate nuclear plants safely and how that responsibility can be best met through international cooperation as well.

Next month, WANO will be having its second meeting. This time the meeting will be held in the U.S, . and the Chairman for this year's meeting will be familiar to all of you, Mr. Nasu. The meeting will be held in Atlanta, Georgia, which will also host the 1996 Summer Olympics, and I hope you can come to both world-class events.

Another avenue for international cooperation is through individual cooperative agreements between utilities that are facing common situations and have common interests in maintaining a mix of energy options. During my recent visits here, I've seen your technical innovations and your advancements in efficiency, I've felt the confidence that your professionals have in their technologies, and I've been impressed with their willingness to share what they have learned.

If TVA makes the decision to order a new nuclear reactor, we will want to open the doors for as much discussion and cooperation as possible. Those doors of discussion and cooperation should be open as well for other energy choices. The energy choices for an individual utility or a nation can all be sustained through international cooperation.

Let me point out the practical choices that a utility such as TVA faces and how the energy options it has to choose from can be enhanced through sharing experiences and technologies. Our options to provide future capacity for our system include oil, natural gas, coal, and of course, nuclear. Our non-generating options include conservation and buying power from other utilities.

Conservation is a necessary part of any long-term energy policy and is a vital element in a world-wide mix of energy options. It's important that we all use electricity wisely and efficiently. Industrial customers especially need to get the maximum economic gain and useful work out of every kilowatthour of electricity they buy. At TVA, we have an Internal Energy Management Program that's identified potential energy savings for our industrial customers of more than 140 million yen.

For several years, TVA participated in an international agreement through which utility engineers and executives from developing countries came to TVA to study our energy conservation techniques so they could apply them to their own utility systems, thus helping to sustain the energy conservation option in those countries.

While conservation is a vital ingredient in future load planning, it may not be enough by itself to meet future energy demands for a particular electric utility. Also, the costs of energy conservation efforts after a certain point is reached may not be the least-cost power supply option, which is now the case for TVA. As for purchasing power from other utilities, that assumes there'll be power to buy. But U.S. utilities haven't ordered any new baseload generating units in the past decade. And demand has been rising faster than expected for the past two years. As a result, this year the U.S. national capacity margin is expected to drop below 17 percent. So there might not be enough power out there to go around, and it would be reasonable to expect that available power would be sold at a premium price.

Under these conditions, one alternative exists for meeting TVA's future energy needs, and that's to add capacity. TVA's capacity options come down to basically two: fossil and nuclear. In the U.S., the principal fossil generating fuels are oil and coal. Oil is used heavily by some American utilities, especially those in the Northeast, where 35 to 40 percent of electricity is generated at oil-fired plants.

The recent Gulf War pointed out the dangers of relying too heavily on an energy source like oil, a substantial portion of which must be imported. Fortunately for TVA, less than 1/10 of one percent of our power is generated from petroleum products. Gas is an important source of clean and efficient power here in Japan, accounting for more than a third of TEPCO's output. But its high cost precludes its becoming a base load energy source for many utilities in the U.S. However, TVA might well be looking at a new gas peaking plant within the next few years.

The bulk of TVA's power, more than 70 percent during fiscal 1990, comes from coal which is abundant in the U.S. The long-term prospects for coal may be limited by its links to acid rain and the greenhouse effect. Because of recently passed Clean Air legislation, TVA may have to invest at least 170 billion yen on new pollution control technologies by the year 2000. And those technologies could increase our operating costs by at least 40 billion yen a year.

TVA is conducting research into promising pollution control technologies that might be more efficient and less costly. Our advanced fluidized bed boiler is one of the national experiments for that technology.

Japanese utilities have achieved remarkable efficiencies in pollution control. TEPCO, for example, spends about one-fourth of its total capital investment budget on measures to protect the environment. And while Japan consumes about 5 percent of the world's primary energy, it emits only 1.2 percent of its sulfur dioxide, and 2.1 percent of its nitrous oxides. With performance figures like that, I'm eager to see some of your coal-burning plants while I'm here, and technological exchanges in the area of coal burning may be just as important to our countries and others as exchanges related to nuclear power.

Nuclear power has the potential to be the safest and cleanest way to meet our future energy needs, and as I have already said, it is one of the options we'll be considering at TVA. It could be considered to be the environmental power source of choice. Even with its potential advantages, nuclear power in America has gone into a holding pattern. Its momentum has stalled. No new nuclear plants have been ordered since 1979, and at least 120 units planned have been canceled. Today, America's 112 operating reactors account for only one-fifth of the nation's electric power.

For nuclear power to expand in the U.S., for it to be a viable power supply option for electric utilities, it must pass three tests: the safety test, the economic test, and the public acceptance test. Passing the safety test is a precondition for the other two because if nuclear power in the U.S. or the world can't pass the safety test, it won't have the opportunity to pass the other two. We've all learned that safety can't be compromised. That's why safety has to be the top concern for any utility that's using or considering nuclear power.

Passing the economic test is just as important for nuclear power in the United States. If every utility executive in the U.S. believes that building a nuclear plant will run their costs so high that the utility will end up pricing itself out of the marketplace, then not one nuclear reactor will be ordered. Right now, U.S. utilities are willing to risk a capacity shortage rather than risk the economic uncertainties of building and licensing new nuclear units. There's no confidence that nuclear power can pass the economic test. That lack of confidence is due in part to a pattern of ever increasing costs of nuclear plant construction and the increasing amounts of time needed to complete a plant. Clearly, that pattern has to be broken.

Standardized construction practices in France and Japan have reduced construction times to as little as four or five years. If the U.S. nuclear industry could build a new advanced nuclear plant in five years, estimates are that the construction cost would be about half that of our most recently built units. But getting good marks on the safety and economic tests won't be enough if nuclear power fails the public acceptance test. In democratic societies, public acceptance of nuclear power is crucial.

In the U.S. we have learned how public confidence in nuclear power can be shaken by an accident at a nuclear reactor, no matter how small. In Japan, you are seeing how fragile public opinion is, following recent minor incidents. Sharing effective ways of communicating with the public about nuclear power is another area in which we all can learn from one another.

In the U.S. public opinion polls indicate that support for nuclear power may be on the upswing. A survey last year found that nearly 60 percent of Americans who considered themselves environmentalists thought that nuclear energy should play an important role in meeting America's future energy needs. And two-thirds of non-environmentalists surveyed supported nuclear power.

We need to build on that positive public opinion through a first-class effort to better educate our young people about nuclear power, and I don't think we're doing a very good job of that in the U.S.

Clearly, the safety, economic, and public acceptance tests must all be passed if the U.S. nuclear program is to break out of the holding pattern it's been in since the late 1970s. To move out of this holding pattern, the U.S. nuclear industry needs four things: a one-step licensing, standardized designs, a nuclear waste disposal program, and a bold spirit of confidence that has been lacking.

One-step licensing will ensure that the economic test can be passed by reducing the time needed to plan and construct a plant and bring it online. And it'll mean that if utilities build their plants to the original specifications, their plants will be licensed.

Standardized designs will also help nuclear power pass the economic and safety tests by speeding up licensing and construction and by increasing the ease of maintenance and operation. In addition to one-step licensing and standardized designs, a long-term national program for nuclear waste disposal is essential if nuclear power is to pass both the safety and public acceptance tests.

The technologies involved in both recycling nuclear fuel and in handling spent fuel as waste are prime candidates for appropriate transfer through international cooperation. And I firmly believe that international cooperation can boost the confidence of those in the U.S. who are in the position to advance the nuclear option in our country.

The nuclear option is vital to the energy future of our country and the world. And I truly believe that international cooperation is a key to keeping that option alive. The larger challenge for all of us is to sustain and enhance all of the world's energy options through sharing knowledge and relevant technologies on a global scale. The growing world population, with its expectations for increased economic development, will need increased energy supplies. To meet that increased demand wisely, we need to enhance our current energy technologies and invent new ones, so that energy needs can be met through choice.

Learning from others can build excitement and motivate change. I'm excited about the possibilities I see in the future for TVA and the changes that can take place through international cooperation. Everyone here today knows that we're living in a world of change, and this is especially true in the world energy arena.

The people who learn the most are those who will meet the challenge of change and succeed. Those who fail to learn will fall by the wayside. Now is the time to invent new avenues to learn from one another, to share our ideas and experiences, and to help keep every energy option we have viable. Through cooperation we can keep our energy choices healthy and vital. We can keep them in good shape so they will be available to all of us when it comes time to choose how best to meet the growing energy needs of the region we serve and the world as a whole.

I would like to thank you again for this opportunity to share my views with you. I've been very impressed with everyone I've met, I've been honored by their hospitality, and I hope we can all share a sense of challenge and excitement as this conference continues to address important energy issues that face us all.

# # #

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セッション1

激動する世界情勢とエネルギー・原子力

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Ｂ．セミョーノフ

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ソ連原子力発電・産業大臣
Ｖ．コノワロフ

２１世紀へ向けてのエネルギー戦略
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Ｊ．イーハ

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フランス電力庁副総裁
Ｒ．カール

JAPAN ATOMIC INDUSTRIAL FORUM
24th Annual Conference

THE FUTURE ROLE OF NUCLEAR ENERGY IN THE GLOBAL ENERGY BALANCE

B.A. Semenov, Deputy Director General
Head of the Department of Nuclear Energy and Safety
D. Guthrie and Y. Tatsuta
Division of Nuclear Power
Department of Nuclear Energy and Safety
International Atomic Energy Agency

THE FUTURE ROLE OF NUCLEAR POWER IN THE GLOBAL ENERGY BALANCE

Introduction

Energy demand and supply predictions for the future beyond the year 2000 should be viewed with great caution since they involve taking into consideration many variables difficult to assess. However, general trends can be more or less reliably identified.

A sound judgement on the role of nuclear power in the global energy balance within the time span of some thirty years ahead should logically be based on the consideration of, at least, the following factors:

- world energy and particularly world electricity demand trends;
- practically available sources or sources estimated to be available to meet this demand;
- major requirements these energy sources should meet;
- nuclear power potentials to meet these requirements;
- realistic assessment of present status nuclear power;
- special nuclear power related problems to be solved to fully meet the requirements.

My intention is to briefly review the items outlined above on the basis of expertise and data collected, assessed, or produced in the International Atomic Energy Agency.

World energy and particularly world electricity demand trends

It is quite clear that large-scale introduction into the global energy mix of a high-tech and rather controversial (in the light of public attitude) energy source may happen only if the world energy demand predictions would reliably demonstrate that at least for thirty years from now energy requirements in general will continue to grow, despite conservation measures in both industrialized, and in developing countries.

Predictions made at the 1989 World Energy Conference (WEC) show that between 1985 and 2020 world energy consumption would rise by 50 to 75%.

Table 1: Primary Energy Demand
(in % with base 1985)

Year	1973	1985	2000	2020
Industrialized countries	88	100	124/115	144/124
Third World	64	100	157/145	231/212
World	80	100	134/125	177/152

N.B. figures in top mean moderate case and bottom limiting scenarios
(Source: Global Energy Perspectives 2000-2020 WEC, 1989
converted from original units)

IAEA estimates for the more limited time period (1989-2005) show the following growth rates (Table 2):

Table 2: Estimates of total world energy consumption (in % base 1989) and percentage used for electricity production (in brackets):

Year	1989	1995	2000	2005
OECD countries	100 (38)	105 (42) 110 (42)	110 (45) 118 (45)	112 (49) 123 (49)
CMEA countries	100 (26)	108 (29) 112 (30)	116 (31) 121 (33)	122 (33) 129 (36)
Rest of the world	100 (23)	117 (27) 120 (28)	131 (30) 139 (33)	143 (34) 155 (39)
World total	100 (30)	109 (34) 113 (35)	118 (37) 126 (38)	124 (40) 134 (42)

N.B. The top and bottom figures are low and high estimates respectively.
(Source: IAEA Reference Data Series No. 1, July 1990 converted from original units)

Estimates of total electricity generation made by the IAEA show that it would grow at an average 3.2% - 4% annually from 11,100 TW.h in 1989 to 18,300 - 20,900 TW.h in the year 2005, with an increase by about 65% to 88% during this period.

The detailed figures of electricity generating capacity required are summarized in Table 3. In Latin American, Eastern European, African, Middle East and South Asian, and Far Eastern regions, electricity generating capacity would be almost doubled by the year 2005.

Table 3: Estimates of total electricity generating capacity [IAEA low estimates case in GW(e)]

Year	1989	1995	2000	2005
North America	871	1035	1133	1268
Latin America	159	224	285	347
Western Europe	564	616	675	731
Eastern Europe*)	477	586	676	759
Africa	73	102	131	161
Mid.East and S.Asia	142	195	243	288
S.East Asia and Pacific	75	92	107	122
Far East	365	453	551	646
World total	2725	3304	3801	4322
OECD countries	1642	1905	2098	2319
CMEA countries	468	574	662	745
Rest of the world	615	825	1041	1258

*) including USSR

(Source: IAEA Reference Data Series No. 1, July 1990 Edition)

Thus WEC and IAEA predictions correlate in forecasting the demand growth. There are also some other studies made by IEA(OECD), CEC, IIASA, Goldemberg, etc., also conforming with the major trend.

Practically available energy sources and major requirements they should meet

Consideration of means able to solve large scale world energy growth problems for the next thirty years or so, should naturally be limited to those sources and technologies already proven and economically competitive or those under development for the future and might be expected to contribute economically within the period under review.

The above condition practically limits our consideration to some well known 'conventional' sources of energy like coal, oil, gas and hydro, and to nuclear energy.

As regards the so-called alternative energy sources now in development stage (solar, wind, biomass, geothermal, tidal, and so on), with full support of their further and more intensive development, we, however, should exclude them from the list of practically available, proven, economically competitive large scale energy sources. The same World Energy Conference conclusions state that new and renewable sources of energy are estimated to meet no more than 3% of world energy demand in 2020.

To assess the potential role of remaining conventional energy sources and nuclear energy, several economical, political, environmental and social factors which may govern the decisions of energy policy makers should be considered.

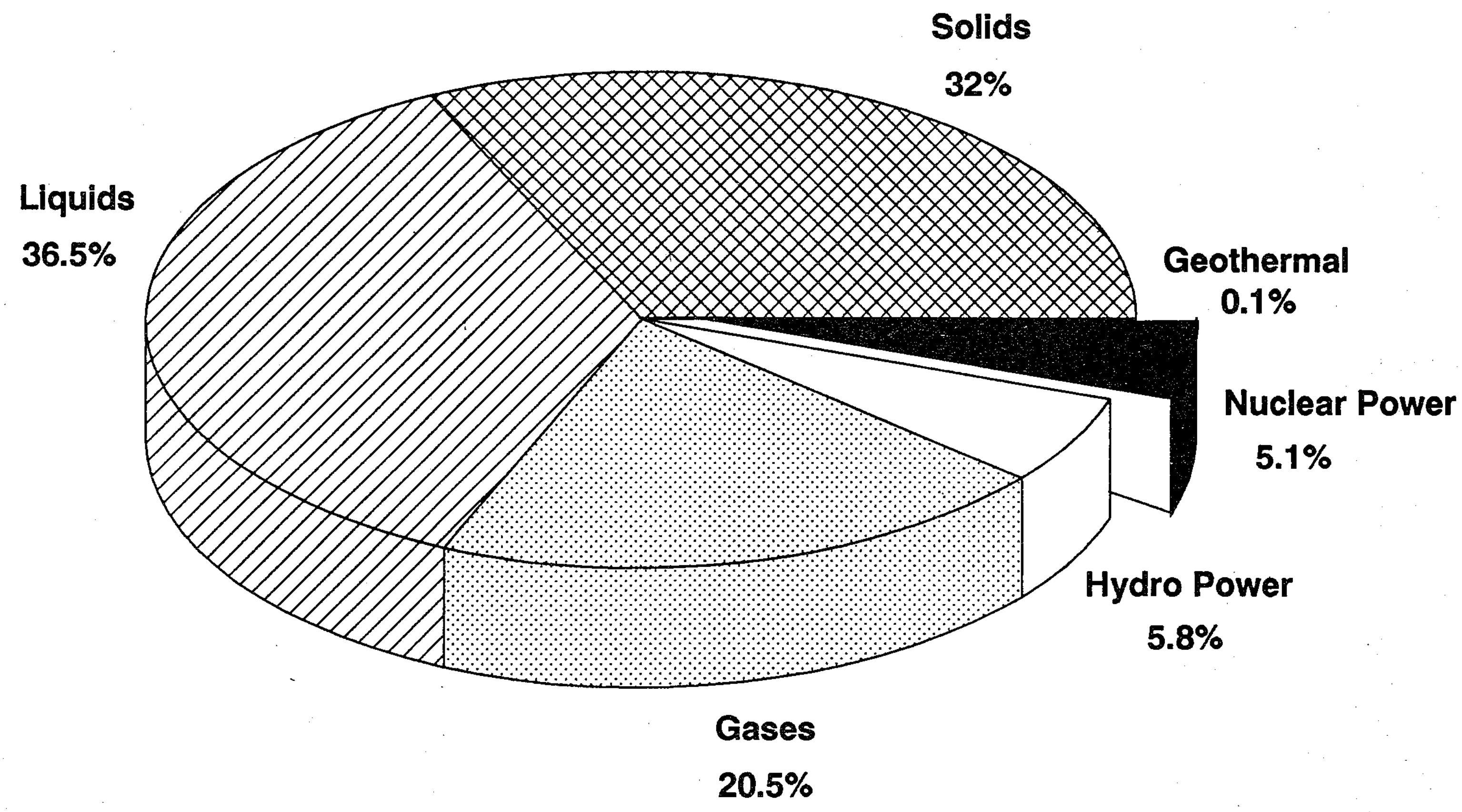
The most important of them, I believe, are:

- economical competitiveness;
- health and environmental impact;
- long-term resource availability;
- desirability of diversification of supplies;
- public acceptance.

Let us very briefly review the practically available energy sources in the light of the above mentioned factors (their role in the present energy consumption is presented in Figure 1):

- coal will be available for many centuries and will probably be economically competitive within existing environmental release requirements, but is ecologically unsound in the long term. Introduction of new sophisticated purification technologies (clean coal technologies) may significantly reduce NO_x and SO_2 releases at the same time significantly reducing economic competitiveness. But the 'greenhouse' impact would in any case remain the major negative factor; CO_2 taxes may further reduce competitiveness.

Fig. 1 **Percentage shares of total energy consumption by type of fuel during 1989**



Source: IAEA - RDS-1, 1990

- oil and gas - may be available for a number of decades with steadily increasing costs and accordingly decreasing economics, but they could and should be more efficiently used in chemical industry as feedstocks. Both are ecologically better than coal in burning. Natural gas (in CO_2 output) is better than coal by a factor of 2, but pipeline leakages of 1% - 2% may offset its advantages. Securing regular supply from far located regions may cause serious problems from time to time.

- hydro - about 60% of the world potential is already exploited (in developed countries close to 100%). Hydro is considered ecologically clean, but on deeper scrutiny not environmentally benign (impact in the storage areas, change in water flow patterns, etc.).

and, finally,

- nuclear - the resources are available for centuries (particularly with the utilization of plutonium), is economically viable, ecologically under normal operation, and can be made acceptable under accident conditions. Nuclear is practically independent of regular fuel supply problems.

Even this short overview, I believe, clearly shows that nuclear power has all the rights to be considered as at least a serious partner in the future global energy mix. Nuclear power's real potential to meet practically all the requirements listed above are very high and in some cases as we try to show later, the potential advantages of nuclear power are obvious.

However its future is still in dark clouds for many countries. What are the problems and what should be done to overcome them. To answer all these questions, let us consider a realistic assessment of the present status of nuclear power, its short term outlook and the problems nuclear power is facing.

Present status of nuclear power

Today 24 countries benefit from nuclear electricity. In addition, four other countries, e.g. China, Cuba, Iran, and Romania, have their first nuclear power plants under construction.

At the end of 1990, 423 nuclear reactors were in operation, with a total installed net nuclear capacity of 326 GW(e), amounting to 5623 reactor years of operating experience. There were also 83 nuclear reactors under construction totalling nearly 66 GW(e), mostly in the USSR - 21.2 GW(e), Japan - 9 GW(e), France - 8.3 GW(e), Czechoslovakia - 3.3 GW(e). and Romania - 3.1 GW(e). During 1990, ten new reactors were connected to electricity grids in Canada (2), France (3), Japan (2), United States (2), and USSR (1).

Table 4 shows the percentage distribution, by country, of the world's installed nuclear generating capacity as of the end of December 1990.

states belonging to the Organization of Economic Co-operation and Development (OECD) accounted for 265 GW(e), corresponding to 81.5% of world capacity in 1990, and the states which belonged to the Council for Mutual Economic Assistance (CMEA) contributed 42 GW(e), corresponding to about 13% of the total, while developing countries account for 18 GW(e) or 5.6% of the total.

Table 4: Distribution by country of the world's installed nuclear generating capacity as of 31 December 1990.

	in operation			under construction		
	No.of Units	Total MW(e)	% of capacity	No.of Units	Total MW(e)	% of capacity
States members of OECD	331	265408	81.45	26	24751	37.64
USA	112	100630	30.88	1	1165	1.77
France	56	55778	17.12	6	8305	12.63
Japan	41	30917	9.49	10	9012	13.70
Germany	26	24430	7.50	6	3319	5.05
United Kingdom	37	11506	3.53	1	1188	1.81
Canada	20	13993	4.29	2	1762	2.68
Sweden	12	9817	3.01			0.00
Spain	9	7067	2.17			0.00
Belgium	7	5500	1.69			0.00
Switzerland	5	2952	0.91			0.00
Finland	4	2310	0.71			0.00
Netherlands	2	508	0.16			0.00
States members of CMEA	62	42167	12.94	40	30438	46.29
USSR	45	34673	10.64	25	21255	32.32
Czechoslovakia	8	3264	1.00	6	3336	5.07
Bulgaria	5	2585	0.79	2	1906	2.90
Hungary	4	1645	0.50			0.00
Romania	0	0	0.00	5	3125	4.75
Cuba	0	0	0.00	2	816	1.24
Other states	30	18298	5.62	17	10571	16.08
Korea, Rep.of	9	7220	2.22	2	1900	2.89
South Africa	2	1842	0.57	0		0.00
India	7	1374	0.42	7	1540	2.34
Argentina	2	935	0.29	1	692	1.05
Mexico	1	654	0.20	1	654	0.99
Yugoslavia	1	632	0.19	0		0.00
Brazil	1	626	0.19	1	1245	1.89
Pakistan	1	125	0.04	0		0.00
China	0	0	0.00	3		3.27
Iran	0	0	0.00	2	2392	3.64
Total (*)	423	325873	100.00	83	65760	100.00

N.B. The total for 'Other states' includes 6 units in operation in Taiwan, China, accounting 4890 MW(e)

(Source: IAEA PRIS database)

In energy terms, nuclear power generated about 1,901 TW(e).h of electricity during 1990, an increase of 2.4% over 1989, and accounted for about 16% of the world's electricity production.

Figure 2 shows a historical development of nuclear electricity generation and its contribution to total electricity production since 1960. After more than 30 years of development, nuclear power is today providing a sizeable portion of the world's electricity. In the period since the first oil shock in 1973, nuclear based electricity production increased by sixfold.

However, the importance of nuclear power is very different in different countries. France is highest in the world with 75% of its electricity coming from nuclear power. Belgium generated 60% of its electricity from nuclear plants, Hungary 51%, the Republic of Korea 49%, and Sweden 45%. Ten countries now generate more than 30% of their electricity from nuclear power. (Figure 3).

Although the Chernobyl accident has drastically influenced nuclear power developments and plans in a number of countries, particularly in the USSR, in the period since the accident, some 98 GW(e) have been built up worldwide to contribute to the world electric power sector, while about 24 GW(e) have been shut down or cancelled.

Future Outlook for Nuclear Power

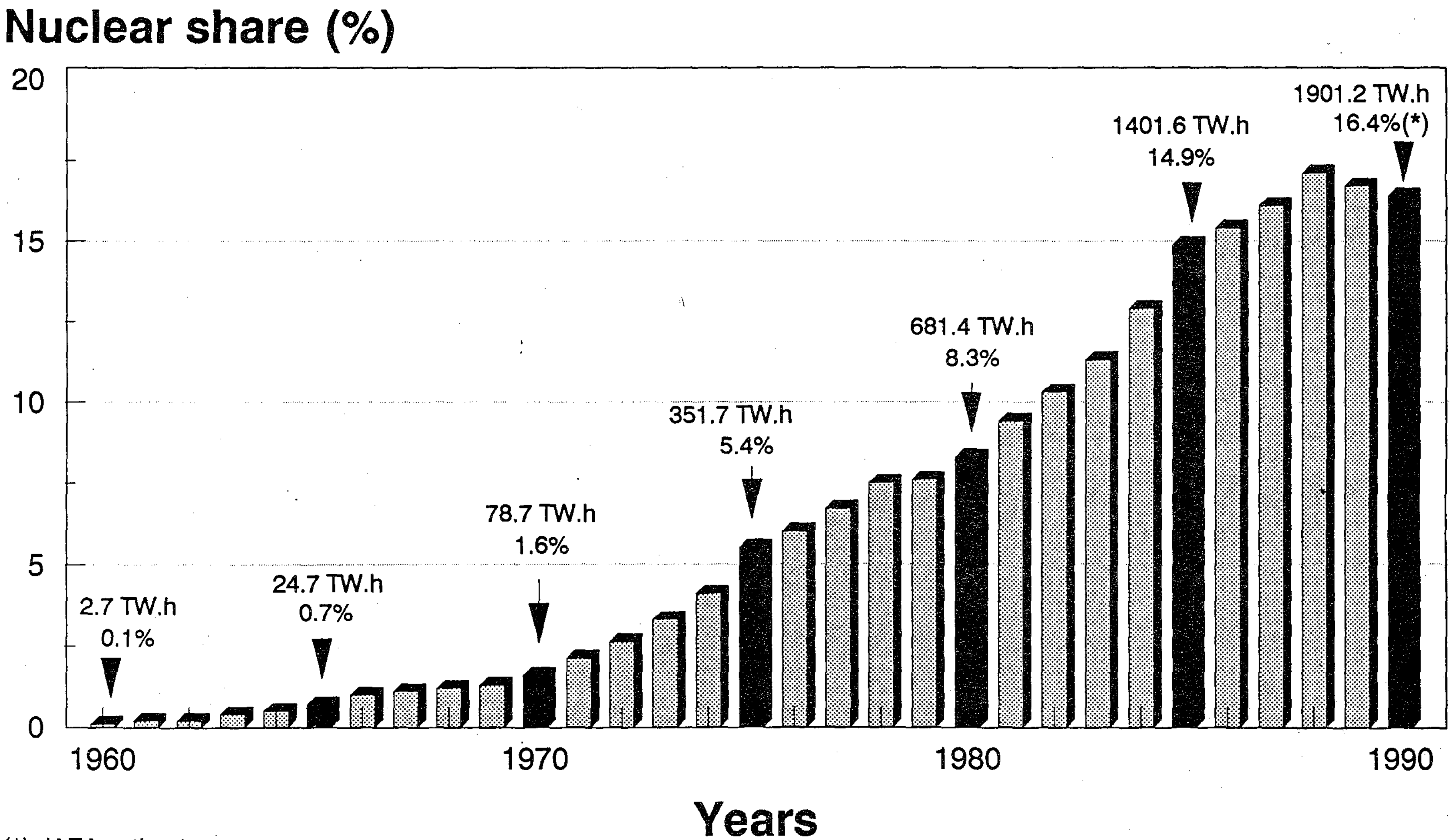
During the next ten years, growth in nuclear power will not resemble the past. Not only have the growth rates for electricity consumption in the industrialized countries declined over the past decade or more, due to either cancellation or delays in previously planned capacity additions, but also public concerns regarding nuclear power have seriously affected its growth. Thus, actual growth has consistently been lower than forecast. Due to the continuing long period for nuclear implementation, nuclear generating capacity additions in the short term (up to about the turn of the century) will largely be determined by past decisions, although construction, licensing delays, or policy changes could still have an effect. The situation after the year 2000 is less predictable but hopefully less gloomy.

The IAEA's most recent estimates of installed nuclear generating capacity and nuclear electricity up to 2005 are shown in Figure 4.

The total (low) projected increase in nuclear generating capacity from 318.3 GW(e) in 1989 to 450 GW(e) in 2005 corresponds to an average annual growth rate of 2.2% and a total increase of 132 GW(e) during this period.

During the same period, nuclear generating capacity in developing countries (here the word 'developing countries' is used to mean states which are neither OECD members nor CMEA members) is expected to reach 40 GW(e) by the year 2005, corresponding to 21.7 GW(e) of nuclear capacity additions and an average annual growth rate of 5.0%. Nuclear power in developing countries is expected to continue to gain an increasing share of electricity generation from 3.8% in 1989 to a 5% share by the year

Fig.2 **Nuclear electricity generation and share of total electrical energy for the period 1960-1990**



(*): IAEA estimate

Source: IAEA - Energy and Economic Data Bank

Fig. 3

Nuclear Share of Electricity Generation

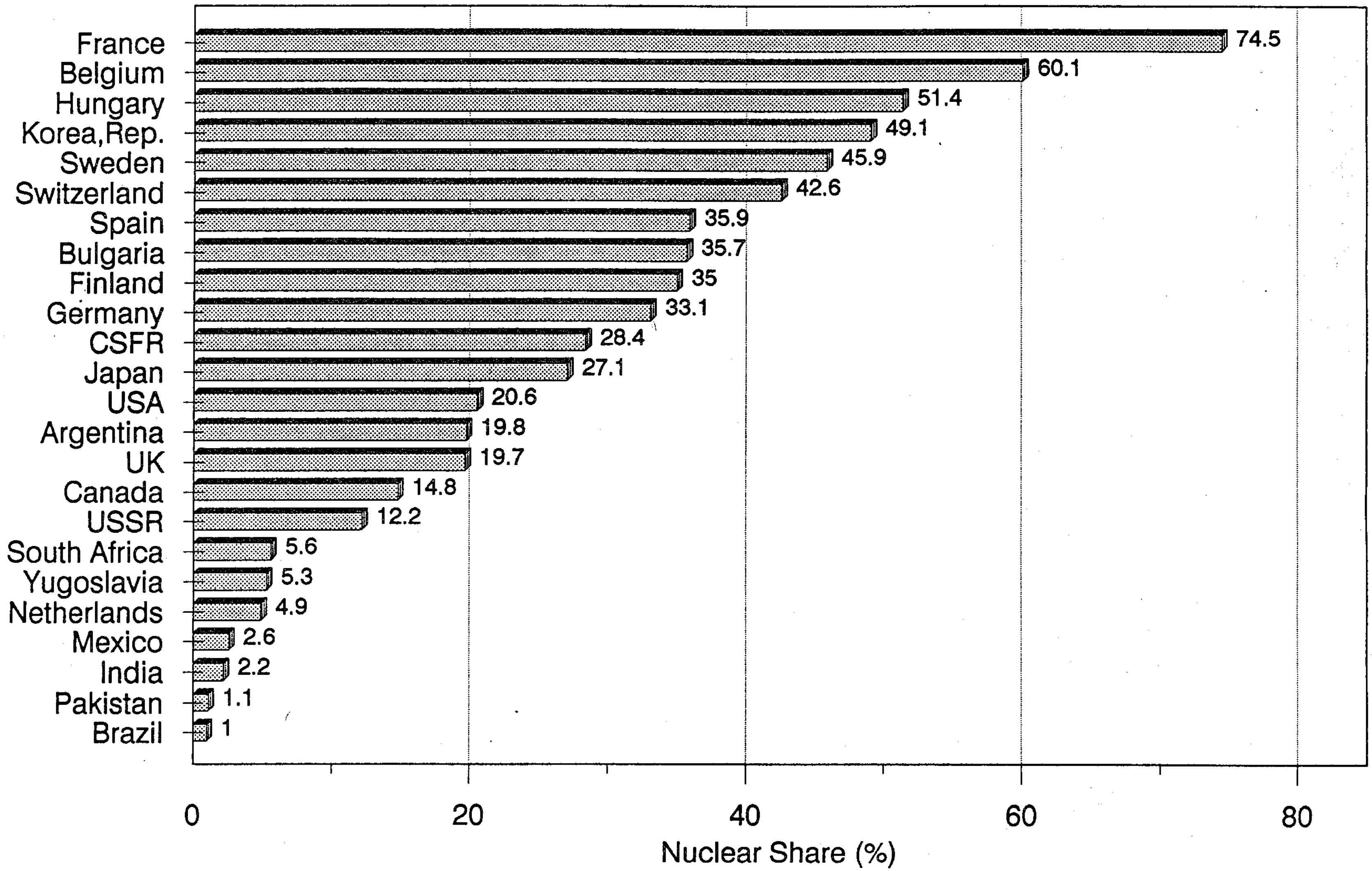


Fig. 4

Future Outlook for Nuclear Power

IAEA projection up to 2005	1989		2005			
	Capacity GW(e)	Share of total electricity (%)	Capacity addition GW(e)	Capacity GW(e)	Share of total electricity (%)	Average rate of addition (%/yr)
World Total	318	11.7	+132	450	10	2.2
			[+210]	[528]	[11]	[3.2]
Developing countries	18	3.0	+22	40	3.2	5.0
			[+43]	[61]	[3.8]	[7.9]

[ ]: indicate high growth scenario

NOI10

2005. In capacity terms, 16.5% of all new nuclear generating capacity to be placed in commercial operation in the world by the year 2005 is expected to be in developing countries.

Factors influencing nuclear power future prospects

In discussing the general factors governing the selection of energy options for the future, we have discussed high nuclear power potentials in comparison with other energy sources. We maintain that nuclear power is economically viable, ecologically clean (adding 'under normal conditions'), and can be made acceptable under accident conditions.

These and similar claims, however, may be questioned by our opponents and to turn the claims into the category of 'proofs', a lot of effort is required. Both in technically supporting and further upgrading the levels of economical competitiveness, ecological cleanliness, high reliability and safety, and in being able to convince our opponents and decision-makers of that.

a) Economics

Economics of nuclear power (as well as of other sources) is a moving target rather than a granted advantage. IAEA and OECD/NEA's recent joint assessment (presented in Figure 5) show that, inspite of a number of well known factors, contributing to the increased cost of nuclear power, it is still highly competitive in a number of countries. However, its competitiveness is closely dependent upon such well known factors as time of licensing and construction, degree of standardization and possibility of serial introduction to say nothing of interest rates and costs of competitive fuels. Therefore, to maintain and further improve the economic competitiveness of nuclear power, further steps should be undertaken, particularly in such institutional areas as licensing and taxes.

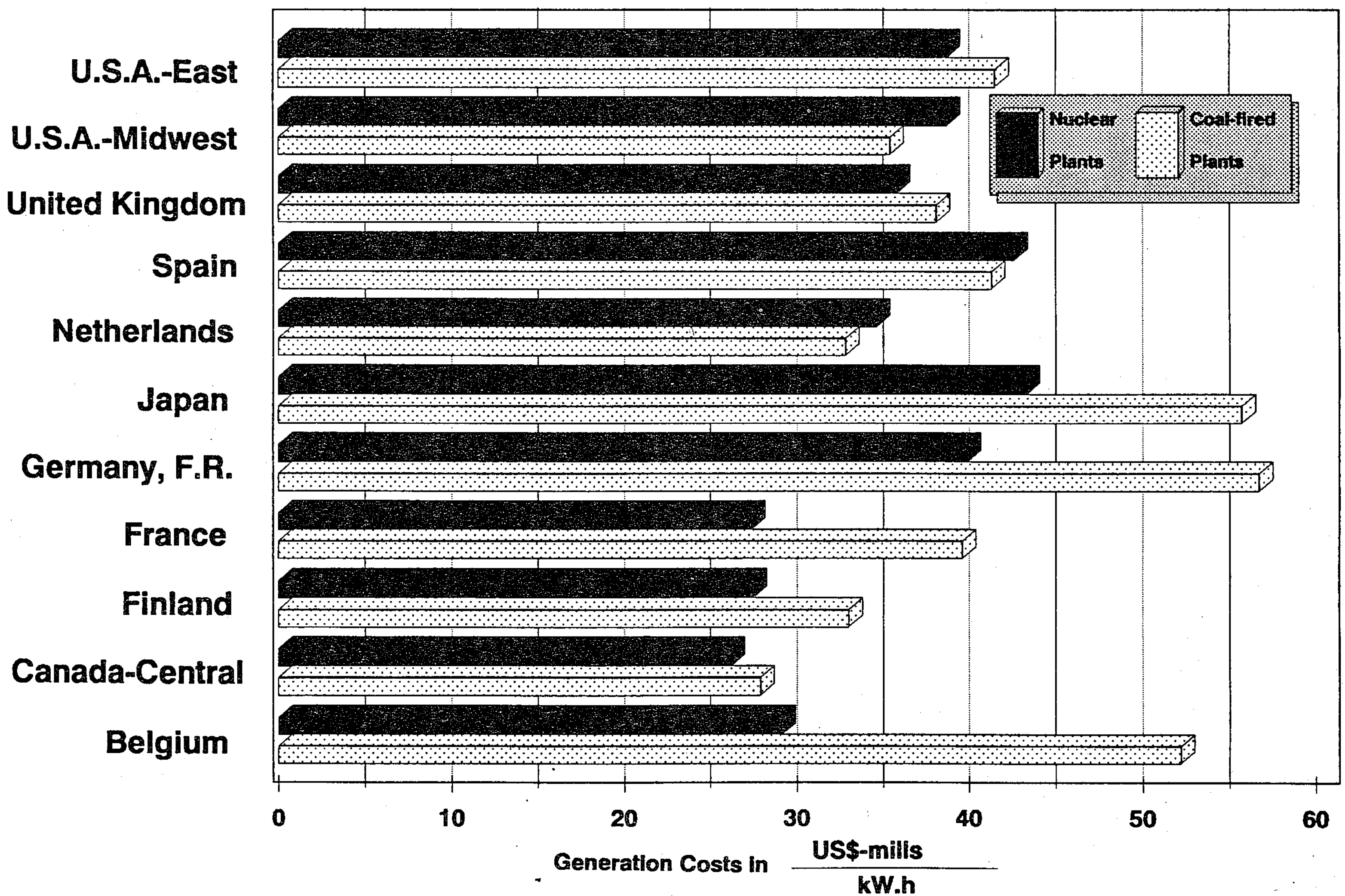
The developments now under way, particularly in the field of so-called advanced reactors, based on proven technologies give us good perspectives for the near future to get easily licensable, simpler, safer and cheaper reactors. The natural trend of gradually increasing oil and gas costs with the depletion of resources will also work to benefit nuclear.

b) Environmental impact

One cannot separate the economics of energy and the environmental consequences resulting therefrom. Environmentally friendly, competitive, and commercially viable energy sources may be an oxymoron. A cost-benefit analysis of the various options available for use may well find that, of those costs and benefits that are quantifiable, the one energy source that will give the most for the least is nuclear power. The Intergovernmental Panel on Climate Change (IPCC), created by the UN Environment Program (UNEP) and the World Meteorological Organization (WMO) was formed in 1988 to provide a scientific assessment, impacts assessment, and elucidate response strategies to global warming. Its final report, produced in 1990, has now served as the platform from which international

Fig. 5

Comparative Costs of Electricity from Coal-fired & Nuclear Power Plants



Source: Joint Study by IAEA and OECD/NEA/IEA negotiations have commenced to prepare a framework convention on global warming. For the energy sector, 'low and non-CO_2 emitting' energy sources are the preferred means. Nuclear power is not explicitly mentioned although in background documents its does appear. Since its inception, the IAEA has been involved in the IPCC, especially in response strategies, to present factual information on nuclear power and to place it in perspective with other energy sources.

As we already discussed, there are now only two energy sources which are technically and economically proven on a large scale and which can produce large amounts of energy without adding significantly to CO_2, NO_x or SO_2 emissions. These are hydropower and nuclear power. For hydropower, there is still an undeveloped potential, in particular in developing countries, and this should certainly be used where environmental concerns can be met. In industrialized countries, there is a limited exploitable potential left. Nuclear power is seen as one of the most feasible sources now available to generate electricity in the quantities needed and without producing greenhouse gases. Although significant opposition to nuclear power exists in many countries, and deliberate attempts are made in some countries to ignore it, it will not go unnoticed if energy demand increases, and as the search goes on for means of restraining CO_2 emissions that nuclear-powered electricity generation is a very substantial source of CO_2-free energy and that the potential for an expansion of this source exists.

Nuclear power is already helping to avoid additional CO_2. Were the electricity currently produced by nuclear to have been produced by coal instead, it would have resulted in approximately 2 billion tons annually of additional CO_2. In an analysis prepared for the IPCC, the IAEA assumed two post-2000 growth paths for nuclear power of 40 and 60 GW/yr respectively. The analysis was not a forecast, but rather a hypothesis: given political will, what would be the amount of CO_2 avoided should one pursue one or the other path. Table 5 shows the results of this exercise:

Table 5: Potential CO_2 emissions avoided as a result of a business as usual and an accelerated nuclear development path (in million tons of Carbon)

	1988	2000	2010
Business-as-usual *)			
CO_2 avoided	438	660	870
Percentage reduction **)	21%	21%	21%
Case 1 (+40 GW/yr) ***)			
CO_2 avoided	438	660	1270
Percentage reduction **)	21%	21%	30%
Case 2 (+60 GW/yr) ***)			
CO_2 avoided	438	660	1590
Percentage reduction **)	21%	21%	38%

*) Nuclear power is introduced at a rate keeping its percentage in the energy mix constant at 1988 level.
**) Relative to total emissions that would result if nuclear were replaced by coal
***) after the year 2000.

The implications of this analysis are that by the year 2010, the assumed addition of nuclear power could have avoided some 30-38% of the CO_2 emissions compared with the case if coal had been used instead.

Since it is almost certain that despite all the measures taken in some, unfortunately limited, countries, the world environmental situation will continue to deteriorate at least up to the end of the century. The chances that environmental considerations will play an ever increasing role in the decision on energy options would again favour a nuclear choice.

c) Nuclear safety and radioactive waste problem

The TMI and particularly the Chernobyl accidents have sharply increased the attention of people and governments to the safety of nuclear power operations.

Notwithstanding all convincing advantages of nuclear power described above, nuclear power has certain chances of not surviving as a significant energy source for the future, if we cannot prove that it is safe enough both under normal and accidental conditions.

The problem of what is 'safe enough' is a problem for specialists, but even more so for the public, which has to get used to the acceptable risk and comparable risk approaches.

Already in the early 1970's, the IAEA served as an instrument for building an international consensus on safety standards and practices, and has updated these standards to reflect current thinking, experience gained, and major advances in the state of the art.

While standards and regulations are indispensable to ensure nuclear safety, equal attention must be paid to operational safety of the 423 nuclear power plants in operation today in the world, and of the 83 plants that will soon be put into operation. In this regard, to assist its Member States, the Agency has been offering several safety-related services, such as the OSART programme, review operational safety of nuclear power plants, and ASSET programme, to assess safety significant events.

The technical causes and phases of the Chernobyl accident were analyzed in detail under the auspices of the IAEA in 1986, and the Agency has since been continuously engaged in various studies concerning the accident.

An important international project corroborating existing data and assessing the current radiological situation, individual and collective doses, environmental contamination and clinical health effects and evaluating the protective measures taken after Chernobyl will be completed in May 1991. Over a hundred international experts in different fields from 24 countries and 6 international organizations, in addition to the IAEA, have visited affected areas and thousands of measurements have been taken. The purpose, of course, is not only to obtain as accurate an assessment as possible, but also, when such an assessment is made, to help identify the most appropriate responses. The results will be presented for international scientific discussion on 21 - 24 May 1991.

In order to strengthen nuclear safety worldwide, a conference is being organized by the Agency in September 1991 to discuss the next phase of international co-operation. After the Chernobyl accident in 1986, an expanded nuclear power safety programme was launched in the IAEA and many new activities were embarked upon. It is felt that the time has come not only to assess what has been accomplished but also to map the road to be taken in the future. Even though ultimate responsibility for nuclear power safety remains vested in the governments of the countries in which the nuclear activity is taking place, safety is at the same time considered a question of international concern.

Figure 6 summarizes the major nuclear safety tasks the nuclear community is facing to secure further expansion of nuclear power development.

Both national and international efforts should be strengthened to fill the gap between technology status and public awareness of it. The major steps should include experimental confirmation of reliability and safety of different waste disposal aspects and particularly those supporting validity of scientific long-term predictions. The very fact of actual operation of a prototype waste disposal repository would be very important.

The Agency has recently initiated new activities in the preparation of safety standards and guides for safe long-term storage of spent fuel, as well as for waste management and disposal of high activity wastes (RADWASS programme).

d) Non-proliferation consideration

There is one more nuclear power specific consideration which, if not understood correctly, may be used by opponents as an argument against further expansion of nuclear power.

This consideration arises from the concern that proliferation of power reactors means proliferation of nuclear weapons.

Let me remind you that the Atoms for Peace programme which contributed to the creation of the IAEA within the UN system was based on the philosophy that nuclear technology, material and equipment would be made available under commitments that they would only be used for peaceful purposes. The IAEA's safeguards system has been created and put into operation to verify these commitments.

Although the Agency's route did not become the major one in the world transfer of commercial nuclear technology, the signing of the NPT in 1968 made use of the Agency's Safeguard System for verification of voluntary NPT signatories (137 countries today) that all their nuclear activity is for peaceful purposes only. Some 90% of all fissionable material outside

Fig. 6

Nuclear Safety

Major Tasks

- Assure safe operation of existing reactors
- Develop advanced modification of power reactors
- Develop next generation reactors with passive safety features
- Further enhancement and harmonisation of safety standards
- Broaden & deepen international cooperation

IAEA is engaged in OSARTs, IWGs, NUSS, INSAG, etc.

nuclear-weapon states is now under IAEA safeguards. The fears which were common a quarter of a century ago that many additional states would acquire nuclear weapons have not materialized.

The years past clearly demonstrated that adherence to the NPT gives in exchange for non-proliferation obligations full rights and opens wide possibilities for access to world peaceful nuclear technology. Recent developments in Latin America and Africa provide further evidence of the importance of NPT adherence.

The entire 50 year history of nuclear development clearly shows that nuclear weapons capability has never resulted from peaceful nuclear power development. Just the opposite has been the case, broad deployment of peaceful nuclear power objectively requires broad international co-operation, broad transfer of nuclear technology which today is only possible in the framework of the non-proliferation regime with verification of peaceful use commitments by means of IAEA safeguards.

Conclusion

The availability of energy is essential for the world economy. The demand for energy has been increasing at a rate of 3% since 1986, in comparison with the stagnated growth of energy at around 1% a year after the second oil crisis in 1979 which was largely due to energy efficiency measures. Current predictions show that despite all conservation measures, world energy demand will rise over the next thirty years by 50-75%.

Electricity is a preferred end-use form of energy for both developing and industrialized countries due to its convenience, efficiency and overall versatility. Increasing demand for electricity is thus the logical future development, and it is clear that it will assume growing importance in the future.

Based on the long term prospects of world energy and electricity demand, the need to diversify energy sources to reduce the world's dependency on oil especially from sources in the Middle East, together with global environmental evolution, nuclear power will remain and even enhance its position as an important element both in the world energy supply mix and in global environmental protection.

The Chernobyl accident heightened public concern on nuclear risks and has had a profound influence on nuclear programs worldwide. The public wishes to be involved in deciding the key directions of policy development, especially in regards to nuclear development. Energy decisions, while never the sole domain of governments, are coming under increasing public scrutiny. Future development of nuclear energy will depend, to a considerable extent, on the nuclear community's efforts in reducing the public concerns and restoring their confidence in nuclear energy. In this regard, the ability to explain to the public why nuclear power is needed and to clarify the main features of this particular technology is much more important than before.

As an international co-operation organization, the Agency will continue to play an instrumental role in assisting Member States in planning optimal energy and electricity systems, with due consideration of the global energy security and environmental protection issues.

PRIMARY ENERGY DEMAND

(in % with base 1985)

	1973	1985	2000 (*)	2020 (*)
Industrialized countries	88	100	124/115	144/124
Third world	64	100	157/145	231/212
World	80	100	134/125	177/152

(*): values represent moderate case / limiting scenarios respectively

Source: Global Energy Perspectives 2000-2020 WEC, 1989

②

Estimates of total world energy consumption (in % with base 1989) and percentage used for electricity production (in brackets).

	1989	1995	2000	2005
OECD countries	100 (38)	105 (42)	110 (45)	112 (49)
		110 (42)	118 (45)	123 (49)
CMEA countries	100 (26)	108 (29)	116 (31)	122 (33)
		112 (30)	121 (33)	129 (36)
Rest of the world	100 (23)	117 (27)	131 (30)	143 (34)
		120 (28)	139 (33)	155 (39)
World Total	100 (30)	109 (34)	118 (37)	124 (40)
		113 (35)	126 (38)	134 (42)

N.B. The top and bottom figures are low and high estimates.

Source IAEA Reference Data Series No. 1, July 1990.

3

Estimates of total and nuclear electricity generating capacity

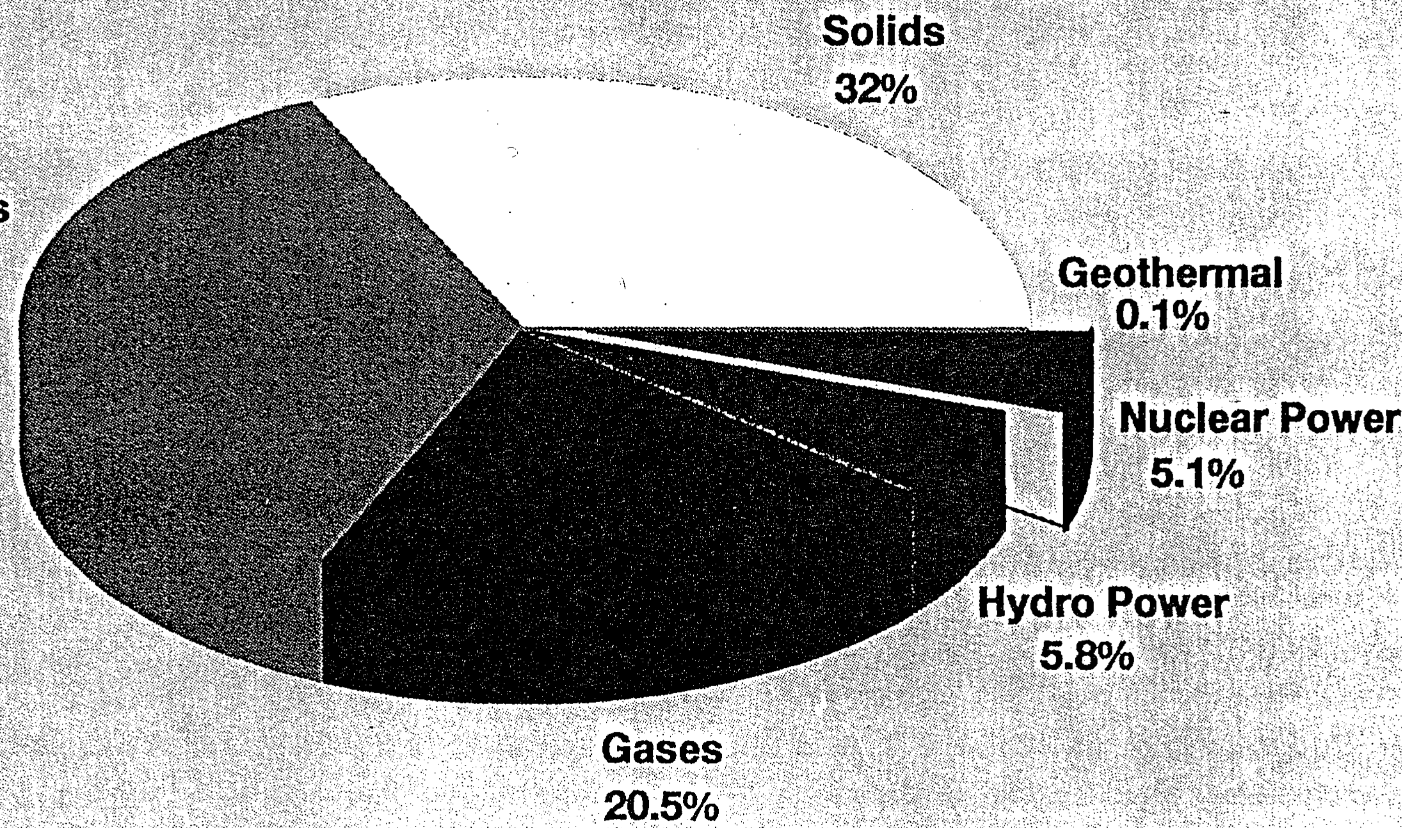
(IAEA low estimates case in GW(e))

	1989 GW(e)	1995 GW(e)	2000 GW(e)	2005 GW(e)
North America	871	1035	1133	1268
Latin America	159	224	285	347
Western Europe	564	616	675	731
Eastern Europe	477	586	676	759
Africa	73	102	131	161
Mid. East/South Asia	142	195	243	288
SE Asia/the Pacific	75	92	107	122
Far East	365	453	551	646
World Total	2725	3304	3801	4322
OECD countries	1642	1905	2098	2319
CMEA countries	468	574	662	745
Rest of the World	615	825	1041	1258

Source: IAEA RDS NO.1, 1990 edition.

(4)

Percentage shares of total energy consumption by type of fuel during 1989



Source: IAEA - RDS-1, 1990

(5)

Status of Nuclear Power

As of 31 December, 1989

In Operation	426 Reactors	318,000 MW(e)
Under Construction	96 Reactors / 19 Countries	79,000 MW(e)
Operating Experience	5201 Reactor Years	
Number of Countries	27	
Electricity Supplied	1855 TW(e).h	17% (of Total)
Construction Starts	5 Reactors	4740 MW(e)
Grid Connections	12 Reactors	10400 MW(e)
Cancelled/Suspended	2 Reactors	880 MW(e)

nucst1

(6)

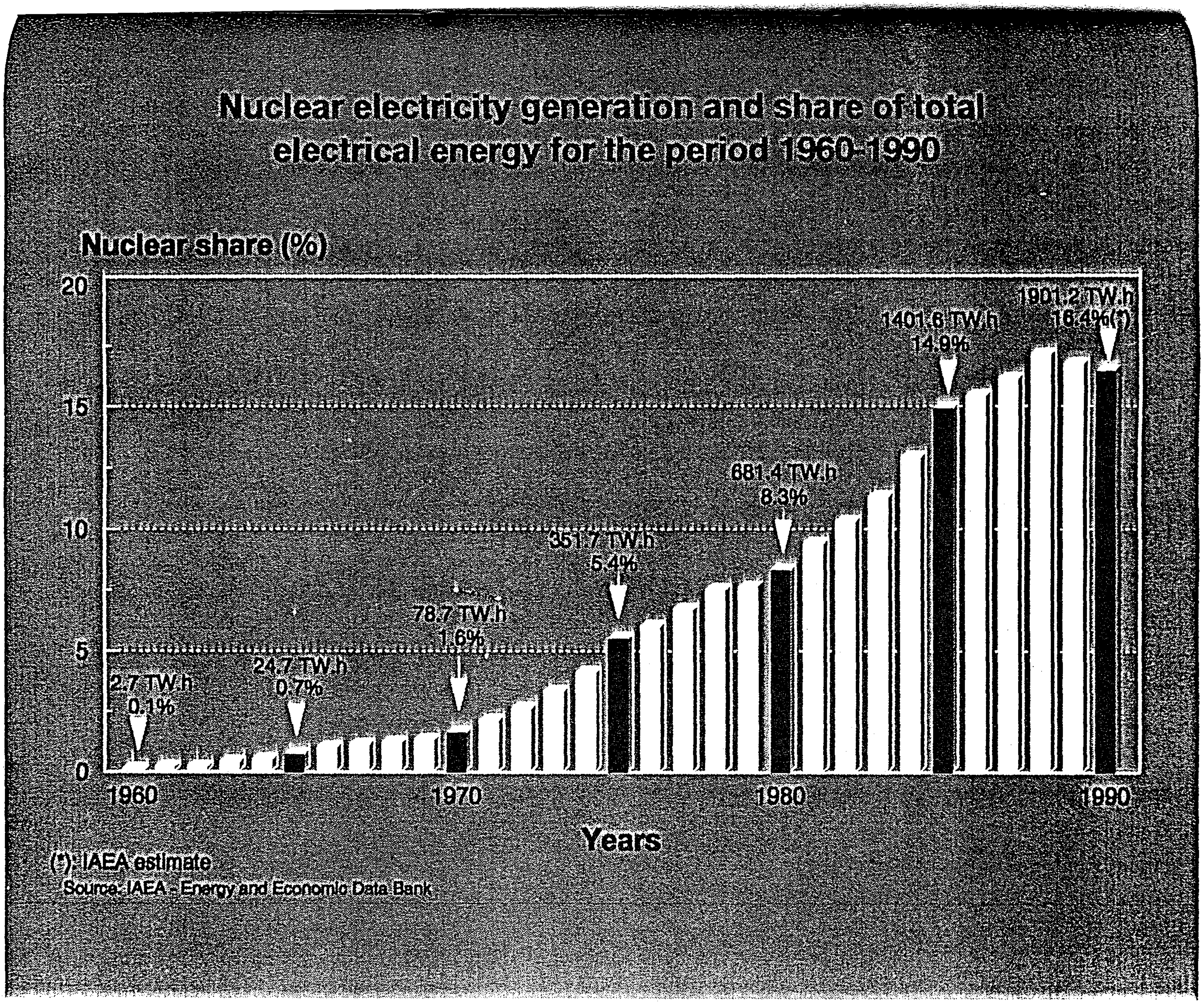
Distribution by country of the world's installed nuclear generating capacity as of 31 December 1990

	In operation			Under construction		
	No of Units	Total MW(e)	% of capacity	No of Units	Total MW(e)	% of capacity
States Members of OECD	331	265,408	81.45	26	24,751	37.64
USA	112	100,630	30.88	1	1,165	1.77
France	56	55,778	17.12	6	8,305	12.63
Japan	41	30,917	9.49	10	9,012	13.70
Germany	26	24,430	7.50	6	3,319	5.05
United Kingdom	37	11,506	3.53	1	1,188	1.81
Canada	20	13,993	4.29	2	1,762	2.68
Sweden	12	9,817	3.01			0.00
Spain	9	7,067	2.17			0.00
Belgium	7	5,500	1.69			0.00
Switzerland	5	2,952	0.91			0.00
Finland	4	2,310	0.71			0.00
Netherlands	2	508	0.16			0.00
States Members of the CMEA	62	42,167	12.94	40	30,438	46.29
USSR	45	34,673	10.64	25	21,255	32.32
Czechoslovakia	8	3,264	1.00	6	3,336	5.07
Bulgaria	5	2,585	0.79	2	1,906	2.90
Hungary	4	1,645	0.50			0.00
Romania	0	0	0.00	5	3,125	4.75
Cuba	0	0	0.00	2	816	1.24
Other States	30	18,298	5.62	17	10,571	16.08
Korea, Rep. of	9	7,220	2.22	2	1,900	2.89
South Africa	2	1,842	0.57	0		0.00
India	7	1,374	0.42	7	1,540	2.34
Argentina	2	935	0.29	1	692	1.05
Mexico	1	654	0.20	1	654	0.99
Yugoslavia	1	632	0.19	0		0.00
Brazil	1	626	0.19	1	1,245	1.89
Pakistan	1	125	0.04	0		0.00
China	0	0	0.00	3	2,148	3.27
Iran	0	0	0.00	2	2,392	3.64
TOTAL	423	325,873	100.00	83	65,760	100.00

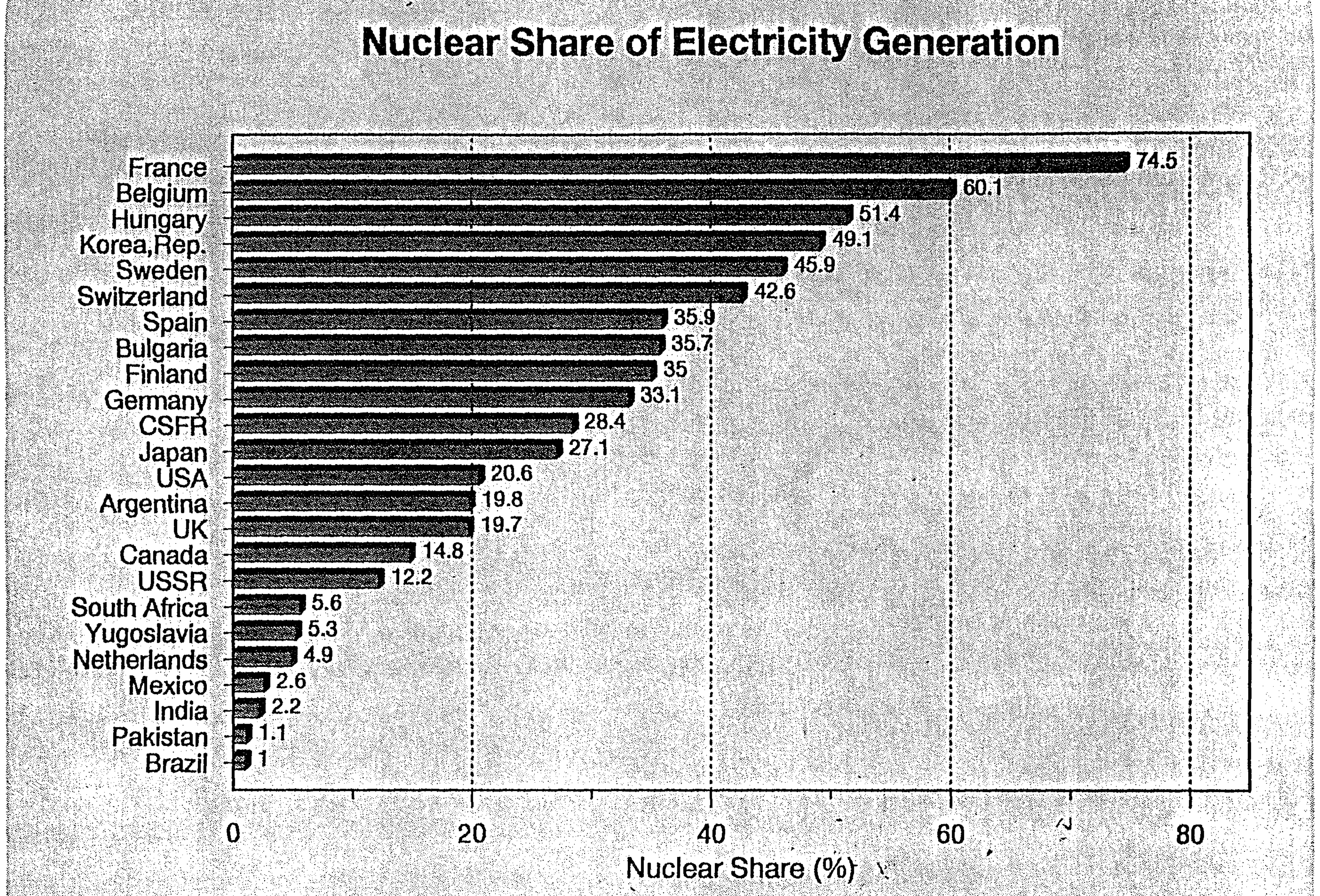
Note: The total for "other States" includes 6 units in operation in Taiwan, China, accounting 4890 MW.

Source: IAEA PRIS database

(7)


Nuclear electricity generation and share of total electrical energy for the period 1960-1990
Nuclear share (%)
20
15
10
5
0
2.7 TW.h
0.1%
24.7 TW.h
0.7%
78.7 TW.h
1.6%
351.7 TW.h
5.4%
681.4 TW.h
8.3%
1401.6 TW.h
14.9%
1901.2 TW.h
16.4%(*)
1960
1970
1980
1990
Years
(*): IAEA estimate
Source: IAEA - Energy and Economic Data Bank

(8)


Nuclear Share of Electricity Generation
France
Belgium
Hungary
Korea,Rep.
Sweden
Switzerland
Spain
Bulgaria
Finland
Germany
CSFR
Japan
USA
Argentina
UK
Canada
USSR
South Africa
Yugoslavia
Netherlands
Mexico
India
Pakistan
Brazil
74.5
60.1
51.4
49.1
45.9
42.6
35.9
35.7
35
33.1
28.4
27.1
20.6
19.8
19.7
14.8
12.2
5.6
5.3
4.9
2.6
2.2
1.1
1
0
20
40
60
80
Nuclear Share (%)

9

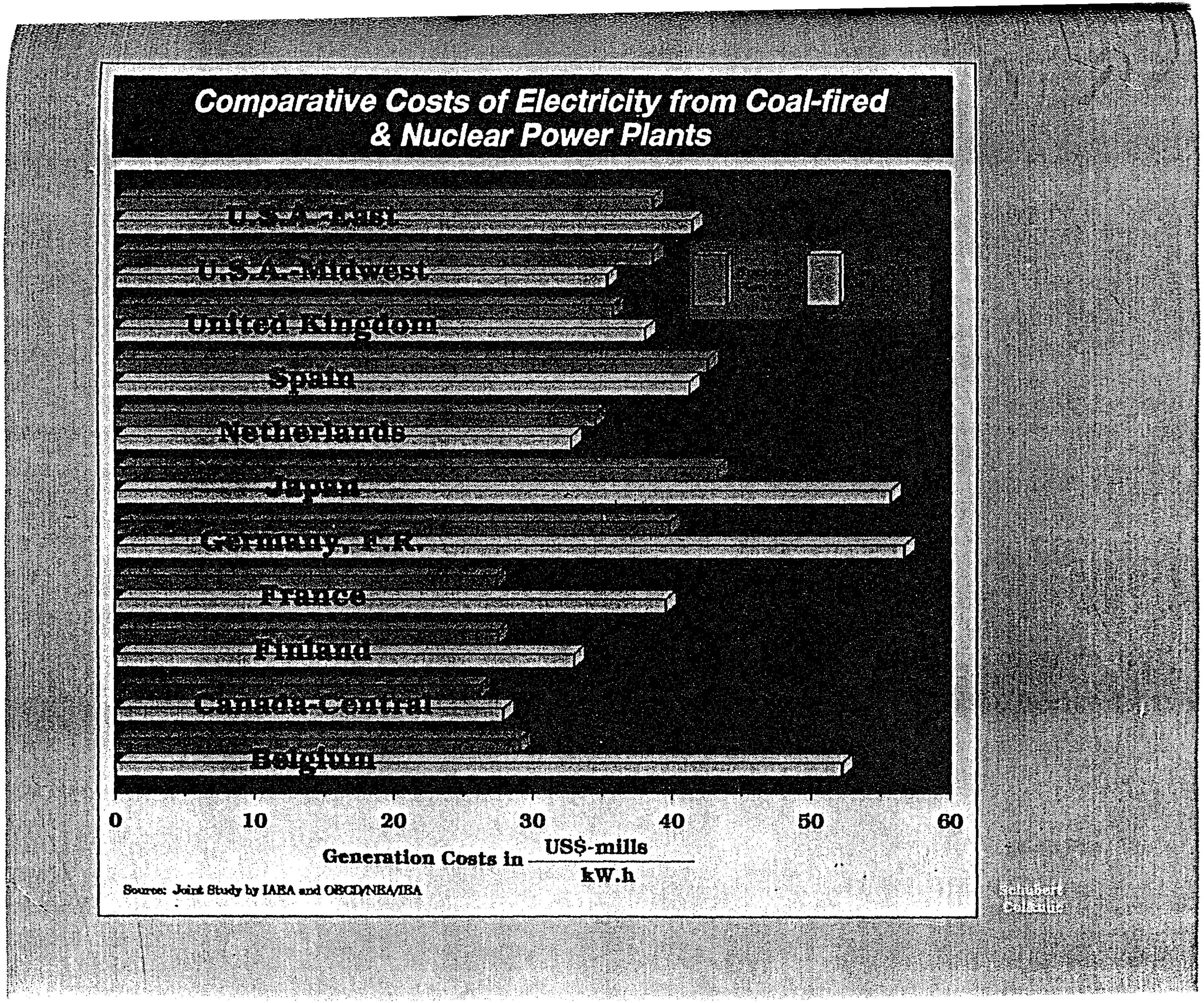
Future Outlook for Nuclear Power

IAEA projection up to 2005

	1989		2005			
	Capacity GW(e)	Share of total electricity (%)	Capacity addition GW(e)	Capacity GW(e)	Share of total electricity (%)	Average rate of addition (%/yr)
World Total	318	11.7	+132 (+210)	450 (528)	10 (11)	2.2 (3.2)
Developing countries	18	3.0	+22 (+43)	40 (61)	3.2 (3.8)	5.0 (7.9)

( ) indicate high growth scenario

10


Comparative Costs of Electricity from Coal-fired & Nuclear Power Plants
U.S.A.-East
U.S.A.-Midwest
United Kingdom
Spain
Netherlands
Japan
Germany, F.R.
France
Finland
Canada-Central
Belgium
0
10
20
30
40
50
60
Generation Costs in US$-mills / kW.h
Source: Joint Study by IAEA and OECD/NEA/IEA

(11)

Potential CO2 emissions avoided as a result of business as usual and an accelerated nuclear development path

(millions of tons of Carbon)

	1988	2000	2010
Business as usual(*)			
CO2 avoided	438	660	870
Percentage reduction (relative to total emmissions that would result if nuclear were replaced by coal)	21%	21%	21%
Case 1 (+40 GW/yr) (**)			
CO2 avoided	438	660	1270
Percentage reduction (relative to total emmissions that would result if nuclear were replaced by coal)	21%	21%	30%
Case 2 (+60 GW/yr) (**)			
CO2 avoided	438	660	1590
Percentage reduction (relative to total emmissions that would result if nuclear were replaced by coal)	21%	21%	38%

(*): Nuclear power is introduced at a rate keeping its percentage in the energy mix constant at 1988 level.

(**): after the year 2000

(12)

Nuclear Safety

Major Tasks

- Assure safe operation of existing reactors
- Develop advanced modification of power reactors
- Develop next generation reactors with passive safety features
- Further enhancement and harmonisation of safety standards
- Broaden & deepen international cooperation

IAEA is engaged in OSARTs, IWGs, NUSS, INSAG, etc.

НАСТОЯЩЕЕ И БУДУЩЕЕ АТОМНОЙ ЭНЕРГЕТИКИ И ПРОМЫШЛЕННОСТИ В СССР

В.Ф. Коновалов

В настоящее время в Советском Союзе атомная энергетика, несмотря на ее относительно небольшую долю, играет значительную роль. Прежде всего потому, что ее вклад в производство электроэнергии в промышленно развитых регионах страны значителен и составляет: 33,1% по объединенной энергетической системе (ОЭС) Северо-Запад, 22,7% по ОЭС Украины, 21,7% по ОЭС Центра и 16,7% по ОЭС Волги. Кроме этого, если рассматривать общее количество находящихся в эксплуатации в СССР в настоящее время энергоблоков на атомных электрических станциях (АЭС) и их суммарную мощность, то по этому показателю СССР находится на третьем месте в мире после США и Франции.

В СССР на 1 января 1991 года на 15 АЭС эксплуатировалось 46 энергоблоков общей мощностью 36 560 мВт (э), на которых в 1990 году было выработано 211,5 млрд. квт. час. электроэнергии, что составляет 12,5% от общего производства электроэнергии в стране.

Говоря о производстве электроэнергии в стране в целом, следует отметить, что около 70% ее вырабатывается на тепловых электростанциях (ТЭС), сжигающих уголь, нефть и газ; около 18% производится на гидроэлектростанциях.

Анализируя возможности развития энергетики в СССР в ближайшее время, следует сказать, что в европейской части страны вряд ли можно ожидать существенного увеличения энергопроизводства на угольных ТЭС. Уже сегодня среднее расстояние транспортировки топлива из восточных районов в центральные и на Урал составляют около 4 тыс. км, а в общем объеме грузооборота перевозки топлива составляют 40%. Кроме того, экологически вредное воздействие угольных ТЭС и высокие капиталовложения, необходимые для его снижения до приемлемого уровня в густонаселенных районах европейской части СССР, ставят угольные ТЭС в неконкурентноспособные условия в этом регионе.

Затраты на добычу нефти по прогнозам резко возрастут уже к 2000 году в 1,5-1,8 раза, а к 2010 году - в 2-2,5 раза, поэтому уже в ближайшие годы использование нефтепродуктов в качестве котельного топлива станет также экономически неоправданным.

Конечно, наличие крупных месторождений природного газа ставит Советский Союз 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 АЭС и ТЭС в европейской части страны.

Однако и в этом случае следует учитывать, что средняя дальность передачи газа увеличилась с 530 км в 1956-60 годах до 2400 км в настоящее время, причем тенденция роста расстояния продолжает оставаться.

Таким образом, с точки зрения экономики преимущественное развитие ядерной электроэнергетики в европейской части представляется обоснованным.

Следует также учитывать то, что развитие топливно-энергетического комплекса должно исходить не только из экономических, но и экологических требований и быть социально приемлемо для соответствующих районов размещения энергоисточников и общества в целом.

Что касается электроэнергетики на органическом топливе, то выбросы (сбросы) загрязняющих веществ при работе ТЭС настолько значительны, что это приводит к хорошо известным последствиям не только в локальном и в региональном плане, но и в глобальном масштабе. К последнему относится изменение теплового баланса Земли из-за выбросов углекислого газа и пыли.

Ядерная же энергетика лишена ряда недостатков, характерных для органического топлива: аэрозолей и необратимого потребления кислорода из окружающей среды. Нет выбросов токсичных химических веществ, для реакции деления урана не требуется кислород. Радиоактивное загрязнение окружающей среды, а также возможная доза облучения населения для безаварийно работающей

АЭС намного ниже установленных санитарно-гигиенических пределов.

Таким образом, как с экономической, так и с экологической точек зрения мы приходим к выводу о необходимости использования атомной энергии в СССР и ее дальнейшего развития, особенно в европейской части страны.

Для того, чтобы правильно понять сегодняшнее состояние как атомной энергетики, так и обеспечивающей ее промышленности в СССР, а также возможности их дальнейшего развития, следует обратиться к истории.

Как известно, к концу 60-х годов в СССР была уже выполнена широкая научная программа поиска наиболее оптимальных для страны типов энергетических реакторов, способных обеспечивать производство электроэнергии в крупных промышленных масштабах. Основу советской ядерной энергетики составили два типа реакторов. Один из них - это наиболее распространенный сегодня в мире реактор с водой под давлением, впервые примененный ядерными державами на подводных лодках. Другой - водо-графитовый реактор, имеющий несомненное родство с промышленными реакторами, использовавшимися в ряде стран для производства плутония. Следует заметить, что выбор второй реакторной концепции для развития энергетики обосновывался трудностями крупномасштабного производства тяжелого энергетического оборудования, в частности, корпусов для водо-водяных реакторов.

Промышленность, обеспечивающая топливный цикл атомной энергетики, создавалась в стране для решения оборонных задач и представляла развитую отрасль, которая включала: добычу и производство природного урана; производство гексафторида урана и разделение его изотопов; производство топливных сборок; радиохимическую переработку отработавшего ядерного топлива.

Следует также добавить, что до чернобыльской аварии необходимость преимущественного развития атомной энергетики мало у кого вызывала сомнения.

В связи с этим энергетической программой Советского Союза, объявленной в начале 80-х годов, предусматривалось:

- быстрое наращивание мощностей атомной энергетики с доведением к 2000 году мощностей АЭС до 190000 мВт с выработкой на на них 1100 млрд. квт. ч. электроэнергии при общем объеме ее производства в стране 2700 млрд.квт.ч.;
- принципиальное расширение сферы использования атомной энергетики за счет внедрения ее в промышленное и бытовое теплоснабжение;
- энергичное развитие реакторов-размножителей на быстрых нейтронах с целью долговременного обеспечения топливом атомной энергетики;
- создание ядерных энергетических установок малой мощности для отдаленных и труднодоступных районов, а также развитие гражданского атомного судостроения.

Основываясь на этой программе, в стране были начаты реконструкция и создание новых мощностей обеспечивающей промышленности.

Пуск в эксплуатацию крупнейшего в стране завода тяжелого машиностроения (Атоммаш, г. Волгодонск) является примером развития намеченной программы. Это производственное объединение оснащено всем необходимым оборудованием для изготовления изделий высокой категории сложности весом до 600 т.

С учетом программы, а также исходя из оптимальных объемов производства и времени, необходимого на его организацию, осуществлялось соответсвующее наращивание мощностей и предприятий топливного цикла.

Таким образом, к середине 80-х годов сложилась развитая инфраструктура атомной энергетики и промышленности. Результатом явился ввод в действие в 1981-1985 годах 17 энергоблоков общей мощностью 15800 мВт. В этот период в СССР был создан и освоен самый крупный в мире энергоблок мощностью 1500 мВт с реактором РБМК-1500. Развернуты работы по сооружению первых энергоблоков на атомных станциях теплоснабжения.

Чернобыльская авария внесла существенные коррективы в ядерноэнергетическую программу СССР. В обществе быстро нарастала острая оппозиция не только дальнейшему развитию атомной энергетики, но и эксплуатации действующих АЭС.

Первым результатом такого подхода стало резкое сокращение планов ввода новых электрогенерируюших мощностей. За последнее время на разных стадиях строительства и проектирования приостановлены работы на площадках атомных станций общей мощностью более 100000 мВт. Вскоре после землетрясения была выведена из эксплуатации Армянская АЭС.

Однако следует отметить, что в последнее время в ряде регионов страны началось изменение общественного мнения в пользу атомной энергетики. Это дает основание полагать, что трезвый подход возобладает. В качестве примера можно привести решения Советов народных депутатов Воронежской, Курской, Мурманской, Челябинской, Семипалатинской, Восточно-Казахстанской, Чимкентской областей о строительстве новых энергоблоков общей мощностью более 12000 Мвт.

Происходящие изменения в стране, безусловно, внесли коррективы в энергетическую программу и реально в период 1991-1995 гг. возможно осуществить ввод 7000 мВт. установленной мощности, а в следующем пятилетии - 12600 мВт. В этом случае к 2000 году суммарная мощность АЭС в стране составит 57000 мВт без учета вывода АЭС из эксплуатации. На этапе после 2000 года прогнозируется повышение темпов строительства АЭС из расчета - обеспечить к 2010 году наращивание установленных мощностей до 100000-150000 мВт с учетом вывода из эксплуатации блоков, исчерпавших свой ресурс. Окончательные решения еще не приняты. Они будут отражены в национальной энергетической программе с учетом необходимости увеличения резерва мощностей в энергосистеме страны, замены отработавших энергоблоков и с учетом структурных изменений, происходящих в народном хозяйстве.

Строительство АЭС в предстоящее десятилетие будет осуществляться в, основном, с энергоблоками ВВЭР-1000 по проекту с улучшенными характеристиками безопасности. На действующих и строящихся в настоящее время АЭС максимально внедряются решения, заложенные в указанный проект.

После 2000 года строительство АЭС предполагается осуществлять по проектам серийных блоков нового поколения повышенной безопасности типа ВВЭР-92, ВВЭР-500 и ВПБЭР-600, БН, реализуемым к 2000 году с учетом приемственности и накопленного положительного опыта.

Таким образом, в стратегии развития ядерной энергетики, удовлетворяющей требованиям приемлемого риска, можно выделить два характерных этапа:

- 1990-2000 г.г. можно рассматривать как "реновационный" этап, на котором происходит обновление энергомощностей с повышением безопасности и незначительным ростом суммарной мощности ядерной энергетики;

- 2000-2010 г.г. - как этап с интенсивным ростом мощностей на основе блоков новых поколений с улучшенной экономикой и повышенным уровнем безопасности.

В связи с тем, что первый этап характеризуется незначительным суммарным ростом мощности АЭС, атомная промышленность СССР, расчитанная на реализацию энергетической программы, о которой говорилось выше, в настоящее время имеет существенные резервы.

Это позволяет провести модернизацию ряда производств в ядерном топливном цикле и перейти к новым технологиям, обеспечивающим лучшую сохранность окружающей среды и более комплексное использование урановых руд. Имеющиеся в настоящее время в СССР технологии позволяют попутно извлекать на гидрометаллургических заводах молибден, рений, скандий, ванадий, золото, редкоземельные и другие ценные элементы.

При добыче урана широко внедряется прогрессивный метод по подземному выщелачиванию. Этот метод позволяет разрабатывать запасы бедных урановых руд, залегающих на различной глубине и в сложных горно-геологических условиях. Планируется увеличение добычи урана этим методом до 40-50% к 1995 году. С учетом возможности использования ранее накопленных запасов урановой руды, сырьевой потенциал отрасли позволяет в настоящее время обеспечить потребности АЭС суммарной мощностью около 100000 мВт, включая и мощности производства по разделению изотопов урана. Причем следует отметить, что газовые центрифуги составляют основу разделительных мощностей страны.

В СССР принята концепция замкнутого топливного цикла, которая предусматривает переработку отработавших топливных элементов. Это обеспечивает комплексное использование ценных компонентов и, в конечном итоге, получаем наименьшее количество отходов для захоронения. У нас уже работает один завод по переработке отработавших элементов и строится второй. Отечественный опыт доказал экономическую целесообразность выбранной концепции.

Второй этап развития атомной энергетики в СССР увязывается с созданием нового поколения атомных реакторных установок и станций, являющихся логическим продолжением отечественного реакторостроения, в котором в полной мере учтен имеющийся опыт и реализуются технические средства "управления аварией". Вероятность серьезного повреждения активной зоны не превысит 10-5 на год эксплуатации блока станции при реализации сформулированных сегодня принципов безопасности.

По мнению советских специалистов, идеология повышенной безопасности реакторных установок включает следующие положения:

- наличие внутренней самозащищенности ректоров (достигается за счет внутренних отрицательных обратных связей активной зоны);

- преимущественное использование пассивных средств для защиты и аварийного расхолаживания, не требующих подвода энергии извне и вмешательства оператора;

- необходимое резервирование средств защиты и расхолаживания;

- представительное обоснование достаточности запроектированной системы защитных барьеров на пути возможного распространения радиоактивных продуктов при максимальных проектных и гипотетических (физически возможных) авариях;

- наличие информационной поддержки и защиты от ошибки оператора.

Впервые указанные выше принципы были реализованны при проектировании атомных станций теплоснабжения с реактором АСТ-500, что позволило разместить их в непосредственной близости от городской черты городов Нижнего Новгорода и Воронежа.

Экспертная комиссия МАГАТЭ, рассмотревшая проект АСТ для г. Нижнего Новгорода и состояние строительно-монтажных работ, подтвердила высокий уровень безопасности АСТ-500, новизну и обоснованность использованных технических решений.

Другим важным аспектом, обеспечивающим реализацию второго этапа развития атомной энергетики, является решение проблемы обращения с радиоактивными отходами.

Разработанная в нашей стране и ныне рассматриваемая государственная техническая политика в этой области предусматривает комплексное решение проблемы обращения с радиоактивными отходами на действующих, строящихся и проектируемых объектах, начиная с нормирования образования отходов, их сбора, регистрации и учета, транспорта, временного хранения, технологии подготовки к длительному хранению и окончательному захоронению, предусматривая при этом надежную изоляцию радиоактивных отходов от биосферы.

Самые большие величины по объему имеют отходы низкой и средней активности. Тем не менее, по этим видам отходов, пожалуй, нет принципиальных проблем ни технологических, ни экономических. В СССР, как и в других странах, разработаны и созданы процессы уменьшения объема упариванием, компактированием, сжиганием различных видов отходов и отверждением их (цементированием, битумированием) с обеспечением достаточно малой степени выщелачивания: не более 10-3-10-4 г/см2 сутки. Отработана технология захоронения таких отходов в изолированные приповерхностные, заглубленные хранилища, которые обеспечивают изоляцию радиоактивности от экосистемы.

Основным и наиболее сложным делом в практике обращения с радиоактивными отходами является обращение с высокоактивными отходами. Ситуация с этим видом отходов различна для стран, имеющих атомную энергетику, в зависимости от выбранного ими подхода к переработке отработавшего топлива.

У нас в стране создана технология остекловывания высокоактивных отходов и ведется работа по использованию других матриц (минералоподобных и искусственных минералов) для включения в них высокоактивных отходов после извлечения урана и плутония из продуктов радиохимической переработки. Технология остекловывания проверена на опытно-промышленной установке и планируется, что она будет использоваться постоянно, начиная с этого года.

Учитывая, что при обращении с высокоактивными радиоактивными отходами приходится иметь дело с радионуклидами, период полураспада которых исчисляется десятками тысяч лет и более, в СССР разрабатываются методы фракционирования, позволяющие отделить такие радионуклиды от основной массы продуктов деления с периодом полураспада несколько десятков лет перед их отверждением. Это дает возможность не только использовать в народном хозяйстве многие изотопы, содержащиеся в высокоактивных отходах, но и создать соответствующие хранилища для каждой из фракций. Причем фракции отвержденных отходов, содержащие в своем составе Sr-90, Cs-137, редкоземельные элементы и другие продукты деления с периодом полураспада 30 лет, могут надежно захораниваться. Что касается фракций, содержащих долгоживущие радиоактивные элементы, требующие для полного распада десятки и сотни тысяч лет, то они также могут храниться в хранилищах с организацией возможности извлечения их оттуда в случае необходимости. Наиболее перспективным вариантом обращения с высокоативными отходами является их трансмутация. В результате ядерных реакций, вызываемых при облучении таких отходов потоком нейтронов порядка 1018 нейтронов/см2 сек., можно получить 99,9% короткоживущих изотопов, которые после выдержки в два-три года можно окончательно захоранивать как среднеактивные в глубинные геологические формации. В Советском Союзе ведутся такие работы.

С проблемой обращения с радиоактивными отходами непосредственно связан вопрос о снятии АЭС с эксплуатации.

Основным направлением исследований является разработка технологии и плана производства работ по выводу из эксплуатации конкретных АЭС, обобщение полученных технико-экономических результатов.

Здесь следует ожидать обоснованных рекомендаций в части оптимизации компоновочных и строительных решений, ответов на вопрос о повторном использовании зданий и сооружений по прямому назначению.

Современные АЭС были спроектированы без четко разработанной технологии их демонтажа. В связи с этим в СССР сейчас ведутся работы по поиску путей решения этой проблемы. Для того, чтобы снять остроту проблемы и уменьшить число снимаемых с эксплуатации блоков АЭС на определенном интервале времени, осуществляется комплекс работ по продлению срока службы их основного оборудования. Так, например, успешно проведены работы по отжигу корпуса реактора с водой под давлением.

Все сказанное выше позволяет заключить, что расширенное внедрение атомной энергетики в СССР предполагает решение целого ряда технических проблем, в значительной степени характерных и для других стран.

В этой связи исключительно важное значение имеет деловое международное сотрудничество. Коллективный путь решения крупных проектов и проблем уже апробирован в мире. Примером тому может служить МАГАТЭ, важная, авторитетная организация, активно содействующая развитию научно-исследовательских работ в различных областях науки и техники и решающая политические проблемы с целью использования энергии атома только в интересах мира.

Трудно перечислить все программы, в которых участвуют советские специалисты. Вот только некоторые из них: реакторные компоненты и системы, технология ядерного топлива, обращение с отработавшим топливом, взаимодействие "человек-машина" в атомной энергетике, методы вероятностной оценки риска, работа с общественностью.

Специалисты СССР совместно со специалистами Финляндии и Швеции ведут совместный мониторинг загрязнения Балтийского моря. Непосредственно связаны с обсуждаемыми вопросами и проблемы восстановления загрязненных территорий в результате ядерной деятельности в прошедшие годы и в результате таких аварий, как аварии в Чернобыле и в Кыштыме. Даже простой обмен опытом по ликвидации последствий этих аварий, по нашему мнению, был бы очень полезен. Следует отметить такое важное событие, как начало работы международного Центра под эгидой МАГАТЭ в Чернобыле.

С японскими научными и промышленными организациями благодаря Японскому атомно-промышленному форуму вот уже в течение многих лет ведется плодотворное сотрудничество в области энергетических реакторов, безопасности АЭС, переработке радиоактивных отходов. Мы надеемся на расширение и углубление нашего двустороннего сотрудничества с Японией, в том числе и в экономической области. Для этого есть все основания, поскольку международная специализация и кооперирование производства - эффективный способ освоения современных технологий и решения задач, финансирование которых затруднительно одному государству.

Так, например, реализуются проекты Европейского быстрого реактора, Международного экспериментального термоядерного реактора. Как следует из моего доклада, советским специалистам есть что внести в качестве вклада в такую кооперацию и сотрудничество. Уже говорилось о проектах реакторов средней мощности 500 и 600 мВт, атомных станций теплоснабжения, которые могли бы представлять интерес для некоторых стран.

Важным элементом нашего участия в международном сотрудничестве и кооперации является предоставление услуг в области ядерного топливного цикла. До недавнего времени в этой области нами оказывались только услуги по обогащению урана, производство топлива для АЭС, построенных с помощью Советского Союза. Недавно наша страна вышла на мировой рынок с предложением о продаже природного и обогащенного урана. Учитывыая избыточность мощностей наших производств, мы заинтересованы в значительном и долгосрочном объеме участия на этом рынке, реализуя как потенциал производственных мощностей, так и наши передовые технологии переработки и извлечения урана.

В период 1991-1995 годов наши возможности по продаже урана на внешнем рынке составляют не ниже 5 тысяч тонн в год природного урана в виде закиси-окиси.

При увеличении спроса на уран на мировом рынке мы сможем увеличить наши предложения. Общие запасы урана в СССР, по данным геологоразведки, на сегодняшний день оцениваются в 2 млн. тонн, причем 735 тыс. тонн из них со стоимостью добычи менее 60 долларов США за 1 кг урана.

Центрифужная технология разделения изотопов урана позволяет предложить иностранным партнерам, наряду с долгосрочными сделками, краткосрочные контракты, а в случае необходимости - контракты на одну поставку. Проведенные испытания подтвердили пригодность центрифужной технологии для обогащения регенерированного урана и производства продукта, пригодного для производства топлива.

Советский Союз открыт в настоящее время для делового сотрудничества в области мирного использования атомной энергии со всеми странами и международными организациями. Мы убеждены, что только совместный поиск путей развития взаимовыгодного сотрудничества, таких, как промышленная кооперация и совместное предпринимательство, двусторонее экономическое и научно-техническое сотрудничество, будут способствовать дальнейшему накоплению знаний в области ядерной физики и практическому их применению.

НАСТОЯЩЕЕ И БУДУЩЕЕ АТОМНОЙ ЭНЕРГЕТИКИ И ПРОМЫШЛЕННОСТИ В СССР

В.Ф. Коновалов

В настоящее время в Советском Союзе атомная энергетика, несмотря на ее относительно небольшую долю, около 12% в общем производстве электроэнергии в стране, играет значительную роль. Прежде всего потому, что ее вклад в производство электроэнергии в промышленно развитых регионах страны гораздо выше и составляет в важнейших объединенных энергетических ситемах (ОЭС) следующие величины: 33,1% по ОЭС Северо-Запад, 22,7% по ОЭС Украины, 21,7% по ОЭС Центра и 16,7% по ОЭС Волги. Кроме этого, если рассматривать общее количество находящихся в эксплуатации в СССР в настоящее время энергоблоков на атомных электрических станциях (АЭС) и их суммарную мощность, то по этому показателю СССР находится на третьем месте в мире после США и Франции.

В СССР на 1 января 1991 года на 15 АЭС эксплуатировалось 46 энергоблоков общей мощностью 36 560 Мвт (э), на которых в 1990 году было выработано 211,5 млрд. квт. час. электроэнергии, что составляет 12,5% от общего производства электроэнергии в стране.

Говоря о производстве электроэнергии в стране в целом, следует отметить, что подавляющая ее доля, около 70%, вырабатывается на тепловых станциях, сжигающих уголь, нефть и газ; около 18% производится на гидро- электростанциях.

Анализируя возможности развития энергетики в СССР в ближайшее время, следует сказать, что в европейской части страны вряд ли можно ожидать существенного увеличения энергопроизводства на угольных ТЭС. Уже сегодня среднее расстояние транспортировки топлива из восточных районов в центральные и на Урал составляют около 4 тыс. км, а в общем объеме грузооборота перевозки топлива составляют 40%. Кроме того, экологически вредное воздействие угольных ТЭС и очень высокие капиталовложения, необходимые для его снижения до приемлемого уровня в густонаселенных районах европейской части СССР, ставят угольные ТЭС в неконкурентноспособные условия в этом регионе.

Затраты на добычу нефти, по прогнозам, резко возрастут уже к 2000 году в 1,5-1,8 раза, а к 2010 году - в 2-2,5 раза в связи с исчерпанием разрабатываемых месторождений. Поэтому уже в ближайшие годы использование нефтепродуктов в качестве котельного топлива станет также экономически неоправданным.

Конечно, наличие крупных месторождений природного газа ставит Советский Союз 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 АЭС и ТЭС в европейской части страны.

Однако и в этом случае следует учитывать, что средняя дальность транспортировки газа увеличилась с 530 км в 1956-60 годах до 2400 км в настоящее время, причем, тенденция роста продолжает оставаться.

Таким образом, с точки зрения экономики преимущественное развитие ядерной электроэнергетики в европейской части кажется обоснованным.

Следует также учитывать то, что развитие топливно-энергетического комплекса должно исходить не только из экономических, но и экологических требований и быть социально приемлемо для соответствующих районов размещения энергоисточников и общества в целом.

Что касается электроэнергетики на органическом топливе, то выбросы (сбросы) загрязняющих веществ при работе ТЭС настолько значительны, что это приводит к хорошо известным последствиям не только в локальном и в региональном плане, но и в глобальном масштабе. К последнему относится изменение теплового баланса Земли из-за выбросов углекислого газа и пыли.

Ядерная же энергетика лишена недостатков энергетики на органическом топливе: аэрозолей и необратимого потребления кислорода из окружающей среды. Нет выбросов токсичных химических веществ, для реакции деления урана не требуется кислорода. Радиоактивное загрязнение окружающей среды, а также возможная доза облучения населения для безаварийно работающей АЭС намного ниже установленных санитарно-гигиенических пределов.

Таким образом, как с экономической, так и с экологической точек зрения мы приходим к выводу о необходимости использования атомной энергии в СССР и ее дальнейшего развития, особенно в европейской части страны.

Для того, чтобы правильно понять сегодняшнее состояние как атомной энергетики, так и обеспечивающей ее промышленности в СССР, а также возможности их дальнейшего развития, следует немного обратиться к истории.

Как известно, к концу 60-х годов в СССР была уже выполнена широкая научная программа поиска наиболее оптимальных для страны типов энергетических реакторов, способных обеспечивать производство электроэнергии в крупных промышленных масштабах. Основу советской ядерной энергетики составили два типа реакторов. Один из них - это наиболее распространенный сегодня в мире реактор с водой под давлением, впервые примененный ядерными державами на подводных лодках. Другой - оригинальный советский водо-графитовый реактор, имеющий несомненное родство с промышленными реакторами, использовавшимися в ряде стран для производства плутония. Следует заметить, что выбор второй реакторной концепции для развития энергетики обосновывался трудностями крупномасштабного производства тяжелого энергетического оборудования, в частности, корпусов для водо-водяных реакторов.

В том же что касается промышленности, обеспечивающей топливный цикл атомной энергетики, то эта промышленность создавалась в стране для решения оборонных задач и к тому времени представляла из себя развитую отрасль, которая включала добычу и производство природного урана; производство гексафторида и разделение изотопов урана; производство топливных сборок; радиохимическую переработку отработавшего ядерного топлива.

Следует также добавить, что до чернобыльской аварии необходимость преимущественного развития атомной энергетики мало у кого вызывала сомнения.

В связи с этим энергетической программой Советского Союза, объявленной в начале 80-х годов,предусматривалось:

- очень быстрое наращивание мощностей атомной энергетики с доведением к 2000 году мощностей АЭС до 190 Гвт с выработкой на на них 1100 млрд. квт. ч. электроэнергии при общем объеме ее производства в стране 2700 млрд.квт.ч.;
- принципиальное расширение сферы использования атомной энергетики за счет внедрения ее в промышленное и бытовое теплоснабжение;
- энергичное развитие реакторов-размножителей на быстрых нейтронах с целью долговременного обеспечения топливом атомной энергетики;
- создание ядерных энергетических установок малой мощности для отдаленных и труднодоступных районов, а также развитие гражданского атомного судостроения.

Основываясь на этой программе, в стране было начато перевооружение и создание новых мощностей обеспечивающей промышленности, как машиностроительного профиля, так и ядерного топливного цикла.

В том, что касается промышленности машино-строительного комплекса, то пуск в эксплуатацию крупнейшего в стране завода тяжелого машиностроения (Аттоммаш, г. Волгодонск) является примером обеспечения намеченной программы. Это производственное объединение оснащено всем необходимым оборудованием для изготовления изделий высокой категории сложности весом до 600 т.

С учетом программы, а также исходя из оптимальных объемов производства и времени, необходимого на его организацию, осуществлялось соответсвующее наращивание мощностей и предприятий топливного цикла.

Таким образом, к середине 80-х годов сложилась развитая инфраструктура атомной энергетики и промышленности. Результатом явился ввод в действие в 1981-1985 годах 17 энергоблоков общей мощностью 15,8 млн. кВт. В этот период в СССР был создан и освоен самый крупный в мире энергоблок мощностью 1,5 млн.кВт с реактором РБМК-1500. Были развернуты работы по сооружению первых энергоблоков на атомных станциях теплоснабжения.

Чернобыльская авария стала поворотным пунктом в судьбе ядерноэнергетической программы СССР. В обществе начала нарастать острая оппозиция не только дальнейшему развитию атомной энергетике, но и эксплуатации действующих АЭС.

Первым результатом такого негативного подхода стало резкое сокращение планов ввода новых электрогенерирующих мощностей. За последнее время на разных стадиях строительства и проектирования приостановлены работы на площадках атомных станций общей мощностью более 100 Гвт. Вскоре после землятресения была выведена из эксплуатации Армянская АЭС. Раздаются требования о закрытии еще ряда АЭС.

На местном и республиканских уровнях одно за другим принимались решения законодательных органов, препятствующих строительству или расширению АЭС.

Однако следует отметить, что в последнее время в некоторых регионах страны началось изменение общественного мнения в пользу атомной энергетики. Это дает основание полагать, что трезвый подход возобладает. В качестве примера можно привести решения Советов народных депутатов Воронежской, Курской, Мурманской и Челябинской областей о строительстве новых энергоблоков общей мощностью более 7000 Мвт (э).

Происходящие изменения в странеб безусловно, внесли коррективы в энергетическую программу: в настоящее время возможно осуществить в 1991-1995 гг. ввод 11 млн.квт. установленной мощности, а в следующем пятилетии - 12,6 млн.квт.. В этом случае к 2000 году суммарная мощность АЭС в стране составила бы 61 ГВт без учета вывода АЭС из эксплуатации. На этапе после 2000 года прогнозируется повышение темпов строительства АЭС, чтобы к 2010 году обеспечить наращивание установленных мощностей до 150-200 МВт с учетом вывода из эксплуатации блоков с недостаточным

уровнем безопасности и исчерпавших ресурс работоспособности. Окончательные решения еще не приняты.
Возможно, что масштабы нового строительства окажутся существенно меньшими, особенно про приросту мощностей в ближайшие 5 лет.

Кроме того, будут происходить структурные изменения в энергопотреблении в сторону расширения использования электрической и тепловой энергии в непроизводственных сферах, развитие энергосберегающих технологий в промышленности, что в совокупности не может не сказаться на общих темпах прироста электроэнергетики. Эти общие тенденции, как мне представляется, в ближайшее десятилетие не смогут, однако, оказать решающего влияния на развитие энергетики, учитывая крайнюю необходимость увеличения резервов мощностей в энергосистеме страны и замену отработавших ресурс энергоустановок.

Строительство АЭС в предстоящее десятилетие будет осуществляться в, основном, с энергоблоками ВВЭР-1000 по проекту с улучшенными характеристиками безопасности. На действующих и строящихся в настоящее время АЭС также будут максимально внедряться решения, заложенные в указанный проект.

После 2000 года строительство АЭС предполагается осуществлять по проектам серийных блоков нового поколения повышенной безопасности типа ВВЭР-92, ВВЭР-500 и ВПБЭР-600, реализованным к 2000 году.

Таким образом, в стратегии развития ядерной энергетики, удовлетворяющей требованиям приемлемого риска, можно выделить два характерных этапа:

- 1990-2000 г.г. можно рассматривать как "реновационный" этап, на котором происходит обновление энергомощностей с повышением безопасности и незначительным ростом суммарной мощности ядерной энергетики;
- 2000-2010 г.г. - как этап с интенсивным ростом мощностей на основе блоков новых поколений с улучшенной экономикой и повышенным уровнем безопасности.

В связи с тем, что первый этап характеризуется незначительным суммарным ростом мощности АЭС, то атомная промышленность СССР, расчитанная на реализацию энергетической прогаммы, о которой говорилось выше, в настоящее время имеет существенные резервы.

Это позволяет провести модернизацию ряда производств в ядерном топливном цикле и перейти к новым технологиям, обеспечивающим лучшую сохранность окружающей среды и более комплексное использование урановых руд. Имеющиеся в настоящее время в СССР технологии позволяют попутно извлекать на гидрометаллургических заводах молибден, рений, скандий, ванадий, золото, редкоземельные и другие ценные элементы.

При добыче урана внедряется прогрессивный метод по подземному выщелачиванию. Этот прогрессивный метод позволяет разрабатывать запасы бедных урановых руд, залегающих на различной глубине и в сложных горно-геологических условиях. Планируется увеличение добычи урана этим методом до 40-50% к 1995 году. С учетом возможности использования ранее накопленных запасов урановой руды сырьевой потенциал отрасли позволяет в настоящее время обеспечить потребности АЭС суммарной мощностью около 100 ГВт.

Существующая же мощность производств по разделению изотопов урана может обеспечить потребность атомной энергетики СССР в 100 ГВт на уровне 2000 года. Причем следует отметить, что газовые центрифуги составляют основу разделительных мощностей страны.

Снижение темпов развития атомной энергетики заставило пересмотреть и планы ввода радиохимических производств, строящихся в соответствии с принятой в СССР концепцией замкнутого топливного цикла, которая предусматривает переработку отработавших топливных элементов. В настоящее время строительство завода по переработке топлива ВВЭР-1000 приостановлено. Тем не менее, полученный на действующем производстве опыт доказал экономическую целесообразность выбранной концепции, в связи с чем налаживается выпуск так называемых смешанных, уран-плутониевых топливных сборок как для быстрых реакторов (БН-350, БН-600), так и для зон реактора ВВЭР-1000.

В том, что касается второго этапа описанной выше стратегии, то его реализация будет зависеть как от создания новых реакторов с повышенным уровнем безопасности, так и от решения проблем, связанных с обращением с радиоактивными отходами.

По мнению советских специалистов, идеология повышенной безопасности реакторных установок включает следующие положения:

- наличие внутренней самозащищенности ректоров (достигается за счет внутренних отрицательных обратных связей активной зоны);
- преимущественное использование пассивных средств для защиты и аварийного расхолаживания, не требующих подвода энергии извне и вмешательства оператора;
- необходимое резервирование средств защиты и расхолаживания;
- представительное обоснование достаточности запроектированной системы защитных барьеров на пути

возможного распространения радиоактивных продуктов при максимальных проектных и гипотетических (физически возможных) авариях;

- наличие информационной поддержки и защиты от ошибки оператора.

Впервые указанные выше принципы были реализованны при проектировании атомных станций теплоснабжения с реактором АСТ-500, что позволило разместить их в непосредственной близости к городской черте городов Нижнего Новгорода и Воронежа.

Экспертная комиссия МАГАТЭ, рассмотревшая проект АСТ для г. Нижнего Новгорода и состояние строительно-монтажных работ, подтвердила высокий уровень безопасности АСТ-500, новизну и обоснованность использованных технических решений.

Как уже говорилось, вторым важным аспектом, обеспечивающим реализацию второго этапа развития атомной энергетики, является решение проблемы обращения с радиоактивными отходами.

Разработанная в нашей стране и ныне рассматриваемая государственная техническая политика в этой области предусматривает комплексное решение проблемы обращения с радиоактивными отходами на действующих, строящихся и проектируемых объектах, начиная с нормирования образования отходов, их сбора, регистрации и учета, транспорта, временного хранения, технологии подготовки к длительному хранению и окончательному захоронению, предусматривая при этом надежную изоляцию радиоактивных отходов от биосферы.

Самые большие величины по объему имеют отходы низкой и средней активности. Тем не менее, по этим видам отходов, пожалуй, нет принципиальных проблем ни технологических, ни экономических. В СССР, как и в других странах, разработаны и созданы процессы уменьшения объема упариванием, компактированием, сжиганием различных видов отходов и отверждения их (цементированием, битумированием) с обеспечением достаточно малой степени выщелачивания: не более 10^{-3}-10^{-7} г/см сутки. Отработана технология захоронения таких отходов в изолированные приповерхностные, заглубленные хранилища, которые обеспечивают изоляцию радиоактивности от экосистемы.

Основным и наиболее сложным делом в практике обращения с радиоактивными отходами является обращение с высокоактивными отходами. Ситуация с этим видом отходов различна для стран, имеющих атомную энергетику, в зависимости от выбранного ими подхода к переработке отработавшего топлива.

У нас в стране создана технология остекловывания высокоактивных отходов и ведется работа по использованию других матриц \минералоподобных и искусственных минералов\ для включения в них высокоактивных отходов после извлечения урана и плутония из продуктов радиохимической переработки. Технология остекловывания проверена на опытно-промышленной установке и планируется, что она будет использоваться постоянно, начиная с этого года.

Вместе с тем, хотя все страны, развивающие атомную энергетику, имеют программы изучения обращения с высокоактивными радиоактивными отходами, к настоящему времени ни в одной стране окончательное захоронение высокоактивных отходов в промышленных масштабах не производится.

Учитывая, что при обращении с высокоактивными радиоактивными отходами приходится иметь дело с радионуклидами, период полураспада которых исчисляется десятками тысяч лет и более, в СССР разрабатываются методы фракционирования, позволяющие отделить такие радионуклиды от основной массы продуктов деления с периодом полураспада несколько десятков лет перед их отверждением. Это дает возможность не только использовать в народном хозяйстве многие изотопы, содержащиеся в высокоактивных отходах, но и создать соответсвующие хранилища для каждой из фракций. Причем фракции отвержденных отходов, содержащие в своем составе Sr-90, Cs-137, редкоземельные элементы и другие продукты деления с периодом полураспада 30 лет, могут надежно захораниваться. Что касается фракций, содержащих долгоживущие радиоактивные элементы, требующие для полного распада десятки и сотни тысяч лет, то они также могут храниться в хранилищах с организацией возможности извлечения их оттуда в случае необходимости. Наиболее перспективным вариантом обращения с высокоативными отходами является их трансмутация. В результате ядерных реакций, вызываемых при облучении таких отходов потоком нейтронов порядка 10^{18} нейтронов/см сек., можно получить 99,9% короткоживущих изотопов, которые после выдержки в два-три года можно будет окончательно захаранивать как среднеактивные в глубинные геологические формации. В Советском Союзе ведутся такие работы.

С проблемой обращения с радиоактивными отходами непосредственно связан вопрос о снятии АЭС с эксплуатации.

Современные АЭС были спроектированы без четко разработанной технологии их демонтажа. В связи с этим в СССР сейчас ведутся работы по поиску путей решения этой проблемы. Для того чтобы снять остроту проблемы и уменьшить число снимаемых с эксплуатации блоков АЭС на определенном интервале времени, в настоящее время осуществляется комплекс работ по продлению срока службы их основного оборудования.

Так, например, в СССР успешно проведены работы по отжигу корпуса реактора с водой под давлением.

Вторым направлением исследований является разработка технологии и плана производства работ по выводу из эксплуатации конкретных АЭС, обобщение полученных технико-экономических результатов.

Здесь следует ожидать обоснованных рекомендаций в части оптимизации компоновочных и строительных решений, ответов на вопрос о повторном использовании зданий и сооружений по прямому назначению.

Все сказанное выше позволяет заключить, что расширенное внедрение атомной энергетики в СССР предполагает решение целого ряда технических проблем, в значительной степени характерных и для других стран.

В этой связи исключительно важное значение имеет деловое международное сотрудничество. Колективный путь решения крупных проектов и проблем уже опробирован в мире.Примером тому может служить МАГАТЭ, важная, авторитетная организация, активно содействующая развитию научно-исследовательских работ в различных областях науки и техники и решающая политические проблемы с целью использования энергии атома только в интересах мира.

Трудно перечислить все программы, в которых участвуют советские специалисты. Вот только некоторые из них: реакторные компоненты и системы, технология ядерного топлива, обращение с отработавшим топливом, взаимодействие "человек-машина" в атомной энергетике, методы вероятностной оценки риска, работа с общественностью.

Специалисты СССР совместно со специалистами Финляндии и Швеции ведут совместный мониторинг загрязнения Балтийского моря. Непосредственно связаны с обсуждаемыми вопросами и проблемы восстановления загрязненных в результате ядерной деятельности в прошедшие годы и в результате таких аварий, как аварии в Чернобыле и в Кыштыме. Даже простой обмен опытом по ликвидации последствий этих аварий, по нашему мнению, был бы очень полезен. Следует отметить такое важное событие, как начало работы международного Центра под эгидой МАГАТЭ в Чернобыле.

Мы знаем также об интересных совместных проектах, осуществляемых такой международной организацией, как Организация экономическому содействию и развитию, а также в рамках Европейского сообщества, в которых советские специалисты тоже могли бы принять участие.

С японскими научными и промышленными организациями благодаря Японскому атомно-промышленному форуму вот уже в течение многих лет ведется плодотворное сотрудничество в области энергетических реакторов, безопасности АЭС, радиоактивных отходов. Мы надеемся на расширение и углубление нашего двустороннего сотрудничества с Японией, в том числе и в экономической области. Для этого есть все основания, поскольку международная специализация и кооперирование производсива - эффективный способ освоения современных технологий и решения задач, финансирование которых затруднительно одному государству.

Так, например, реализуются проекты Европейского быстрого реактора, Международного экспериментального термоядерного реактора. Как следует из моего доклада, советским специалистам есть что внести в качестве вклада в такую кооперацию и сотрудничество. Уже говорилось о проектах реакторов средней мощности 500 и 600 мВт, атомных станций теплоснабжения которые, по нашему мнению, могли бы представлять интерес для некоторых стран и мы были бы готовы оказать содействие в их сооружении, в том числе и с участием в качестве партнеров других крупных реакторостроительных фирм.

Другим важным элементом нашего участия в международном сотрудничестве и кооперации является предоставление услуг в области ядерного топливного цикла. До недавнего времени в этой области нами оказывались только услуги по обогащению, да производство топлива для АЭС, построенных с помощью Советского Союза. Недавно наша страна вышла на мировой рынок также и с предложением о продаже природного и обогащенного урана. Учитывая избыточность мощностей наших производств, мы заинтересованы в значительном объеме участия на этом рынке, реализуя как потенциал производственных мощностей, так и наши передовые технологии переработки и извлечения урана.

В период 1991-1995 годов наши возможности по продаже урана на внешнем рынке составляют не ниже 5 тысяч тонн в год природного урана в виде закиси-окиси.

При увеличении спроса на уран на мировом рынке мы сможем увеличить наши предложения. Общие запасы урана в СССР, по данным геологоразведки, на сегодняшний день оцениваются в 2 млн. тонн, причем 735 тыс. тонн из них со стоимостью добычи менее 60 долларов США за 1 кг урана.

Центрифужная технология разделения изотопов урана, имеющаяся в СССР, позволяет предложить иностранным партнерам, наряду с долгосрочными сделками, краткосрочные контракты, а в случае необходимости - контракты на одну поставку. Проведенные испытания подтвердили пригодность центрифужной технологии для обогащения регенирированного урана и производства продукта, пригодного для производства топлива.

Советский Союз открыт в настоящее время для делового сотрудничества в области мирного использования атомной энергии со всеми странами и международными организациями. Мы убеждены, что только совместный поиск путей развития взаимовыгодного сотрудничества, таких, как промышленная кооперация и совместное предпринимательство, а также двусторонее экономическое и научно-техническое сотрудничество, будут способствовать дальнейшему накоплению знаний в области ядерной физики и практическому их применению.

THE PRESENT AND THE FUTURE OF NUCLEAR ENERGY AND INDUSTRY IN THE USSR

V.F.KONOVALOV

Nuclear energy in the USSR is laying an important role in spite of its relatively small fraction in the present day overall power production. First of all the input of nuclear energy in the power production for industrially developed regions of the country is considerable and equals 33.1% for the North-West integrated power system, 22.7% for the Ukrainian one, 21.7% for the Central, and 16.7% for the the Volga region. At the same time if one considers the entire number of nuclear power units in operation in the USSR and their total power, then the USSR is the third in the world after the USA and France.

As of January 1, 1991, 15 nuclear power plants (NPPs) had 46 units in operation with total power of 36 560 MW (e). In 1990 they produced 211.5 billion KWh of electricity, i.e. 12.5% of all the electricity generated in the USSR.

Speaking about electricity production in general one should say that almost 70% of it is produced by fossil fuel plants on coal, oil or gas and about 18% by hydro power stations.

When analyzing the near term prospects of power industry in the USSR it should be mentioned that in the European part of the USSR one can hardly expect significant increase in power production by thermal power plants (TPPs) using coal. Already at present the average distance for fuel transportation from the East to central regions and the Urals is about 4 thousand kilometers and fuel makes up to 40% of all the cargo. At the same time ecological burden of the coal plants and high capital investments to reduce it down to acceptable level in densely populated European part of the USSR make coal plants non competitive in this region.

The cost of oil production by 2000 is expected to increase by 1.5-1.8 times and by 2010 - by 2-2.5 times due to its limited amount in the developed oil fields. Thus in the coming years the use of oil products as fuel for boilers will become economically unjustified.

Surely the availability of big natural gas resources gives the Soviet Union a unique advantage over other industrially developed countries of the world. It is evident that in the coming 30-40 years the power plants and boiler houses using natural gas may be really considered as an alternative to NPP and TPP in the European part of the country.

In this case it should also be taken into account that the average distance for gas transportation increased from 530 km in 1956-60 to 2400 km at present, and the tendency remains.

Thus, from the point of view of national economy priority in development of nuclear power in the European part of the USSR appears to be justified.

It should be remembered that the development of fuel and power production complex must pursue not only economic, but ecological requirements and should be socially acceptable for the respective regions and the society as a whole.

The use of fossil fuel in power industry is accompanied by significant releases (discharges) of contaminants in the environment and this leads to well known consequences not only for the localities or regions, but for the whole world. The global influence includes the change in the thermal balance of the earth due to carbon dioxide and dust.

Nuclear power is free from several drawbacks of the fossil fuel power industry, such as aerosols and irreversible consumption of oxygen from atmosphere. There are no toxic chemicals and uranium fission reaction require no oxygen. The radioactive contamination of the environment and possible exposure for the population during normal operation of the NPP are much lower than the sanitary and hygienic limits.

Thus, the conclusion is that both from economic and ecological point of view it is necessary to use and develop nuclear power in the USSR and especially in its European part.

The right understanding of the present state of nuclear power and supporting industry in the USSR as well as the prospects of their development is possible, if we briefly consider the historical aspects.

It is known that by the end of the 60s the USSR had accomplished wide scientific program of developing the most optimal for the country types of power reactors, which were capable of producing electricity on a big industrial scale. Two types of reactors formed the basis of the Soviet nuclear power industry. One of the reactors was a well known pressurized water reactor, which was first used by nuclear states to power submarines. The other type was an original Soviet design of the graphite-moderated reactor which is similar to commercial reactors, utilized by some countries for plutonium production. It should be noted that the selection of the second reactor concept for the development of power industry was based on the difficulties in large scale production of heavy power-generating equipment, particularly vessels for water type reactors.

The industry supporting the nuclear fuel cycle was formed in this country for defense purposes and was well developed to include mining and processing of natural uranium, production of hexafluoride and separation of uranium isotopes, production of fuel assemblies, radio-chemical reprocessing of spent fuel.

Before the Chernobyl accident the need for predominant development of nuclear power was of little doubt to the majority.

The Soviet power generation program was made public in the beginning of the 80s and provided for:

- rapid growth of nuclear power so that by 2000 the combined capacity of all NPPs would be up to 190 000 MW and the total electricity generated by nuclear reactors 1100 billion KWh out of the total production in the country equal to 2700 million MWh;

- principal expansion of nuclear power application for areas of industrial and district heating;

- dynamic development of fast breeder reactors with the purpose to provide nuclear power with the fuel for a long period of time;

- development of low-power nuclear facilities for remote and almost inaccessible regions, as well as for merchant nuclear fleet.

On the basis of this program the country started to renew the equipment and develop new capacities for supporting industry.

The commissioning of the biggest in the USSR heavy machine- building plant at Volgodonsk (ATTOMMASH) was one of the examples of realization of the program. This industrial enterprise was provided with all the necessary equipment for the production of highly sophisticated equipment weighing up to 600 tons.

Following the program and proceeding from the optimal production volumes and time, required to organize such production, there was a respective growth in the capacities and number of enterprises of the fuel cycle.

Thus by the middle of the 80s a well developed infrastructure of the nuclear power and industry was established in the country. As a result in 1981-85 17 power units with total capacity of 15 800 MW were commissioned. At that time the Soviet Union developed and brought to commercial level the biggest (1500 MW) power unit in the world with RBMK-1500 reactor. Work has started on the first units of district heating nuclear plants (DHNP).

The Chernobyl accident has brought considerable changes in nuclear power production program of the USSR. The society started to actively oppose further development of nuclear power and even operation of the existing NPPs.

The first result of the negative approach was drastic cut in the plans of introducing new power production capacities. Recently, 100 000 MW of nuclear power plants were abandoned at different stages of design or construction. Soon after the earthquake in Armenia the Armenian NPP was shut down.

But it should be noted that lately in a number of regions one can see a tendency towards understanding of the need for nuclear power and especially among people with influence on decision making. Judging by that good reasoning should win. As an example, the decisions of the Soviets of people's deputies in Voronezh, Kursk, Murmansk, Chelyabinsk, Semipalatinsk, Chimkent and Eastern Kazahstan regions favoured the construction of new power units (more than 12 000 MW in total).

Naturally, the changes taking place in the country introduced corrections into power production program making it real to instal 7000 MW of power for the period 1991-1995 and 12600 MW during the next five-year period. In this case by 2000 the total installed power of the NPPs in the country will amount to 57 000 MW without taking into account decommissioning. For the period after 2000 the predicted increase in the rate of construction is such, that by 2010 growth in the installed power shall be 150 000-200 000 MW with due account for decommissioning of units which exceeded the service life. The final decisions are not yet taken. They will be reflected in the new national nuclear power program with due account for the necessity of encreasing installed power in the national integrated power system, decommissioning of units with exceeded their service life, and structural changes in the national economy.

The construction of the NPPs in the coming ten years will be on the basis of VVER-1000 reactors having enhanced safety performances. The technical findings of the project will be to the maximum possible extent introduced in the NPPs in operation or under construction.

After 2000 the NPPs under construction shall have commercial units of new generation, having enhanced safety (type VVER-92, VVER-500, VPBER-600 and FBR) which will be realized by 2000 on the basis of previous designs and 30 years of experience in the field of nuclear power.

Thus, two important stages may be marked in the strategy of nuclear power development meeting the requirements of acceptable risk :

- 1990-2000 may be considered a "renovation" stage with introduction of new units with enhanced safety, and low rate of increase in the total power production by nuclear. This should be a period of extensive R&D to form scientific and design basis for future intensive development of nuclear power.

- 2000-2010 is the stage of dynamic increase of power production on the basis of the new generation of units having better economic features and enhanced safety.

Due to the fact that the first stage is characterized by insignificant increase in the overall power generation by NPPs the supporting nuclear industry of the USSR, which was developed to realize the above mentioned power production program, at present has fundamental reserves.

So, there is a possibility to modernize a number of production enterprises in the nuclear fuel cycle and switch over to new technologies, ensuring better environment protection and more complete use of uranium ores. The present Soviet technology allows segregation of byproducts, such as molybdenum, rhenium, scandium, vanadium, gold, rear earth and other valuable elements.

Progressive method of underground leaching is being widely introduced in uranium mining. This new method allows to mine the reserves of depleted uranium ores at different depths and in complicated rock conditions. Plans are to produce by 1995 up to 40-50% of uranium by this method. Taking into account previously accumulated resources of uranium ore the amount of the available raw material allows us to ensure supply for NPPs of the total power of about 100 000 MW including the existing capacities for separation of uranium isotopes. It is worth mentioning that separation process in the USSR is based on the use of gas centrifuges.

In the USSR there has been adopted the closed nuclear fuel cycle concept envisaging the reprocession of spent fuel. This method ensures complex use of valuable components and getting the fewest amount of wastes for final disposal. A plant for reprocessing spent fuel has been put into service in our country, the second one is being constructed. The national experience has proved economic feasibility of the chosen concept.

The second stage in nuclear power development in the USSR is tied up with new generation of reactors and power plants which will be the logical continuation in the development of Soviet reactors designs fully realizing the experience and using technical means of "accident management". Once the present day safety concepts are in action probability of severe damage of the core is not over 10^{-6} per reactor-year.

According to Soviet experts the ideology of enhanced reactor safety incorporates the following postulates:

- succesion of the nuclear power programs and concepts ensuring safety;
- inherent self protection of the reactors (due to inherent negative feedbacks in the core);

- primary use of passive means of protection and emergency cooling, requiring no external energy or operator actions;

- required redundancy of protection and cooling means;

- representative justification of the sufficiency of the designed protective barriers for possible radioactive products releases in maximum design-base and hypothetical (physically possible) accidents;

- availability of information backup and protection from operator errors.

The above principles were realized in designing ACT-500 district heating nuclear plants (DHNP), which allowed to locate them close to the boundaries of such cities like Voronezh and Nizhny Novgorod.

IAEA experts mission studied the design of ACT for Nizhny Novgorod and the construction activities there and confirmed high level of ACT-500 safety, novelty and soundness of the technical solutions.

The next important aspect in ensuring realization of the second stage of nuclear power development is the solution to nuclear waste management problem.

The related national technical policy developed in our country is now under consideration. The policy provides for comprehensive solution of the problem of nuclear waste for the operating NPPs, the NPPs under construction and at the design stage. It establishes the norms for amount of produced nuclear waste, procedures of their collection, logging and accounting, transportation, temporary storage, preparation for long term storage and final disposal with reliable isolation of the waste from biosphere.

The biggest amount comes from low- and medium-level wastes. And still for this types of waste there are no principal problems neither in the process nor in the economy. The technology, adopted in the USSR, as well as in other countries reduces the volume of such waste by evaporation, compression, burning different sorts of wastes and their solidification (cementing or bitumizing) with rather low degree of leaching - not more than 10^{-3} - 10^{-4} g/cm^2 per day. We have a well developed technology for disposing of such a waste in isolated near-surface or shallow storages, which ensure isolation of radioactivity from the ecological system.

The main and the most complicated matter in practical handling of nuclear waste is handling high-level nuclear waste. The situation with such waste is different for different countries having nuclear power and depends on the approach selected for reprocessing nuclear fuel.

In the USSR use is made of the process of vitrification for high-level waste and work is carried out on the use of other matrices (mineral-like and man made minerals) for inclusion of radioactive waste after extraction of uranium and plutonium out of the products of radioactive treatment. The vitrification technology is proved by pilot facility and starting from this year we plan to use it continuously.

Taking into account that high-level waste management involves dealing with radionuclides having half-life more than tens of thousands of years the Soviet scientists are developing methods of fractionation to separate such radionuclides from the main mass of fission products having half-life of several tens of years, and their subsequent solidification. It is possible to use many isotopes, contained in high-level waste, in national economy and develop appropriate storages for each fraction. In this case the fractions of solidified waste with Sr-90, Cs-137, rare earth elements and other fission products with half-life of 30 years may be reliably stored. The fraction of long-lived radioactive elements, requiring tens and hundreds of thousands of years for their decay, may also be stored in depositories with the possibility to retrieve them, if necessary. One of the important variant of radioactive waste management is their transmutation. On the other hand, the development of fast breeder reactors and using them for burning actinides is surely of interest both from the point of view of waste handling and for national electricity generation program. Such work is carried out in the Soviet Union.

The issue of decommissioning is closely related to the problem of nuclear waste.

The main trend of research is the development of a technology and a plan of decommissioning for individual NPPs and generalization of the obtained technical and economic results.

This should give proven recommendations on how to optimize the components and constructions, and subsequently use buildings and structures in their pimary role. Nuclear power plants should be operated to full extent of the main equipment design service life provided appropriate measures are undertaken to enhance safety (with regular monitoring of their state). The reactors or power plants should not be just decommissioned or shut down but reconstructed in such a way as to permit their futher use within the formed infrastructure.

Modern NPPs were designed without due concern about their decommissioning. This problem is now being addressed in the USSR. In order to make the problem easy and reduce the number of units to be decommissioned at the same time there work is carried out to extend the service life of the main equipment. For example, successful annealing of the pressurized water reactor vessels is done in the USSR.

All the above leads to a conclusion, that wide introduction of nuclear power in the USSR should be accompanied by the solution of a number of technical problems which are to a great extent similar to those in other countries.

With this in view it is exceptionally important to have worldwide cooperation. Joint efforts in working at big projects and solving common problems have already being tried in the world. One of the examples is the IAEA which is an important and competent organization actively promoting research and development efforts in different fields of science and technology, and solving political problems to support peaceful use of nuclear power.

It is hard to enumerate all the programs where Soviet scientists participate. Some examples are: reactor components and systems, nuclear fuel technology, spent fuel handling, man-machine interaction in nuclear power, probabalistic risk assessment, public information.

Soviet experts together with the experts of Finland and Sweden monitor the contamination of the Baltic Sea. Other issues directly linked to the above are the problems of recovery of territories contaminated as a result of previous activities and due to such accidents as the Chernobyl and Kyshtym accidents. Even simple exchange of information on the experience in mitigating the consequences of such accidents, to our opinion, is very fruitful. It should be noted that International Chernobyl Center started to function under the auspices of the IAEA, development of joint Soviet-Italian complex dynamic programs for reactor calculations helped to understand better the reasons for Chernobyl accident and the important aspects of nuclear power safety in general; cooperation with Canada on channel-type nuclear reactors; with Sweden on boiling water reactors and, finally, a unique opportunity to make direct comparison of safety assesments both in the USSR and abroad which is now possible due to introduction of powerfull computer (Syber), delivered to the USSR as a result of agreement between the Presidents of the USA and the USSR

Due to the efforts of Japan Atomic Industrial Forum we are fruitfully cooperating for a number of years by now with the scientific and industrial organizations of Japan in the field of power reactors, safety of NPPs, bilateral seminars on problems of extending service life, reliability of fuel and structural elements of the power generation reactors and radioactive waste management. We hope to expand and make more profound our bilateral cooperation with Japan including cooperation on commercial basis. There are all the good reasons for this since the international specialization and cooperation in industrial spheres are the most effective means of mastering modern technologies and solving tasks which are hard to finance by one state.

For example, this is used to realize the project of European fast breeder reactor and ITER project. As you may see from my presentation the Soviet scientists may well contribute to such cooperation and collaboration. I have mentioned already the reactors of medium power (500 and 600 MW) and district heating nuclear plants which may be of interest to a number of countries.

An important element of our international cooperation is services in nuclear fuel cycle. Up till lately we were offering only uranium enrichment services and fabricated fuel for the NPPs constructed with the help of the USSR. Recently our country offered natural and enriched uranium to the world market. Taking into account excessive capacities of our factories we are interested in substantial participation for a long period in this market, realizing the potential of our industry and our advanced processes off uranium extraction and processing.

For the period of 1991-95 our capabilities of selling uranium to the world market are at least 5 thousand tons of natural uranium per year in the form of peroxide.

With the increase in demand for uranium in the world market we may increase our offers. The reserves of uranium in the USSR according to geological surveys at present are estimated at 2 million tons (735 thousand tons may be mined at a cost less than 60 US dollars per kilogram of uranium).

Centrifugal separation technology for uranium isotopes allows us to offer to our foreign partners apart from long term contracts also short term contracts and contracts for one supply. The tests proved that it is possible to use centrifugal process for enrichment of regenerated uranium and to produce product suitable for fuel manufacturing.

At present the Soviet Union is open for business cooperation with other countries and international organizations in the field of peaceful use of nuclear power. We are convinced that only mutually beneficial joint efforts in search of ways to develop international cooperation - such as industrial cooperation and joint venturous- and bilateral commercial and scientific cooperation will favour further accumulation of knowledge in the field of nuclear physics and its practical application.

REMARKS OF

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AT

THE JAPAN ATOMIC INDUSTRIAL FORUM

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ENERGY IN THE 1990s: EXPECTATIONS FOR NUCLEAR POWER

United States Energy Policy - The Role of Nuclear

I would like to take this opportunity to thank the Japanese Atomic Industrial Forum for inviting me to discuss the role of nuclear energy in United States energy policy.

United States Energy Policy

Let me start by saying that in July 1989, when President Bush directed the Secretary of Energy Admiral Watkins to develop a National Energy Strategy, he requested an approach that balanced -- in the President's own words, "Our increasing need for energy at reasonable prices, our commitment to a safer, healthier environment, our obligation to maintain an economy that is second to none, and our goal to reduce reliance on insecure energy supplies."

At the time, of course, things looked pretty good. Oil prices had been low for some time and generally there was not much concern throughout the United States about energy. The events in the Persian Gulf have quickly brought that to an end.

The U.S. Department of Energy has completed the task of developing the National Energy Strategy -- in December we submitted to the Cabinet and the President a series of options. The options were based on information gathered during an extensive public hearing process (which had culminated in the

Interim Report of the National Energy Strategy in June, 1990), as well as a comprehensive analysis phase. And we have finished the final strategy development. The Strategy was issued in February, and implementing legislation was sent to the U.S. Congress on March 4th.

The Role of Nuclear Energy

I would now like to turn to the subject of nuclear energy in the context of United States energy policy. We in the States are near a critical juncture for nuclear energy. I am optimistic about its future, and I believe that both public acceptance and the use of nuclear energy will grow in the United States.

American public attitude toward nuclear energy is beginning to turn around. A Gallup poll conducted in 1990 found that 78 percent of Americans thought that nuclear energy should play a role in meeting our Nation's future electricity needs. This was consistent with the information gathered during the public hearings process prior to the June, 1990 Interim Report. A large portion of the public commented on the importance of keeping the nuclear option open. Now that the conflict in the Persian Gulf has brought home the fundamental importance of a secure energy supply, I expect that American public attitude will be even more favorable.

The National Energy Strategy identified four goals related to nuclear energy in the United States. They are:

- maintaining exacting standards of safety in design and operation;
- demonstrating the capability to dispose of spent fuel and radioactive waste in an acceptable manner;
- improving the predictability and efficiency of the regulation and licensing process; and
- eliminating barriers to efficient and cost-effective operation.

The Department of Energy has a number of programs underway to meet these goals, which are complementary to the Nuclear Power Oversight Committee's Strategic Plan goal of having a new nuclear power plant operational in the United States by the year 2000. I would like to spend a few minutes discussing these with you.

Safety of Operations

The first goal, safety of operations, confirms our belief that the key to restoring the public's confidence in nuclear energy is a continued record of safety in the operation of nuclear power plants. Simply put, human performance, both in management and operations, is critical to maintaining our track record of nuclear safety. Rising public expectations for safety are such that we must continually strive to attain higher levels of performance.

These expectations touch both our institutions as well as nuclear technology. I believe that the public expectations of and reservations about a technology such as nuclear energy are based largely upon a cynical, pessimistic view of technological institutions. This view pervades the United States. By operating plants safely, we will be building public confidence in our institutions, as well as in our technology.

For our part at the Department of Energy, we are moving aggressively to ensure that our own facilities are operated with enhanced attention to safety, environmental protection and excellence in operations. Admiral Watkins has made this a priority and has taken many initiatives to improve the performance of the Department and to demonstrate openness in dealing with the public. These initiatives should help restore public confidence in Department of Energy operations.

Our safety efforts are international in scope, as well. In September 1989 Admiral Watkins proposed that the United States and the Soviet Union enter into a cooperative effort to encourage improvement in operating practices, which is the most practical, near term way to enhance nuclear power plant safety in that country. The Institute for Nuclear Power Operations in the United States has joined with us in this endeavor. The Soviet response has been very positive, and considerable work by both sides has begun to translate the joint effort into effective action.

New Plants and Initiatives

Returning now to our domestic initiatives, the Department of Energy supports a program to extend the life of the more than 100 reactors currently operating in the United States. These plants are licensed for an arbitrary 40 years. To lead the way, we are co-funding a license renewal demonstration program with United States utilities under which we hope to obtain Nuclear Regulatory Commission approval by 1993 of a 20-year license extension for two plants.

The Department of Energy also has a cost-sharing program to demonstrate the nuclear plant standardization and licensing process. The objective is to obtain United States Nuclear Regulatory Commission certification of two evolutionary Advanced Light Water Reactor designs and two simplified mid-size advanced light water reactors employing passive safety features and modular construction. These advanced designs, which rely on natural phenomena such as the characteristics of materials, gravity, or natural circulation to provide safety, rather than engineered systems, should increase the likelihood of both public and investor acceptance of new nuclear powerplants. Our goal is to demonstrate certification and standardization of at least one Advanced Light Water Reactor by 1995, providing the basis for the next generation of nuclear powerplants. We are pleased to see that American industry interest in support of this program seems to be developing.

Further, we are supporting the development and possible certification early in the next century of the Advanced Liquid Metal Reactor and the Modular High Temperature Gas-Cooled Reactor plant designs.

We also plan to demonstrate the Nuclear Regulatory Commission's early-site approval licensing process, through a cost-sharing arrangement with the private sector, by obtaining from the Nuclear Regulatory Commission an Early Site Permit by 1994. This activity will complement the design certification demonstration and will be a major step in gaining utility and investor confidence in the licensing process.

Nuclear Waste Management

The second goal, that of resolving the nuclear waste management issue, is critical to the revitalization of nuclear power in the United States. Significant progress must be made before American utilities, and more importantly, the American public will be willing to support nuclear energy.

The Department of Energy is finally beginning to move forward to resolve the nuclear waste management issue. Significant progress toward developing a radioactive waste management system should be made by 1995. Key milestones include characterization of a site for a waste repository and progress on site selection for a Monitored Retrievable Storage Facility. Meeting these milestones is very important to give both utilities and their state public utility commissions confidence that the Department of Energy will be able to accept spent nuclear fuel.

On a final note related to nuclear waste management, a long-term contribution to the radioactive waste management system may be made by a new reactor and fuel cycle concept under development. The Advanced Liquid Metal Reactor, which uses the Integral Fast Reactor fuel cycle, has the capability to consume long-lived, transuranic actinides such as plutonium, neptunium and americium in spent fuel. If this technology can be economically deployed, it has the potential to make long-term improvements in the radioactive waste management system.

Regulatory Practices

The third goal identified in the Strategy, that of improvement of the regulatory process, would dramatically enhance the attractiveness of nuclear power in the United States. Public interest in a sound energy future requires a process which permits completed and operational nuclear power plants to be permitted to produce electricity, and not be delayed until a lengthy and unbounded hearing and appeal process is completed. In the past, the nuclear licensing process in America has been abused by an activist minority who has learned to use procedural means to reopen issues already resolved or raise issues of little or no safety significance, causing delay in the operation of a constructed plant.

The Nuclear Regulatory Commission took a major step forward in issuing a Licensing Reform Rule. The rule is a substantial improvement over the previous licensing process and could significantly cut nuclear construction times and construction costs. However, the rule does not address some issues. These include emergency planning requirements necessary to ensure that state and local governments cannot needlessly delay plant operations, and the possibility of lengthy procedural delays caused by formal hearings when plant construction is completed and the plant is ready for operation.

In November 1990, a Federal Court struck down a critical part of the new rule. The court found that the rule violated the Atomic Energy Act and limited the public's right to petition for a formal hearing prior to plant operation. The court's finding puts additional emphasis on the need for licensing reform legislation to provide stability for the licensing process.

Nuclear Plant Economics

The fourth goal identified by the National Energy Strategy is the elimination of barriers to cost-effective nuclear operations, a crucial factor for nuclear power everywhere. If the economics of nuclear energy are not competitive with other options, the nuclear option indeed will be "the option of last resort". As one United States utility executive said, "the nuclear industry . . . has to understand that utilities and generating companies don't need or necessarily want the latest or greatest technology with catchy names like passive, advanced, or naturally safe. What they want is simple and straightforward: nuclear plants that can produce clean, safe economic power reliably with high capacity factor with minimum hassle."

We believe that the best way to make nuclear energy economically attractive is to develop and deploy standardized reactor designs as soon as they become available. Standardization will achieve capital cost reduction, as well as operations and maintenance cost reduction when compared to our experience with many of today's nuclear plants.

We believe that the advanced light water reactors -- both the evolutionary light water reactor and the designs having passive safety systems -- can meet the cost targets set by the United States Electric Power Research Institute's "Requirements Document". They are designed for simplicity of operation and ease of maintenance. It is also possible that with continued research and design effort, the Liquid Metal Reactor and the Modular High Temperature Gas Cooled Reactor technologies will be able to meet these cost targets in the future.

Legislative Priorities

Turning now to the Department's legislative priorities, our top priority is the enactment of the comprehensive and balanced legislative package to implement the National Energy Strategy. Regarding nuclear energy, we have proposed language which would reform the current licensing process by codifying provisions of the Nuclear Regulatory Commission's Licensing Reform Rule, resolving emergency planning issues before construction, and avoiding the often lengthy and costly procedural delays of the currently unbounded post-construction hearing process.

Other important legislative issues relating to nuclear energy in the United States include legislation to resolve the persisting problems at Yucca Mountain so that we can proceed with characterization of the site as a repository for high-level radioactive waste.

Our Uranium Enrichment Enterprise is also a high priority. Legislation needs to be enacted to restructure the enterprise into a government sponsored corporation. The Bush Administration proposed such legislation before and has submitted similar legislation again.

Timing

If we can realize the promise and potential of the programs I have outlined, I believe we will have accomplished several things in the United States by the middle of the decade. We will have put the Department of Energy's house in order. United States nuclear utilities will have continued to improve the industry's reputation for safety and excellence in operations. We will be able to point to solid progress in the resolution of the nuclear waste management issue. We will have demonstrated nuclear power license renewal. We will have advanced light water reactor designs available which will be economically competitive with clean coal technologies. Finally, in order to certify and utilize these designs, we will have successfully demonstrated an improved licensing and siting process.

If we can achieve these things, and I believe we can, I am confident that the nuclear option will be restored before the end of this decade in the United States. This means a new plant order by the middle of the 1990s, so as to have a plant in operation by the year 2000.

National Trends

There are several trends which will intensify the United States' focus on energy in the coming decade and influence nuclear energy's future role.

First and most importantly, the demand for electricity will continue to grow well into the next century. Historically, electrification seems to be linked to economic growth in the United States, and we expect that relationship to continue. Let me give you a few numbers to illustrate my point. At the time of the first oil embargo, electricity amounted to 27 percent of primary energy consumption in the United States. By 1989, it had grown to 36 percent. By 2030, that number is estimated to be approximately 50 percent.

The United States presently has about 700 gigawatts of installed electric generating capacity. From our National Energy Strategy efforts, it appears that the United States will require between 190 and 275 gigawatts of additional capacity in next 20 years, most after 1995, with that number climbing substantially through 2030. About 85 percent of this needed capacity will be baseload or intermediate generation.

Let's examine choices for baseload capacity in the United States. These include natural gas, oil, some renewables, coal, and nuclear energy. In the next few years, natural gas probably will dominate baseload additions. Gas is an attractive choice now because of its comparatively low price and because the capital cost-per-kilowatt of a combined-cycle, gas-fired generating unit is lower than a conventional coal-fired plant with a scrubber. However, gas prices are expected to continue to rise, limiting gas as a future source of baseload capacity.

The events in the Middle East emphasize that oil is not a secure and economical choice for future baseload capacity. We believe it would be imprudent for our electric utilities to rely heavily on unreliable sources of oil for electricity generation in the future.

Renewable energy sources will be an important part of our electrical capacity mix and will play a role in providing intermediate and peaking power. However, renewables cannot be expected to supply the large quantities of baseload capacity that will be needed.

Although our scientific knowledge about possible global climate change due to carbon dioxide emissions is not certain, nuclear power produces no direct carbon dioxide emissions which could be a contributor to possible global warming. If current trends continue with no major policy changes and no expansion of nuclear power use, coal's share of the fuel generation mix in the U.S. would have to grow from 51 percent in 1990 to 63 percent by 2010. By 2030, coal's share would have to rise as high as 81 percent.

Conclusion

In conclusion, the days, months and immediate years ahead promise to be challenging. The United States faces difficult energy decisions to ensure our energy security in a dangerous world and to supply electricity for economic growth and environmental protection. These decisions can no longer be postponed.

The actions identified in the United States nuclear industry's Strategic Plan must be successfully completed so that a new nuclear plant order will be placed in the mid-1990s for operation by the year 2000. This is a tall and challenging assignment. And, we must convince the United States Congress to enact a comprehensive, balanced legislative package to implement the U.S. National Energy Strategy, as well as legislation on the other issues I mentioned.

As I said in the beginning, the coming decade will be an exciting time to be in the nuclear industry. We have an opportunity to make great technical and institutional strides. We have an opportunity and obligation to reach the American public. And we have an opportunity to help the world respond to its energy and environmental needs.

It was a pleasure to be here, and I am grateful for the opportunity to discuss the expectations for nuclear power in United States energy policy.

The second trend that is very apparent in the United States is increased concern for the environment. Environmental matters will be a primary consideration in energy decisions now and for the foreseeable future. Energy production and consumption will be increasingly scrutinized in relation to how they affect the environment. We must anticipate and meet the twin imperatives of the 1990s -- economic growth and environmental protection.

In regard to the latter imperative, I was intrigued by the results of a public opinion poll, conducted in the United States in February 1990 for the U.S. Council for Energy Awareness. It indicated that a majority of Americans who believe themselves to be committed environmentalists, and who have donated to or worked for environmental groups, think nuclear energy will and should be important in meeting the Nation's future electricity needs. That many American environmentalists have cut through the rhetoric and now recognize the environmental benefits of nuclear power is indeed encouraging.

A third trend stemming from the conflict in the Persian Gulf, will be to attempt to wean ourselves of imported sources of energy, particularly oil. The simple truth is that the U.S. cannot -- and should not -- continue to rely on imported petroleum supplies, particularly for electricity generation.

These trends -- growing electrification, increased concern for the environment, and enhanced awareness of the need to reduce dependence on imported oil -- will present both opportunities and challenges to us in the energy industry in the coming decade.

「我が国の長期エネルギー需給展望と原子力開発の考え方」

資源エネルギー庁長官
緒方　謙二郎

1．はじめに

本日、第２４回日本原子力産業会議年次大会が、内外からの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、円城寺会長、生田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２４回目を迎える今年の年次大会のテーマは、「９０年代のエネルギー：原子力に何を期待するのか」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、積極的な議論が行なわれることとなっておりますので、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「激動する世界情勢とエネルギー・原子力」ということで、これまで海外におけるエネルギー政策についてのお話しがありましたが、私からは「我が国の長期エネルギー需給展望と原子力開発の考え方」ということで、昨年とりまとめられました長期エネルギー需給見通しの考え方と今後の我が国のエネルギー政策の基本的方向及びその中での原子力推進の考え方についてお話しさせていただきます。

エネルギーというのは、各国の経済発展、人間生活の基盤でありますが、近年、エネルギーを巡る状況は、ますます複雑さを増しながら大きく変化しつつあります。すなわち、以前は、エネルギー問題は、主に「資源の安定供給」の文脈のみから語られてまいりました。エネルギー消費の増大と化石エネルギーの枯渇の問題、エネルギー供給を海外に依存する場合のエネルギーセキュリティ等が主な問題であったのであります。

しかしながら、現在、局面は一層難しいものとなっております。すなわち、今回の湾岸戦争を見るまでもなく、資源の安定供給という観点は依然として重要性を失うものではありませんが、地球温暖化問題を始めとする地球環境問題が、エネルギー分野における大きな課題として、新たに顕在化してきたのであります。

こうした状況のもとで、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」は、２１世紀初頭を見通した我が国のエネルギー政策の基本的方向を示すべく、約１年の審議を経て、昨年６月、「地球規模でのエネルギー新潮流への挑戦」と題する報告をとりまとめました。通産省では、現在、この報告に即したエネルギー政策の展開を図っているところですので、まず、この内容について御紹介いたしたいと存じます。

２．我が国のエネルギー政策の基本的方向

今後のエネルギー問題を取り巻く状況は、国民がゆとりと豊かさのある生活を追求する中でエネルギー需要が増大傾向を示す一方、資源の枯渇と地球温暖化等環境問題がエネルギー利用の大きな制約要因となってくるでありましょう。

しかしながら、我々は、いたずらに萎縮すべきではありません。未来に向かっての持続的発展を目指すとの積極的発想に立って、このような状況変化への対応を図るべきであり、２１世紀への助走期に入った現在から、長期的な視点に立った段階的かつ計画的なエネルギー政策を果敢に展開していくことが必要であると考えます。

（長期エネルギー需給見通しと原子力の位置付け）

総合エネルギー調査会の報告は、このような認識に立ち、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」を提言しております。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」として示しております。通商産業省では、これを踏まえ、昨年１０月の閣議決定を経て、「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。

本供給目標は、政府及び民間による最大限の努力の傾注を前提として策定されたものでありますが、その概要を申し上げると次のとおりであります。

第１が、エネルギー需要面の目標として、「徹底的なエネルギー利用の効率化」であります。

石油危機以降低い伸び率で推移してきた我が国のエネルギー需要が、近年、再度急速に伸び始めてきており、具体的な数字でみますと、１９７３年の第一次石油危機以降、ＧＮＰの伸び率が年率約４％程度で推移してきたのに対し、エネルギー需要はおおむね年率１％の増加にとどまっていました。しかしながら、１９８７年以降では、景気の持続的な拡大もあって、ＧＮＰの伸び率自体もやや上昇しておりますが、それ以上にエネルギー需要が急速に伸びてきております。

今回のエネルギー需給見通しでは、このような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、徹底的なエネルギー利用効率化を進めることにより、トータルとしてのエネルギー需要の増大を最大限抑制することを政策目標として、エネルギー需要を見通しております。

今後、２０１０年度に向けて、エネルギー消費構造は、産業分野のシェアが５３％から４８％に減少する一方、家庭部門及び業務部門によって構成される民生部門のシェアが２４％から３１％にまで増加することが見通されております。これは、国民生活におけるゆとりと豊かさの追求等を背景にした変化であると申せましょう。

そして、エネルギー需要全体では、通産省が試算して総合エネルギー調査会に報告した「自然体ケース（business as usual case)」、すなわち現在の水準の政策を続けたケースに比べてみますと、概ね１２％の需要減少となっております。すなわち、これから追加的に実施する政策等によって概ね１２％の省エネを行うことが目標となっているのであります。

既に御承知のこととは思いますが、我が国は、第１次石油危機以降、官民挙げてエネルギー利用の合理化に努め、エネルギー消費原単位で３６％というＯＥＣＤ平均をはるかに上回る抜群の改善をしてきております。今回の供給見通しは、今後、さらにこれと同程度の省エネ努力を前提としており、まさに、「乾いたタオルをもう一度絞る。」ような厳しい目標ということができましょう。

では、このような徹底的な省エネ目標を達成するためには、具体的に何を行っていくべきでしょうか。国民生活の質的水準を低下させずにエネルギー消費を少なくさせることが望ましいことは言うまでもありません。このため、国民に対し、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、技術開発等を通じた省エネ設備・プロセスの導入、省エネ機器の開発・導入等が重要でありましょう。また、それに加えて、今まで捨てていたり見過ごしていたエネルギー、即ち、海水、河川水、下水等の温度差エネルギー、発電所廃熱、都市廃熱といった未利用エネルギーの活用などによるエネルギー供給・利用システムの効率化、更にはリサイクルの推進などを通した省エネルギー対策を抜本的に強化することも重要です。以上は、対策の一部ですが、省エネルギーの推進にはこの他にも多岐にわたる各種対策が必要であります。

しかしながら、このような厳しい省エネ努力を前提としてもなお、エネルギー需要全体について約４割、使いやすいエネルギー源である電力については、電力化の進展が見込まれることもあって、約６割の増加を見込まざるを得ない結果が出ているわけです。

第２が、以上のような需要面の見通し及び対策に対応したエネルギーの供給面の目標である「適切なエネルギー供給構造の構築」であります。

これは、先にお話ししました需要面の見通しに対して、これに対して、エネルギー供給源としてどのようなエネルギーをどれだけ見込むのが適切かということであり、今回の供給面の見通しの基本的な考え方になっているわけです。

すなわち、特定のエネルギー源に過度に依存しない各種エネルギー源の適切な組み合わせを目指したものと言えましょう。かつて、我が国は、過度に石油に依存したエネルギー構造を有しておりました。そして、過去２回の石油危機において、そのような構造の脆弱性を痛感するところとなったのであります。そこで、これらの教訓を踏まえまして、原子力を始めとする石油代替エネルギーの積極的導入を図り、石油依存度の低減に努力してまいりました。その結果、石油依存度は第１次危機の時の７７％から、現在５７％にまで低減いたしました。今回の湾岸危機に際し、冷静な対応をとっていられた一因も、このようなエネルギー構造の改善に求められると申せましょう。

今回の石油代替エネルギーの供給目標でも、引き続き石油依存度の低減を目指しております。２０１０年度には、石油依存度を４５％まで低減させることを目標としております。一方、水力、地熱、原子力、新エネルギー等の非化石エネルギーへの依存度については、石油代替エネルギーの供給目標においても、現在の約１５％から２０１０年約２７％まで高めることとしており、地球温暖化問題に留意し、二酸化炭素を排出しない非化石エネルギーの積極的な導入にも大きな力点を置いております。

それでは、具体的なエネルギー供給源ごとに見て行きたいと思います。

まず、誰からも期待されている新エネルギーについてですが、我が国においては、第1次石油危機以降、サンシャイン計画の一環として、これまでに約５０００億円を投じ、太陽、地熱、風力等の新エネルギーの開発を積極的に進めてきており、現在、世界的にもトップクラスの技術力を有するに至っております。その成果として既に実用化されている住宅用のソーラーシステムや太陽熱利用温水器については、４００万台以上の導入実績があり、太陽を始めとして新エネルギーの導入促進に努めてきたところであります。

また、燃料電池につきましても、ムーンライト計画の中で積極的に技術開発に取り組んできているところであり、現在、米国に次ぐ技術レベルを有するに至っております。

２０１０年に向けてのエネルギー供給におきましても、新エネルギーを非化石エネルギーの１つの柱として位置付けており、特に、太陽エネルギーについては、ストックベースで日本の一戸建て住宅の約半分が太陽光発電施設か太陽熱利用施設を備え付けるという極めて野心的な目標の下、新エネルギーの導入促進に最大限の努力をしていくこととしておりますが、全体では、２０１０年のエネルギー需要の約５％しか賄えない見通しです。

現在、エネルギー供給の約４０％を賄っている石油については、イラク問題に見られるように政治的に不安定な中東地域に供給の多くを頼っているという問題がある訳です。我が国の場合、中東への依存度は実に７２％にも上ります。世界全体でみれば、依存度は、現在こそ２４％にまで低下していますが、今後は北海、北米等やその他多くの産油国での供給余力の縮小等により、世界的に供給力が減退し、９０年代半ば以降、再び急速に中東シフトが高まるものと予想されています。ＩＥＡにおいても、２００５年には、石油の中東依存度が過去の石油危機発生時並の３３％にまで高まるものと予測しています。

石炭については、御承知のようにＮＯxやＳＯxの発生が不可避であり酸性雨の原因になっています。この他にも、化石燃料については、燃焼の際にＣＯ2 を多量に排出するという特性が最近、国際的に問題になってきています。具体的には、その排出に対する国際的条約が検討されていることや、我が国においても去る１０月に地球環境保全関係閣僚会議が開催され、２０００年以降、我が国の一人当たりのＣＯ2 排出量を１９９０年レベルで安定化するという目標が掲げられる等地球環境問題を巡る議論が活発化しています。こうしたことを勘案すると、今後、石油、石炭等の化石燃料に現状以上に依存していくことは難しい状況になってきています。米国においても、これは酸性雨に対応する観点からですが、大気浄化法（Clean Air Act）が十月に改正され、ＮＯx 、ＳＯx の排出量が規制されています。

化石燃料の中では、同等のカロリーを得るのに石炭が排出するＣＯ2を５とすると、石油が４、天然ガスが３になりますから、天然ガスをより多く利用していこうという動きになってきます。すなわち、地球環境問題との関連から、欧米も含めて、やはり天然ガスを使わざるを得ないという方向に傾いてきており、このように世界的に天然ガスの需要が拡大していくことにより、価格の上昇が懸念されております。また、我が国の場合は、島国であるということから、欧米のように天然ガス産出国から直接パイプラインで持ってくることができず、液化して専用船でもってこなければならないという事情もあります。

更に、日本のエネルギー需給の安定という考え方のみではなく、世界という観点から考えれば、使いやすい化石燃料については発展途上国が使う余地を残しておくという考え方も重要です。

こうした制約を考えると、切りに切った需要見通しと供給のギャップは、量的、価格的に安定した唯一の非化石エネルギーである原子力で埋めざるを得ないというストーリーになってくる訳です。新聞等では、２０１０年までに４０基の増設ということが書かれましたが、もっとも、このうちには、既に建設に着手していたり、あるいは計画が既に確定している地点もあるわけでして、こうしたものを除いた今後の開発規模としては、２６００万ｋＷ、１基１００万ｋＷとして２６基程度ということです。

もちろん、この２６００万ｋＷの開発は容易ということではありません。チェルノブイル事故以降の世界的な反原発運動に見られるように、原子力を巡る状況は厳しいものがあり、現に、今建設中の発電所にしても、全部チェルノブイリ事故以前に地元の合意が得られていたものであって、これから開発する施設については、これから新たに地元合意を得ていく必要があるわけです。

今回の見通しでは、このようなことから、開発の可能性も念頭に置きつつ最大限の努力によって達成すべき目標として開発量が示されたわけで、結果として過去に作られた開発目標と比較すると、２０００年については５３００万ｋＷから５０００万ｋＷへ、２０１０年についても８７００万ｋＷから７２００万ｋＷへと、今までよりも下方修正されている訳です。これは、単に絶対値で下げただけではなくて、電力供給におけるシェアということで見ても、２０００年時点で４０％としていたのが３５％に、２０１０年時点では４９％としていたのが４３％に、それぞれ低下しています。

これまでお話しして参りましたエネルギー需給をめぐる議論というのは、昨年総合エネルギー調査会の報告書が出されました時に、稲葉修三会長がいっておりましたように「長期エネルギー需給見通しは連立方程式なのです。」から、どこか１行が抜けてしまうと、とたんに解答不能ということになってしまいます。すなわち、「原子力はいやだが生活水準は向上させたい、更に地球環境問題にも配慮したい。」ということを充足させ得るエネルギー源というものはないのです。

（総合エネルギー施策の推進体制）

以上、我が国の需給両面にわたるエネルギー政策の目標及びその中での原子力の位置付け、特に、長期エネルギー需給見通しの中の原子力の役割についてお話しして参りました。

通商産業省としては、目標の達成のために、総合的なエネルギー施策を省をあげて具体化・推進していくため、「総合エネルギー対策推進本部」の会合を開催し、その本部の下に、

1)エネルギー利用効率化推進チーム

2)エネルギー源多様化推進チーム

3)国際協力推進チーム

4)エネルギー広報推進チーム

の４つのチームを設置し、目標達成のための施策を積極的に展開しているところであります。

また、エネルギー施策の具体化・推進に地域の特性を反映させるとともに、草の根レベルでの広報活動を推進させる観点から、各通商産業局等に推進本部支部を設置し、講演会、セミナー、シンポジウムの開催、地方自治体等関係機関との連絡会議の開催、未利用エネルギー・ローカルエネルギー等の利用推進に係る調査・研究等の活動を実施するとともに、エネルギー広報推進チームと協力しつつ地域における各界の有識者からなる推進会議を設置して有識者等の理解の増進に努力しているところであります。

さらに、総合エネルギー調査会長期展望小委員会を開催し、施策の進捗状況等について報告をし、委員各位から意見を聴取し、今後の施策等に反映させることにより、目標達成を図っていくこととしております。

３．我が国の原子力開発の考え方

次に、今回の長期エネルギー需給見通しの中でも大宗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。

（我が国原子力政策の基本理念）

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、価格安定性に優れ、環境負荷が小さい等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、適切なエネルギー供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。

このような原子力を推進する上で、核燃料サイクルの確立は、それを支える重要な政策課題となっており、我が国においては、従来から、原子力の供給安定性をより高め、原子力を純国産エネルギーとして位置付けるため、核燃料サイクルの確立による再処理リサイクル政策をとってきております。すなわち、原子力発電所で使用した使用済燃料を再処理して、そこから得られるウランとプルトニウムを原子力発電所において平和的に再利用して行こうというものです。このような核燃料のリサイクルは、ウラン資源の安定供給と有効利用の観点から重要であるのみならず放射性廃棄物の適切な処理処分の観点からも我が国においては極めて重要であります。

皆様御存じの通り、核燃料サイクル関連の施設については現在、電気事業者が中心となって、青森県六ヶ所村においてウラン濃縮施設、再処理施設、低レベル放射性廃棄物埋設施設の核燃料サイクル３施設が建設中であり、政府としても立地対策等の面からこれを支援しているところであります。

（原子力開発目標実現のための原子力政策の重点）

以上のように、原子力の平和利用、安全確保が我が国の原子力政策の大前提でありますが、次に、今後、エネルギー需給上不可欠な原子力７２５０万ｋＷの開発目標に対して、どのようにこれを実現していくか、という課題について、お話ししたいと思います。

この原子力の開発目標の達成に必要な今後の原子力政策の方向性については、総合エネルギー調査会の原子力部会で昨年６月までの約半年にわたり御審議いただいたわけでございます。

原子力部会というのは、従来は、原子力の開発利用に係る専門的事項を中心に審議いただいていたということもあり、人数も四十名近く、構成も原子力の専門家の方々が中心になっていました。

ところが、現在の一番の問題点は、原子力の社会的受容性をいかに高めるか、換言すれば、原子力専門家とそれ以外のコミュニティのコミュニケーションに最大の問題がある訳ですから、今回は、議論の可能な人数ということでメンバーの数も２０名強まで減らし、専門家以外の評論家や社会科学者等に入っていただきました。女性の委員も、これまでは皆無であった訳ですが、今回は３人入っていただき、原子力の専門家だけでは議論し足りない点を補っていただくよう配慮しました。

この場における半年強の検討の結果出てきた結論が、目標達成のためには、安全確保対策、バックエンド対策、立地促進対策、広報対策の四つを早急に講じなければならないということです。

安全確保対策については今更申すまでもありませんが、原子力発電施設の安全な運転実績が何よりも国民の理解を得るためには重要であります。このような観点から、2月9日の関西電力美浜発電所2号機の問題は、国民各層に不安を与える結果となり、誠に遺憾なことであったと考えております。今後本件については、徹底した原因究明と再発防止対策を講じることにより、国民の信頼を回復することが重要と考えておりますが、中長期的な観点からは、今後の基数の増大等に対応した安全確保体制の充実を図っていく必要がありますので、今後検討を進めていくこととしております。

バックエンド対策というのは、使用済核燃料に含まれている高レベル廃棄物の最後の処分がどうなるのか見えないという不安を解消しようということです。高レベル廃棄物というのは、再処理工程を経ると、ガラス固化体にして30年から50年置く訳ですから、その後の処分の話はまだまだ先だ、そのための会社をつくるのも先の話だと電気事業者も思いがちですが、立地に対するリードタイムを考えると、そういうことではないのではないか、ということです。体制固めということからも、早めに取り組まなければならないと考えております。一方では、新しいアプローチとして、群分離・消滅処理といった技術開発への夢を含めてバックエンド対策に取り組むことが必要だと考えております。

立地対策については、日本全体が豊かになってきたことに伴って、立地対策としても、単に公共事業的なものをつくっていくだけでは、地元としても「それなら原子力をやろう。」という形にはなかなかなっていかないのではないか、ということです。原子力立地をした地域が、原子力をきっかけにして長期的に自立した形で発展をしていくということが、今後ますます必要になってくるのではないかという問題意識です。

そのため、企業立地の促進、地域振興のための人材育成等のソフト面での支援対策の拡充を図り、新しい時代の原子力施設と地域の共存共栄を実現していく必要があると考えております。具体的には、これまでの立地交付金を活用した公共施設の整備等を図ってきたのに加え、昨年から財団法人電源地域振興センター関連事業ができまして、企業誘致、人材育成や電源地域の特産品を紹介するイベント等を開催し、電源地域の長期的かつ自立的な振興を図り、電源立地の円滑化を図って行くこととしております。

広報対策については、安全の確保とか廃棄物対策とかを地道にやっていくだけではなくて、これらに対する「認識」が原子力についての意見に直結してくる訳ですから、広く国民の方々に知ってもらい、また耳を傾けようということです。国民の方々といっても、主として国民の中間層に対するアプローチを狙いとしており、その中間層にいかにコミュニケートできるか、というのが基本です。特に、原子力は、使用される言葉、単位やその概念が一般の方々にわかりにくいことから、わかりやすい言葉で、かつ、タイムリーに情報を提供していくことが必要であります。そのため、普通の一般市民、あるいはメディアの立場から、非常にアクセスしやすい形の情報提供インフラの整備を図っていきたいと考えております。昨年9月には、原子力情報サービス・ネットワーク（アトム・ネット）事業を開始しており、故障・トラブル等の積極的な提供に努めているところであります。

4．おわりに

以上、今後のエネルギー政策上の原子力の役割をみてきましたが、原子力は、この二月の青森県知事選でも最大の争点の一つとなったことにも象徴されるように、国内では政治・社会的問題を抱えています。また、国際軍事・政治上も、東西冷戦構造の崩壊に伴い、湾岸・東欧等における地域紛争のリスクが高まるにつれ、核不拡散政策上の問題がクローズ・アップされてきています。しかしながら、そのような問題点を十二分に認識した上でも、なおかつ、原子力なしでは今後の経済社会の絵が描けないというのが内外のエネルギー関係者に共有されている見方になっています。

このような厳しい環境の中で原子力の開発利用を進めていくためには、いかに社会的な受容性を高めていくかが重要なカギとなっております。そのためには、関係者が協調を図りつつそれぞれの役割分担の下、これらの対策を地道に積み重ねていくことが重要であります。

この場にお集まりの皆様方をはじめとして、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参ることを申し上げて、私の御報告を終わらせていただきます。

ありがとうございました。

我が国エネルギー需要の推移　（年平均伸び率　単位：%）

年度	69〜73（第一次石油危機）	73〜79（第二次石油危機）	79〜86（石油価格下落）	86〜87	87〜88	88〜89
最終ｴﾈﾙｷﾞｰ消費	９．２	０．９	△　０．４	４．８	５．７	３．４
産業	８．５	△　０．８	△　２．１	４．８	５．９	２．７
民生	１１．５	３．３	１．９	５．３	５．４	２．３
運輸	９．２	４．２	１．３	４．１	５．６	６．３

エネルギー供給見通し

	1989年度（実績）（平成元年度）		2000年度（平成12年度）		2010年度（平成22年度）		石油代替エネルギーの供給目標 2010年度（平成22年度）（原油換算万kl）（ ）内は石油代替ｴﾈﾙｷﾞｰ中のｼｪｱ
総供給量	4.99億kl（100%）		5.94億kl（100%）		6.57億kl（100%）		
新ｴﾈﾙｷﾞｰ等	640万kl（ 1.3）	14.8	1,740万kl（ 3.0）	20.2	3,460万kl（ 5.3）	26.8	3,500（ 9.7%）
水力	880億kwh（ 4.6）		910億kwh（ 3.7）		1,050億kwh（ 3.7）		2,500（ 6.9%）
地熱	40万kl（ 0.1）		180万kl（ 0.3）		600万kl（ 0.9）		600（ 1.7%）
原子力	1,830億kwh（ 8.9）		3,300億kwh（13.3）		4,740億kwh（16.9）		11,100（30.8%）
天然ガス	4,990万kl（10.0）		6,500万kl（10.9）		8,000万kl（12.2）		8,000（22.2%）
石炭	11,360万t（17.3）		14,200万t（17.5）		14,200万t（15.7）		10,300（28.6%）
石油	2.89億kl（57.9）		3.05億kl（51.3）		2.98億kl（45.3）		

（注）（　）内は構成比（%）

年度末電源構成

（単位：万kW）

	1988 年度末	構成比（%）	2000 年度末	構成比（%）	2010 年度末	構成比（%）
原子力	2,870	17.4	5,000	22	7,200	27
石炭	1,112	6.7	2,960	13	4,000	15
LNG	3,306	20.1	5,030	22	5,300	20
水力	3,613	21.9	4,450	19	5,170	19
一般	1,913	11.6	2,150	9	2,500	9
揚水	1,700	10.3	2,300	10	2,670	10
地熱	18	0.1	100	0.4	350	1
石油等	5,563	33.8	5,120	22	4,020	15
メタノール	——	-	——	-	100	0.4
分散型電源	——	-	110	0.5	570	2
合計	16,482	100	22,770	100	26,700	100

（ 分散型電源 ： 燃料電池、太陽光、風力 ）

電力供給目標

	発電電力量（億kWh）					
	1988年度	構成比（%）	2000年度	構成比（%）	2010年度	構成比（%）
原子力	1,776	26.6	3,290	35	4,730	43
石炭	636	9.5	1,560	16	1,630	15
LNG	1,414	21.2	1,880	20	2,010	18
水力	886	13.3	1,010	11	1,180	11
一般	801	12.0	850	9	990	9
揚水	85	1.3	160	2	190	2
地熱	11	0.2	60	1	210	2
石油等	1,944	29.2	1,630	17	1,050	10
メタノール	——	——	——	——	40	0.3
分散型電源	——	——	30	0.3	250	2
合計	6.668	100	9,460	100	11,090	100

（ 分散型電源 ： 燃料電池、太陽光、風力 ）

ENERGY PRIVATISATION AND THE FUTURE OF NUCLEAR POWER IN UK

1 It is a great pleasure to be here at the 24th Annual JAIF Conference. There are two themes to this speech. First, the importance of market mechanisms in developing and implementing energy policy; second, the increasingly international nature of the nuclear industry, demonstrated incidentally by the attendance this afternoon.

2 There is an increasing trend all over the world to move towards market solutions to economic problems particularly in relation to resource allocation. Britain's experience in the energy area is particularly instructive in this context. It is 12 years since the incoming Conservative Government - then under the leadership of Mrs Thatcher - embarked on a radical new direction in the energy sector with the aim of introducing a genuinely competitive market in energy.

3 The recent successful flotation of the generating companies, National Power and PowerGen, represents only the latest stage in this development. It followed the sale of the 12 Regional Electricity Companies in England and Wales, and marks a further important milestone along a road which is now fast changing the nature of Britain's energy economy. With the majority of the electricity

industry in England and Wales now sold, the next stage will be the sale of the vertically integrated Scottish electricity companies, Scottish Power and Scottish Hydro-Electric, which is now expected very shortly. John Wakeham, the Secretary of State for Energy has also recently confirmed that the UK government intends to privatise the British coal industry after the next election.

4 The UK electricity supply industry provides perhaps the clearest example of the move away from centrally planned public ownership, and its replacement by a regulated commercial market. Ministers took the view that, until very recently, our electricity industry was still dominated by a monopoly cost-plus producer selling to a number of regional monopoly suppliers - a system which not only denied customers any effective choice, but which arguably also encouraged a heavy over-reliance on the technology of a relatively few very large power stations, whether fossil fired or nuclear.

5 Now a thriving new market has developed in electricity, putting pressures for increased efficiency on everyone serving that market. The removal of the generating monopoly has encouraged a new wave of independent power producers and introduced a more dispersed pattern of investment in alternative sources of power generation, particularly in 'cleaner' combined cycle gas turbine power stations.

6 As a result the restructured electricity industry in the UK is becoming a different kind of business from that of its predecessor. A recent independent study has suggested that the introduction of new producers; continued progress towards the Single European Market; and public demands for a cleaner environment, are now all converging to create growing pressures for a similar change of direction in Western Europe.

7 Britain's experience provides a clear demonstration that the transition from monopoly to regulated markets can help to bring about changes which would be hard to contemplate under public ownership. The aim of Ministers has been the injection of new ideas and of a more entrepreneurial spirit; the challenging of old orthodoxies; and an increase in the pressures to use energy more efficiently supported by the Department of Energy's Energy Efficiency Office. Their objective has been to stimulate the energy sector to be far more responsive to the needs of customers.

8 Government policy is that the new market-based approaches remain the key to maximising the efficiency of energy production and use and determining the most efficient allocation of energy resources. The price mechanism is crucial in influencing changes in behaviour, as the world's energy-saving response to the oil price rises in the 1970s demonstrated, and market-based systems

now look set to become steadily more influential in responding to the threat of global warming - both in Britain and throughout Europe.

9 That does not mean that there is now a total free-for-all in the UK. Private ownership is coupled with public regulation for both electricity and a number of other industries. Regulation continues to play an important role in our energy sector, not only to reinforce competition and to protect the consumer, but increasingly to protect the environment - an issue which has grown dramatically in international political importance during the last decade.

10 One of the central objectives of UK energy policy is to maintain a wide diversity of energy resources so as to enhance the security of our energy supplies. This policy has stood us in good stead in the past during the long strike by coal miners in the UK when nuclear energy made a valuable contribution. It will be equally important in the future to insure against unforeseen developments by deriving our energy from a variety of sources.

11 The UK is of course an island built on coal. Calder Hall which opened in 1956 was the first industrial-scale power station in the world to demonstrate the commercial potential of generating electricity through nuclear fission. It is still operated by BNFL and its life is likely to be extended to 40 years. This Magnox station

provided the model for the first commercial nuclear reactor in Japan which was completed in 1965. And now the UK is one of the world's leading producers of oil and natural gas through the development of our substantial North Sea oil and gas reserves.

12 This means that the UK can draw on a wide variety of primary energy resources to generate the electricity we need including coal, oil, natural gas, nuclear power and, mainly in Scotland, hydro-power. At the moment, coal provides some 70% of the fuel used for electricity generation in the UK, nuclear 20%, oil around 8% and hydro just under 2%. Gas is only playing a negligible role at the moment, but this will change, partly as a result of electricity privatisation. The British Government is also continuing to demonstrate its commitment to the development of "clean" renewable energy resources, both by supporting a growing programme of research and by the new incentives introduced under the electricity privatisation legislation. These have already ensured a virtual doubling of renewable capacity in England and Wales.

13 What role is there for nuclear power in the UK in this new market dominated environment? Much will depend on the industry itself. If nuclear is to continue to play its part, the industry will need to demonstrate that:-

* it can maintain high safety standards; and that

* it can generate electricity in an environmentally beneficent way.

* it can also generate electricity at an economic price.

The history of recent years also suggests that the future of nuclear power in one country is also dependent on its success (or otherwise) in other countries, hence the second theme of this speech, the internationalisation of the nuclear industry and the need for co-operation in an increasing number of areas.

14 First, safety. All forms of energy production entail risks if not properly controlled. Nuclear power is not unique in this respect. Both the coal and the offshore oil and gas industries have experienced major disasters in the UK, such as those at Aberfan and Piper Alpha. Nevertheless, for whatever reason the nature of nuclear technology arouses special public concern.

15 The British nuclear industry has an excellent safety record. Indeed, it is arguably the safest industry in the UK as well as the most regulated. Only 0.1% of the annual radiation dose to which the British population is exposed comes from the nuclear industry. About 87% of the radiation to which we are exposed each year comes from natural sources such as rocks, soil, cosmic rays, food

and drink. Most of the remainder comes from medical uses, such as diagnostic X-rays.

16 We are, as many of you will know, expecting new recommendations from ICRP to be published any day now which will in turn lead to further pressure and requirements aimed at improving radiation protection. The Government policy is that the basic principles of ICRP should be followed - namely, that all individual doses should be kept below the statutory limits and that all reasonable steps should be taken to reduce doses even below dose limits.

17 As all of us here know, the nuclear industry gives safety extremely high priority, starting with the initial design of a plant through construction, commissioning and operation to decommissioning. In the UK all these stages are subject to rigourous licensing procedures administered by the Health and Safety Executive's Nuclear Installations Inspectorate. Other countries have similar arrangements. This commitment to safety, together with the highest standards of regulations are important, because public concerns about nuclear power are often based on fears of the unknown - on misunderstandings about the dangers of all sources of radiation and misconceptions about nuclear safety aspects.

18 Some of their concern has been stimulated by accidents in other countries or by misinformation about

procedures elsewhere. There can be no doubt that responsibility for nuclear safety must remain with individual governments. Nevertheless there is cope for improving the exchange of information between regulators and working towards a greater commonality of standards. Useful work is being carried out under the auspices of the International Atomic Energy Agency through INSAG and NUSSAG and through the regional groupings of regulators. Through these processes we are all developing a greater understanding of procedures adopted by other countries and are in a better position to learn from them.

19 At the same time many countries have offered help to the countries of Eastern Europe so that they can develop an improve their own standards. Some of this is at a governmental level, including action through the European Community. Some is through the IAEA - for example the work on VVER reactors; other important assistance is provided through WANO which has developed a useful mechanism for passing on experience between operators themselves.

20 Looking to the future, the nuclear industry will need to explain its record on nuclear safety more clearly and more persuasively. It will need to dispel, once and for all, the view often voiced in public, that the industry is a closed world where secrecy prevails. It will also be necessary for this to be done to satisfy a wide range of international opinion.

21 This will not be easy. There are, of course, some whose opposition to nuclear power is so deeply rooted that they will seek to exploit any information to discredit the industry and those who work in it. But if the nuclear industry is to allay the concerns of the wider public, the operators of nuclear sites, the industry and Governments must take every opportunity provide clear factual information to enable people to make their own judgement based on a rational assessment of the facts.

22 We have certainly found this to be the case in the UK. The Visitor Centre at Sellafield has proved to be one of the most successful tourist attractions in the country and attracted more than 130,000 visitors last year. A large number of the public also visit the UK's nuclear power stations and our nuclear industry is developing a more open approach to the public as well as a co-ordinated strategy for providing information about its activities. This will take some time to bear fruit but it is interesting to note the positive experience of Nuclear Electric from consulting the public about the best way to decommission their gas cooled power stations.

23 I should stress that there is an international element to this issue. We need to develop ways of communicating not just within our own countries but between them and to exchange experience of the most

effective ways of explaining the facts about nuclear power. Here the current trial of the International Nuclear Event Scale (INES) - in which the UK is participating - is an important test of the advantages of greater co-operation in order to allay fears about events at nuclear power stations.

24 Similar considerations apply to the environment especially some materials can remain radioactive for hundreds or thousands of years. The UK Government has therefore set strict safety standards for their use, storage and disposal. The Government is confident that the present disposal and safety arrangements in the UK are safe, but it recognises the need to provide methods of permanent disposal eventually for intermediate and high-level waste. NIREX, the company charged with developing a site for a repository for low and intermediate level waste is making good progress and hope to be able to choose a site later this year. It will then develop the safety case in very great detail and put in a planning application. This will build on the very considerable expertise of the UK in the management of nuclear waste, expertise which is now providing itself by being chosen by a number of other countries.

25 I know that here in Japan many of you are aware of the excellent work BNFL has done in this area. Over the last 12 months they have successfully commissioned at Sellafield both their vitrification plant for high level

waste and an encapsulation plant for intermediate level waste. A number of additional waste management plants are also now nearing completion. These plants demonstrate clearly that the wastes arising from reprocessing can be safely treated and stored, and are further evidence of the considerable progress that has been made in solving one of the key problems faced by the nuclear industry worldwide.

26 Environmental concerns have, of course, been with us for a long time. We have removed many of the slag-heaps from past coalmining operations; and introduced the Clean Air Act to banish smog from our towns and cities. More recently, we have been much more aware of the damage from acid rain and of the threat of global warming, further examples of the international aspects of these issues.

27 The British Government made a commitment in May last year to stabilise the country's carbon dioxide emissions at 1990 levels by the year 2005, provided other countries also played their part. This is a demanding target involving costs to the economy. Nuclear energy has, and will continue to have - an important part to play both in curbing acid rain and in combating global warming.

28 This is because nuclear stations emit practically no sulphur dioxide or nitrogen oxides - the principal ingredients of acid rain - and practically no carbon dioxide - the principal greenhouse gas. If the

electricity currently provided by nuclear power stations were to be generated by gas, Britain would emit about 7 million tonnes more carbon, increasing total emissions by about 4.5% each year. If the same amount of electricity were generated by coal our emissions would increase by around 15.5 million tonnes each year, increasing total emissions by nearly 10%.

29 For these reasons the UK Government wishes to maintain the nuclear option, but only if nuclear power in the UK becomes more economic and the industry demonstrates it can continue to maintain high standards of safety and environmental protection.

30 At current levels of fossil fuel prices, nuclear power in the UK is more expensive than electricity generated from new coal, oil or gas-fired stations although this is not true of other countries. These extra costs were present before and have not been increased by privatisation. While they were collected from the customer before privatisation through the bulk supply tariff, which essentially arranged costs over all fails, they are now paid by consumers in an explicit way through the nuclear levy which, under the present arrangements, runs until 1998. In the longer term, nuclear power will have to improve its competitiveness and will only attract investment if it is economic in comparison with other fuels. Nuclear will have to compete with other technologies, on fair terms, while

winning public confidence through its high safety standards and by generating electricity in an environmentally beneficent way.

31 I believe that there should be scope for the costs of nuclear power in the UK to be reduced, without in any way compromising the industry's high standards of safety. It will be necessary to reduce both operating and backend costs but a key will be to reduce the capital costs of new stations. In terms of construction, it will be important not to build a series of individual prototypes but to gain from the experience elsewhere in the world. Obviously greater international standardisation of designs would be an important factor in allowing vendors to go down the learning curve quicker and hence to reduce costs faster.

32 Concern about the environment may also help nuclear power improve its competitive position vis-a-vis other fuels. One reason for the high cost of nuclear power is that under other fuels it bears directly the environmental costs of its fuel cycle, in particular the cost of the safe disposal of its waste. The relative economics of nuclear power (and also of renewable energy) could improve if the environmental costs of fossil fuels were taken into account on a comparable basis: more work is needed to explore this.

33 I should say a few words here about the new nuclear Company, Nuclear Electric, which has been created from the nuclear division of National Power within a remarkably short time and has now completed its first full year of existence. A new organisational structure is in place, as well as a new Board and they are addressing both the problems of cost reduction and the future of nuclear power.

34 The fact that this year Nuclear Electric has produced more nuclear electricity than ever before in the UK - a notable performance - is a very encouraging start to the Company's existence. This is an example of what can be achieved by a company concentrating on its own business. I know that John Collier has made a continuing improvement in output one of his central objectives for this company, and further improvements in the performance of the AGR stations will clearly be a vital component in achieving this aim. Exploring the scope for extending the lives of the Magnox stations (it seems an average life extension of 6 years is achievable) could also make a major contribution, provided that any investment involved gives a full economic return. The Government has made clear that as far as existing nuclear stations are concerned in principle and subject to the views of the Nuclear Installations Inspectorate, it would be willing to sanction economic investment in life extensions of existing plant.

35 The Government has said it will undertake a full-scale and wide-ranging review of the prospects for nuclear power as Sizewell B nears completion 1994. Construction of Sizewell B is now, of course, well under way. Progress by Nuclear Electric is ahead of schedule and the station is on course to generate full power in 1995.

36 This timetable for the construction of Sizewell B means that we should have some firm evidence of the cost of PWR construction in the UK, when we undertake a comprehensive review of the prospects for nuclear power in terms of diversity, environmental and economic arguments. This intervening period will allow the industry time to reduce costs as far as possible to help the economic case for nuclear power. As you will know, the Secretary of State has given consent to the construction of a PWR at Hinkley Point but has made clear that his decision on whether Nuclear Electricity would also be given the necessary financial approval would depend on the economics and on the outcome of the 1994 review.

37 The review will have to consider every aspect relevant to nuclear power, including its economics and its contribution to the diversity of energy supplies, as well as the development of new generating technologies and their economic and environmental implications. But Nuclear Electric's own business record and prospects for

viability will obviously also be a major factor in influencing the outcome of the review.

38 The review will also have to take account of the experience of other countries. It will have been clear from this talk how many of the issues relevant to the nuclear industry have an international dimension. Indeed public opinion would, I am sure, take comfort from a greater commonality of approach to nuclear issues. It was for this reason that the five countries and substantial nuclear programmes in the European Community issued only [two weeks] ago a joint declaration stressing the importance of nuclear power as an energy source in their countries and committing themselves to developing and strengthening their existing co-operation. This will include:

exchanges of information and staff
trying to align safety objectives
spreading best practice
co-operation on design of new reactors
co-operation on aspects of the fuel cycle

This declaration makes an important step forward in co-operation between our countries and one on which we are all keen to build, taking account of course of our membership of the European Community and in the IAEA.

39 Where, finally, does all this leave Nuclear Electric? History demonstrates it is a brave man who speculates about the long-term energy market. But I can say this. Nuclear power has two important things in its favour.

40 First, it remains an important component in the diversity of our energy supply - and thus the security of our supply - whose importance has been demonstrated a number of times in recent years. Secondly, nuclear energy remains the only large established technology for baseload power stations which emits no greenhouse gases. It will be very difficult for the world to meet future energy demand without adding to global warming in the absence of a contribution from nuclear power.

41 For these reasons, the British Government wants to maintain the nuclear option, provided the industry can demonstrate it is an economic option and that it can maintain its own high standards of safety and environmental protection. It is also clear that whether these demands are met will depend on what is achieved internationally by the nuclear industry and in no small part by how prepared are the nuclear industry and the regulators in different countries to work together for common ends.

CZECHOSLOVAK ENERGY POLICY AND NEEDS OF INTERNATIONAL COOPERATION

In the end of 1990, a new energy policy of Czechoslovakia was formulated. The draft was submitted for approval to the Federal Government, both republic governments and all three parliaments. The energy policy should represent a joint product of all partners involved, mainly of those who are responsible for environmental matter in our country.

The new policy´s global strategic objectives are as follows :

- Reduction of Energy Demands of Our Economy

The consumption of and demand for energy in all former Eastern Bloc countries are so high that these countries should focus, as their first-rate priority, on reducing the demand for energy dramatically in every sector of their economies, mainly in the industrial one.

- Giving a Necessary Background to the Czechoslovak Economy

We are aware of the fact that ensuring a continuous supply of all types of energy is a prerequisite no economic reform activities in our country can dispense with.

- Utilization of Domestic Energy Resources

In the future, we would like to be as independent as possible, because we know from our own experience what being dependent on a single supplier, in our case the Soviet Union, amounts to. There was nearly a hundred percent dependence in oil, a hundred percent dependence in natural gas and a hundred percent dependence in nuclear fuels.

- Intergartion of the Czechoslovak Energy System into the European System

This is a big task for all energy-related industries of our country, a key to the diversification in all forms of energy, which we have to achieve in a few years. We would like to connect our high-voltage networks to the Western grid and this means our power system will have to meet a number of conditions and requirements. At the moment, our power system is connected to the Western part of Europe by means of DC stations. The capacity of these DC stations is not high enough to permit establishing in Central Europe, which is where our country lies, what I call "a crossroad of energies". So far as natural gas is concerned, our position is advantageous in that all gas supplied by the Soviet Union to Western Europe has to be delivered there by means of a transit gas pipeline going through our territory. Of course, we will have to diversify even in this field in the future. This means we will have to build a gas pipeline with a capacity high enough to permit us to use, apart from Soviet gas, also Norwegian, Algerian and in the future also Iranian gas. As to oil, the situation is the same - we fully depend on supplies from the Soviet Union. We are trying to build a pipeline connecting Austria and Czechoslovakia as fast as possible, and another pipeline to Germany, by means of which we would be able to get oil from South European ports. The ultimate objective is to make Czechoslovakia completely independent on any single source of oil. All these diversification programmes are being discussed either bilaterally, with different European countries, or in the framework of a group called "The Pentagonal", which comprises countries working together on these big projects - Italy, Czechoslovakia, Austria, Hungary and Yugoslavia.

The most important objectives of our new energy policy are as follows :

- Reduction of the production of black and brown coal as a step necessary to improve the environmental situation in our country

For example, our 1989 outputs of brown coal and hard coal were about 100 Mt and 26 Mt, respectively. We have already cut down the brown coal production by some 20 Mt and we plan to reduce it to 50 % of the 1989 figure by 2005. Brown coal is mainly used to generate electricity. As its parameters are rather bad (approx. 4% of sulphur and about 30 % of ashes), we will have to slash down its uses as much as possible, or find a clean way to burn it.

By 1995, we plan to phase out 1,200 MW of the generating capacity of conventional power stations located in North Bohemia, which is the worst-polluted region in Europe.

We will have to increase the proportion of gas in our structure of energy resources and build bigger underground gas storage facilities to be able to make the system capable of meeting all relevant requirements. As in every country, we will have to reduce the consumption of oil and we will also have to build storage capacities which are practically nonexistent at the moment.

We will also try to make a better use of our hydropotential, although most of it has already been in use.

We will have to finish the construction of the Mochovce nuclear power plant, which should deliver 4 x 400 MW, as well as the first and second generating units of the Temelín nuclear power plant, where we will build two units 1,000 MW each.

In the very near future, we will have to choose construction sites for two additional nuclear units delivering 1,000 MW each.

As in every country, there is a lot of discussions between professionals and the public in Czechoslovakia as well, which are concerned with the future ways of generating electric power in our country. Potential options include

- clean combustion of coal,
- gasification of coal and steam-gas cycle power plants, including a higher use of gas for these plants,
- nuclear power plants.

We should also be able to make our energy policy to be reflected much more on a regional scale, and to work more closely with inhabitants of these regions. In the future, even the energy industry will be open for Western capital and, indeed, any capital willing to come to our country. We have established a Federal Energy Agency which we hope will facilitate the implementation of all energy conservation and saving programmes. We are aware that these programmes could only be launched when we will have abandoned the policy of cheap energy, which has been in effect until now. We plan to introduce a policy of expensive energies.

We also intend to make our conventional power plants cleaner and more environment-friendly, which will amount to fitting them with desulphurization and denitrification systems. We do not have these technologies at our disposal in Czechoslovakia yet. Consequently, we would welcome if foreign enterprises dealing in this sphere of business came to Czechoslovakia, established joint ventures with our companies and helped retrofit these old conventional power stations.

We will have to equip our central heating systems with accurate instrumentation and meters permitting the consumption of heat to be measured in an exact way. We anticipate that these measures might result in savings as high as 40 % in this type of energy, which is supplied to many places and to our households.

The Role of Nuclear Energy in Czechoslovakia

The role of nuclear energy in our country is important not only because these plants presently account for some 28 % of the total power production. It is also important because our country lies in the middle of Europe and, as you know, there is a lot of talk in Europe now at the governmental or parliamentary level as to whether nuclear power is really the best way or the right way to follow as far as the future production of electricity is concerned.

Our situation is maybe even more sensitive in this respect because - as you know - we have some 3,250 MW of nuclear power generating capacity in operation. For historical reasons, there nuclear power plants are based solely on Soviet technology. After the Chernobyl tragedy, we had to explain for many, many months that the reactors we were using - VVERs - are of a physical desing utterly different from that used in Chernobyl. Other Eastern countries, such as Bulgaria or Hungary, find themselves in the same situation. This also applies to the former German Democratic Republic. All these countries use the same type of reactors that we have.

Our installed capacity is based on Soviet VVER 440 reactors. We have two units of the oldest type, V 230, which is the same reactor as that in Greifswald, formely in the German Democratic Republic, and additional six units of the more advanced VVER 440 type, also known as V 213. All these units are operating in Slovakia, in Jaslovské Bohunice. Additional four units are operating in Moravia, the local site being called Dukovany. To upgrade these units, we organized international expert teams, which helped us evaluate and assess their safety sytems and enabled us to take measures that would bring the safety of our units to a level consistent with European standards. In this respect, we have been cooperating very closely with the International Atomic Energy Agency in Vienna, and we are also trying to make use of services and assistance of the WANO.

We have two nuclear power plants under construction at the moment, one of them being Mochovce, with a capacity of 4 x 440 MW. The other site is Temelín, where we are building two units 1,000 MW each. Both power plants are again based on Soviet technology. We will have to upgrade these units as well before they will be put into operation. In particular, we will have to improve their instrumentation and control systems. The building procedure for deliveries of the above equipment has already started and I must admit it is the first big tender we have to cope with after so many years of planned economy, during which such approaches were unthinkable. In order not to waste much time, we are organizing a tender for additional two nuclear units the size of which should not exceed 1,400 MW each and which should meet the most stringent nuclear safety standards.

Of course, all this has been taking place alongside with talks and discussions as to what source of energy should be best for Czechoslovakia in the future. We have nuclear power in our country and we will have to solve all problems associated with the nuclear energy production. These are as follows:

- As we have enough uranium, we try to be independent on the Soviet Union in manufacturing our own nuclear fuel. This is our objective. Naturally, it will require a lot of efforts to talk it out with our Soviet colleaques.

We might establish a joint venture or a consortium to be able to produce nuclear fuel whose parameters would be better than those of the fuel we import from the Soviet Union, by using Western technology for this purpose. This will of course be a part of the diversification programme I have mentioned before.

- Another problem we are facing consists in our very limited capacities for the storage and disposal of spent nuclear fuel. Until now, we have been fully dependent on an agreement with the Soviet Union, pursuant to which the Soviet Union has undertaken to take back the burnt fuel which it supplied for our plants. In the future, we will have to prepare ourselves for a situation in which it will no longer be possible to transport spent fuel back to the USSR. Consequently, we are now assessing various concepts involving intermediate or long-term storage facilities. In this respect, we will also have to cooperate with or find partners among our much more experienced Western colleagues.

- We also have to take care of all kinds of radioactive wastes. We are now building two regional radioactive waste storage and disposal sites located at nuclear power plants. These are surface pool-type waste disposal sites. So far as the disposal of highly radioactive wastes is concerned, Czechoslovakia has not yet taken any decision as to what technology should be employed. In this respect, we would also like to cooperate with industrially developed Western countries.

- During the last two decades of the development of our nuclear power capacities, the sphere of public relations has been completely neglected and we are paying for our negligence dearly at the moment. Consequently, our efforts are now focusing on explaining all aspects of energy, environment and especially nuclear energy at every level (power plant, regional, parliamentary, national, international). Hence, we would also like to seek advice in countries such as France and Japan, which we know are very experienced in public relations with respect to nuclear energy, as their results in this sphere indicate.

Ing. Jan J í c h a, Deputy Minister,
Federal Ministry of Economy

29. března 1991

JAPAN ATOMIC INDUSTRIAL FORUM

April 7, 1991

Towards new global cooperation

by Rémy CARLE
Deputy General Manager
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Mr Chairman, ladies and gentlemen,

I am extremely honored to have been invited by the JAIF to address this annual congress. There is certainly no better demonstration of the international character of nuclear energy than the worldwide importance and reputation of the JAIF congress.

I think this is the fifth paper I have been asked to present before this distinguished audience. Over the years nuclear energy has increased its presence in our world, its industrial performance and its experience. In all nuclear countries, 1990 was a year of impressive records regarding availability, safety and economy of nuclear installations. And yet during the same years the distrust or the opposition of the public increased in most countries ! Shall we accept this paradoxical situation ? It could mean losing fifty years of scientific and technological efforts and putting in danger the energy and ecological future of our planet.

At the risk of repeating more or less my previous speeches I would like to develop three simple points :

- first, my conviction that the world will not be able, in the next decades, to balance its energy budget without nuclear energy,
- second, that nuclear energy is precisely the form of energy which best fits with the profound aspirations of our societies for a clean world,
- and lastly in a more and more interconnected, unified world, we must unify our efforts both to make these convictions clear to all people (Nuclear energy is first and foremost a public relations problem) and to build the worlwide nuclear market which will assure the best performance of nuclear energy. And we must achieve this at all levels : research, manufacturing, electrical utilities and safety authorities. It is not too early to do so because we have a long way to go and because this is the only way to go : the way towards new global cooperation.

Nuclear energy is a must

Japan and France are certainly the best proof of this necessity. Both countries are confronted with the same problem : limited natural energy resources to satisfy both the growing electricity consumption needs of an advanced industrial infrastructure and the quality of life aspirations of a large population.

There is no oil, no natural gas and little coal either on the Japanese archipelago or in continental France. There are hydropower resources, of course, but nearly all the capacity has been exploited. Furthermore, one cannot expect any significant contribution from renewable energies such as solar, geothermal, wind or waves, which remain dreams more than viable industrial solutions. Our two nations have therefore made a choice: patiently, step by step, we have built -- and will continue to build -- a comprehensive system of nuclear facilities. We have decided to guarantee control of the entire chain, from uranium mines to storage of waste. And we have shown that it is possible to develop a major nuclear program within a reasonable time frame, under competitive economic conditions and in strict observance of the most exacting regulations concerning safety and protection of the environment.

The figures behind this achievement are impressive and worthy of note: at the beginning of 1991, Japan counted 40 reactors in commercial operation and France 53. In addition, a further fifteen reactors in Japan and eight in France are either on order, under construction or in their commissioning phase. The results are equally eloquent: three quarters of France's electricity and nearly one third in Japan is nuclear generated.

In France, the restructuring of the country's installed base to shift from fossil-fired to nuclear power plants has been terminated. New projects now focus solely on meeting increased demand. Work will begin on only a few plants in the next ten years, before major projects are initiated to replace the existing generation of reactors.

In Japan, the carefully planned development of your nuclear power program covers several decades. As is the case in France, your government is aware of your country's greater interests. And like France, the Japanese utilities know where their best interests lie. The public, while expressing a certain amount of concerns since the Chernobyl accident, remains in the majority favorable to operation of existing plants. However, there is greater reticence among the general public with regards to creation of new plants.

I often note that each particular country can certainly banish nuclear energy if it decides to do so. Even Japan and France could do. They would pay more for their electricity ; they are probably rich enough for that ; they would pollute the atmosphere but that would not add so much to global pollution. They would lose their energy independence ; many countries accept this situation.

It would not be a catastrophy for any nation to avoid nuclear energy, but it would be a catastrophy for the world.

I shall not repeat here the demonstrations made at the last World Energy Conference in Montreal ; they will be repeated in the same terms in Madrid next year.

With an increased population estimated at 12 billion people in 2020 even with still great inequalities in economic and living conditions, the current figures of energy consumption have to be doubled somewhere in the next decades. The eight billion metric tons of oil equivalent consumed each year must be increased to about fifteen. Such figures will not be reached without a significant contribution of uranium.

The Gulf crisis reminded us the fragility of the oil market. We have surprisingly seen rather low costs per barrel but it made clear that this situation can change any time for some political reason. The world coal market remains and will remain low ; coal will be burnt near the mines, which means in few countries. Renewable energy sources - as I noted - are dramatically limited.

In today's world, and most certainly in the future, a growing number of people seek a better life - with continuing progress. To achieve this, they need more and more energy and electricity.

If nuclear energy is not available worlwide during the next century, the world will face a deep energetic deficit, which means great dangers for social and political welfare.

Today a quarter of this energy is in the form of electricity. And of this electricity, nuclear power supplies a little less than 20 %. This is both a little and a lot. In terms of relative proportions, it is not very much, but it does represent major growth potential. In absolute terms, it is a great deal, representing some 450 million metric tons of oil equivalent and equal to all hydroelectric-generated electricity. What would happen if these 450 million tons of oil wore suddenly to disappear ? It would result in a sharp increase of the costs, of the various energy materials. Here again rich countries, even strongly affected, would progressively recover. But the poor countries would become poorer, without hope of restoring their economies.

Let me add that most of these countries do not now have the necessary competence for nuclear operation. As developed countries we have a duty to leave them the time needed to improving their industrial capabilities and their technological skill.

<u>An ecological source of energy</u>

Nuclear power also responds to environmental needs. It's clean, it avoids the emission of dust particles, sulphur and nitrogen dioxides, and has no harmful effect on land surface, unlike hydroelectric power.

Today, we have become aware of our limitations. The human race can no longer ignore the fact that its activities have altered the face of the natural environment, polluted the water we drink and the air we breathe. In addition to the gradual destruction of the forests, the world climate itself is now changing. And as for the greenhouse effect, how justified are peoples' fears? I would not like to venture into drawing conclusions. In any event, the question is still to be answered. But in fact we already know the answer: we have to slow down our consumption of fossil fuels, or at least reduce it. As for renewable energy sources, such as solar energy, these are not tangible alternatives and no one is capable of predicting the miracle that might solve this situation. Under such conditions, how could we possibly dispense with nuclear power without worsening the very situation we are trying to improve ?

I would not like to be too dogmatic about acid rain or the greenhouse effect. I feel much has still to be learnt ; and it is our duty to learn, as quickly as possible. The only conclusion I stress at this point - but I think it is a vital one - is that we must keep all available options open. When we know more, we shall be able to choose if necessary and more probably use all of them.

But we must understand that an energy option remains open only if we use it today, if we improve it tomorrow and make use of all technological progress to improve it.

Of course there are some stones on the path we have to follow to prove the ecological value of nuclear energy. First of all, public opinion remains extremely influenced by Chernobyl. But Chernobyl is not the only issue and a satisfactory response to the question of storage of nuclear waste must also be found.

Regarding Chernobyl, we must clearly and repeatedly communicate the following points :

- Chernobyl was an unacceptable disaster and if it is thought that a similar accident could occur in one of our own reactors, then we, as nuclear operators, should be the first to refuse to continue operations and set about installing new units.
- unfortunately, it is likely that a disaster of this magnitude may have delayed consequences for the health of those people most directly affected by the accident. This is no reason however, to draw a comparison just to cause a sensation. Soviet officials have indeed confirmed to us that malformations among livestock are no more widespread that those that existed before the accident. Is it not out duty to clearly establish this fact and to say it aloud, if only to reassure public opinion ?
- our reactors are safe and "Chernobyl" could never happen in ours. The accident was the result of a combination of errors and failures due to a political and technical system totally opposite to our own ; a system which adopted an unstable type of reactor, which we had refused to use ; a system which considered it was possible to bypass the use of a containment building that would have limited the consequences of the accident ; a system which tolerated technical incompetence and inexperience on the part of operators, which allowed for an accumulation of mistakes, violation of regulations and the removal of safety systems. All of this is totally inconceivable in our countries.
- we do not claim to be infallible nor do we exclude the possibility of an accident. We can, however, guarantee that in the event of an accident, there would be no possible comparison between its consequences and those of Chernobyl, nor would there be any serious repercussions on either public health or the environment.

So what cowardice is it that prevents those who are aware of these facts, be it engineers, politicians or journalists, from clearly stating them ?

Of course, even if our present installations have achieved a high degree of safety, we have to conceive for the future still better plants and factories. We want to reduce even further the probability of serious accidents and to restrict their consequences in terms of releases.

Although extremely low, there still exists the risk of releasing radioactive products created by fission into the atmosphere. In our reactors, we have reduced this risk to an extremely low level, but we wish to reduce it even further. We should, however, be very careful about trying to convince the public that zéro risk is still an attainable goal. We run the risk of discrediting existing installations without having first convinced public opinion, or bringing significant improvements to safety.

The reactors of the future must not become purely passive systems, nor must utilities operate systems for which they would have no means of intervening in the case of an unforeseen event.

Do not conclude from the remarks, however, that there is no room for progress. The solution lies in the development of reactors which combine a "forgiving" design and operating features. It would be absurd to make a clean sweep of our experience with proven reactor types under the pretext that we are aware of some small disadvantages.

The construction now underway of large ABWRs in Japan is certainly an excellent contribution to this progress. And we must hope that some APWRs will be built in the near future in this country. Significant steps forwards in the fuel cycle (enrichment, reprocessing) will also appear during the next decade, particularly in Japan.

In France, we are building the first two units called N4 which take into account all the feedback of ten years of operation and include a particularly performing man-machine interface. The studies of the plants to be built in the next century, particularly to replace the present reactors, have begun, under the name REP 2000.

Eurodif continues its remarkable performance. The "La Hague" reprocessing plant has now been enlarged to a capacity of 1600 tons/year : the startup of UP3, part of this enlarged plant, has been remarkably successfull.

All these steps forwards are being made in a full continuity with the past and the present nuclear achievements in our two countries, which is the best assurance we can have for the future.

Towards global cooperation

Let's not forget that nuclear energy has long been, since its beginning, the focus of strong international cooperation. Of course, this aspect somewhat disappeared during the sixties and the seventies when nuclear energy seemed to evolve competitive market business. It is clear today that the advantages of cooperation prevail over competition.

And we must go further.

The first area we must examine is certainly Public Relations. Our problem is no longer a technical problem but a P. R. problem. And we have to defend nuclear energy with one voice. Any discrepancy will be used by opponents to attack our good faith.

It's also clear that some arguments given to media by a foreign source will have more strength than those given by the usual domestic counterparts.

This collaboration is already currently reflected by Japanese and French organizations. We have sent a woman who is in charge of one of our nuclear plants for an interview on Japanese TV. Her remarks, as a woman and as a responsible person in France, probably for some illogical reason, have more weight than a similar Japanese person would have. In France, we often use the exemple of Japan as the best exemple of another country strongly committed in nuclear development. Of course, the mentalities, the context of the Japanese and the French public opinions are somewhat different and the messages have to be adapted. But why should'n't we succeed where internationally minded environmentalist organizations do ? Let's not forget the opposition to nuclear power is clearly a multinational entreprise.

I am convinced that in a few years from now we shall have to extend our P. R work beyond borders and create some international agencies. Right now, Foratom, the European nuclear lobby, has decided to ask a representative to defend the nuclear option in Brussels, before the European Commission and the European Parliament - And this is only the beginning.

On the industrial side, we must recognize a very important point : most nuclear power plants built in the West are based on the same technology, whether pressurized water reactors (the most frequent) or boiling water reactors. Since the 1960s, when the first reactors of this type were installed in the United States, these plants have accumulated a wealth of experience. Lessons learned in plant operation have been taken into account when designing new facilities and, where necessary, corresponding modifications have been incorporated into units already in operation. All units have now reached a similar stage of development. First built under licence, i.e., based on common plans and specifications, nuclear plants were subsequently built using the same principles, but integrating the individual features of utilities in the different countries. This unity of technology makes cooperation between manufacturers easy and natural.

There is probably not enough room in today's market for as many manufacturers as in the past. Today, as a united Europe is gradually constructed, we are witnessing the formation of transnational industrial alliances. Joint ventures, such as those set up between Framatome and Siemens, Asea-Atom and BBC, Alsthom and GEC, offer the ideal opportunity for creating common standards for future production units. In particular we hope that the common subsidiary of Framatome and Siemens, Nuclear Power International, will define in the next years, a European PWR, which could be adopted by all European (or non-European) utilities.
Ties between Japanese and American manufacturers express a somewhat different approach to this cooperation. This concentration process will continue, and only a handful of suppliers will remain. Electricity producers must also join forces to a greater extent. Only through the type of cooperation that has already begun will they be able to take advantage of possible interconnection of their grids to make better use of their generating resources and avoid excess investments, while at the same time augmenting grid stability. Both the producers and consumers will benefit from such cooperation. There is considerable room for further exchanges among utilities. This is vital in Europe if we are to satisfy the needs of East European nations, which must close a large number of both lignite-burning plants due to the excessive pollution they produce, and numerous nuclear units, given the danger posed by their continued operation.
Electricity producers must also unit to define a maximum number of common standards. There is every incentive for such standardization, from lower equipment costs to easier maintenance and better control over safety.

Looking beyond differences among specialists, electricity utilities must join together to clearly define their needs to the manufacturers, and lay the foundations for the nuclear power plants of the future.

Lastly, they must share operating experience. The formation in 1989 of the World Association of Nuclear Operators -- WANO -- has provided a vehicle for this, not only with regards to incidents but also concerning positive operating experience. The opening of WANO centers in such diverse parts of the globe as Paris, London, Moscow and Tokyo and Atlanta reflects the excellent climate surrounding this cooperation.

Cooperation in the area of safety is of course a fundamental necessity.

The public is well aware that problems posed by the implementation of nuclear energy know no frontiers and should therefore be examined in a uniform manner in all countries.

The public is first and foremost concerned about the safety of nuclear installations. The Chernobyl disaster revealed the international implications of nuclear safety. Clouds of radioactive particles emitted by a reactor some 300 kilometers from the nearest border crossed Europe ; furthermore only a handful of specialists outside the USSR were familiar with the name and technologies of this type of reactor.

Other areas of concern for the public include emergency plans in case of accidents, acceptable radiation protection standards and environmental pollution.

In an era when the media endeavors to inform the public of the slightest incident, even on the other side of the world, people insist on knowing all that goes on. The public wants to be informed about any event involving nuclear power and which, it believes, may have an effect on its daily life.

In all these areas, the populations involved are concerned about the disparities which seem to exist between national legislation and practices in their different countries.

Of course we know it is difficult to create international safety rules. It will probably take many years to achieve. How can we succeed in defing common safety standards, even in Europe, where we have to work with some countries which have abandoned any nuclear development ? My personal view is that we shall succeed only progressively and mainly by bilateral agreements, on the occasion of precise projects. In this regard we very much hope the NPI model will oblige French and German safety authorities to agree on the most important safety rules. We must, in any case, try.

We should encourage this type of development ; the public insists on this point. People have the right to expect a minimum level of quality in installations and to demand a minimum level of safety. We achieved this minimum a long time ago. It is unfortunate, however, that the different ways of formulating the statutory directives leave the general public thinking that discrepancies exist in approaches to safety. I believe that few real obstacles still lie in our way in this field, but there remains a great deal to be done to illustrate the coherent nature of our procedures.

Another cause for concern is the safety of fissile materials and the guarantee of "non-proliferation" of atomic weapons based on civil nuclear energy.

The IAEA, officially inaugurated in 1957, unites most of the countries in the world, including East European states. One of its main functions has been and continues to be safeguarding against the proliferation of nuclear weapons. In pursuit of this objective, IAEA inspectors monitor the civil installations of nations who have signed the Non-proliferation

Treaty, as well as those of countries which accept the modes of the treaty without actually being signatories.

In addition to these activities, the agency puts forward recommendations in numerous fields, especially concerning safety. The IAEA comprises leading international experts. In agreement with the electricity utilities requesting such action, the experts carry out extensive safety inspections of plants, under the OSART designation. Following these inspections, reports are written assessing plant safety and, if necessary, recommendations are submitted. The IAEA, in conjunction with its members and upon their request, also draws up good practices guides, which cover management organization, choice of sites, design and operation of installations and safety guarantees.

In the wake of the Chernobyl accident, the agency established an agreement whereby member states were committed to immediately inform the IAEA and the international community of any serious accidents as soon as they pose a potential danger to the environment in terms of radioactive releases.

Another agreement focuses on mutual assistance in the event of a nuclear accident. It aims to facilitate rapid assistance in accident situations in order to restrict the consequences and protect human lives, property and the environment from radioactive releases. I would also like to point out that the IAEA concluded an agreement with the World Association of Nuclear Operators (WANO) to facilitate the exchange of experience between operators.

Is it necessary to go even further and standardize policies and safety procedures ? For many years, the basic principles have been the same throughout the industry. No major new idea has ever emerged in a nuclear-generating country without also being analyzed and considered by other users. There is, of course, a certain degree of diversification due to local conditions and specific laws and traditions in particular. But, in general, there is already a high level of consistency between existing policies. Bodies such as the IAEA have made major contributions towards establishing minimum levels of uniformity. The agency has, however, endeavored to be flexible in its actions so as to remain effective. Lastly, nuclear research is a prime area for international cooperation, in particular as regards definition of the reactor technology and fuels of tomorrow. Advanced research work on nuclear units testifies to efforts already under way. Likewise, joint work on fast breeder reactors must be pursued and expanded. I persist in believing that these reactors will find a place in the nuclear power solutions needed to replace the current installed base in the next century. But first, their industrial development must be completed, and new prototypes built. This will require pooling of our financial and human resources, as well as our manufacturing and operating experience. My sincere wish, not only for this technology, but also in the much longer term for the much more costly development of nuclear fusion technology, is that Japan, the United States and Europe -- East and West -- consolidate their efforts.

Although my remarks on cooperation have focused on nuclear power plants, I would also like to note another area of truly exemplary cooperation between Japan and France: reprocessing of fuel, which will take on concrete form in just a few years at Rokkasho-Mura.

From the outset, nuclear energy has been an international industry. Today, this is a matter of survival: either our industry will remain international, or it will cease to exist.

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To conclude, I would like to outline for you the reasons behind my optimism. There are clear signs that the situation is changing in a number of countries. In Sweden, after a fifteen-year moratorium and a stated intention to shut down existing plants, the time has come to take stock, as it were. Faced with the consequences of having abandoned nuclear-generated electricity, our Swedish friends are again listening to the voices of reason and have delayed the closing of the Ringhals plant. Elsewhere, in Finland and Taiwan, there are plans for construction of new nuclear power plants. In the United States, the excess capacity of fossil-fuel plants has diminished, and nuclear power is again being given a chance. Finally, Eastern Europe must modernize its installed base, and only state-of-the-art nuclear power plants, built according to the criteria we have developed, will provide a solution. As a result, I am firmly convinced that this decade will see the relaunch of nuclear programs.

Nuclear energy has reached technological maturity and already makes a major contribution to electricity production for the modern world. After rapid development, nuclear programs slowed down over a certain period. Several signs point to the re-emergence of a further period of expansion. Nuclear energy is still a young technology, being constantly updted and improved. Its environmental and economic advantages are beginning once again to be perceived by the public. Once we have convinced the public that ils fears about safety are unfounded, nuclear energy will take its place as a key supplier of tomorrow's electricity. The conditions for a new start have already been satisfied - and it is now our duty to prove this to the satisfaction of our fellow citizens.

今後の原子力開発と核不拡散問題

－核不拡散対策強化のために－

核不拡散レジームの直面する諸問題

１．Threshold CountriesのＮＰＴ未加盟

南ア、イスラエル、ブラジル、アルゼンチン、インド、パキスタン等

２．ポスト冷戦の国際情勢

３．現行ＮＰＴ／ＩＡＥＡ制度の問題点

イラク、北朝鮮のケース

発展途上国のケース

Tetsuya Endo
Ambassador, Permanent Mission of Japan to
the International Organizations in Vienna

核不拡散レジームの新たな発展

仏、南アフリカ、アルゼンチンとブラジル

核不拡散レジームの改善、強化

１．ＮＰＴをいかにして魅力あるものにするか

核軍縮への努力

優遇的な経済・技術協力

２．ＩＡＥＡ保障措置制度の見直し

特別査察制度

ＩＮＦＣＩＲＣ　１５３の諸問題

３．原子力関連資機材の国際的な輸出規制

ザンガー委員会リスト

ロンドン・ガイドライン

輸出条件の厳格化
（フルスコープ・セーフガード）

汎用品の取扱い

新興供給国問題

Iyos Subki
Deputy Director General
National Atomic Energy Agency
INDONESIA

April 8, 1991

The Nuclear Power Program in Indonesia

It is a great honour for me to address you on my countriy's nuclear power program.

The nuclear power program in Indonesia is an integral part of its Long Range Development Plan (LRDP) whose duration is 25 years. Each LRDG consists of 5 Five Year Development Programs (5-FYDP). The first LRDP started in 1969 and will end in 1994.

The mission and objectives of our nuclear power program are to develop and utilise nuclear science, technology and energy for peaceful purpose only, since our country is committed to the NPT and to contribute positively to the world peace and welfare.

The nation-wide long range plan (LRDP) inevitably gives general guidence to the nuclear power program which should consequently be planned on a long range and holistic basis. This means that we look into the needs of present generation and to do justice to the needs of our future generations; in addition it should be holistic since nuclear plan and policy cannot be framed on the basis of technological fixes only, but we should also take into account social, political and cultural considerations.

The science and technology base (STB) for nuclear energy in Indonesia has been set up in SERPONG, 45 km from JAKARTA, to support a wide range nuclear R&D and develop high quality human resource for nuclear program implementation. This nuclear complex will be fully operational in 1992 and open to international cooperation.

The nuclear power plant program in Indonesia will grow in importance within the Second Long Range Development Plan which will start in 1994 and end in 2019. The installed electric capacity in JAVA alone (which has no natural resources but has high population) will grow from 8,000 MW in 1990 to 27,000 MW in 2015. This increase will be fulfilled by coal and gas (12,000 MW) and nuclear will supply around 7,000 MW of power.

The Feasibility Study for the First Nuclear Power Plants at the Muria Peninsula Region/Central Java will be started in the fiscal year 1991/1992 (for 4 years). It covers among others: techno-economic, safety, financing, site, environmental, social and cultural aspects.

As regards fossil fuel resources, Indonesia has some oil, gas and coal, which at the present day consumption rate will be depleted in 20, 60 and more than 200 years respectively. It would be an illusion if we call ourselves as rich in natural resources. So, we should in fact start now developing new technologies (including nuclear) for <u>post oil</u> era.

Due to increasing demand for better guality of life, big population and industrialization, the government has the following energy policy: stable supply of energy at an affordable price, diversification, efficiency, export opportunity (for oil and gas) and consciousness on energy environmental impacts.

The main problems facing nuclear power program in Indonesia are: <u>financing</u>, transfer of technology and public acceptance.

These aspects need not only <u>international cooperation</u> but also <u>strong international partnerships</u>. We should therefore build an environment conductive to these purposes especially political stability in each country and region, commitment to peaceful solutions of conflicts and peaceful uses of nuclear energy. In such a condition cooperation can go beyond national boundaries and be based solely on mutual respect and benefit. The history of nuclear energy will flourish in the 21st century if nuclear technocrats can cooperate with politicians to avoid any future moratorium on nuclear energy in our countries and additionally the nuclear technocrats should be able to avoid any major nuclear accident in future. At the national level strong partnership between technocrats and social scientists should be developed. Development and for that matter nuclear development is a learning process. Not only do they (other people) need to learn from us (through nuclear information) but most importantly we need to learn from them as regards feelings and perceptions on nuclear energy and its risks. This is strategic for public acceptance.

I cannot comment on financing, it is too technical .

This is what I choose to mention in a very limited of time.

Thank you for your attention.

セッション2

脱原子力政策のゆくえ

スウェーデンにおける原子力発電早期廃止政策の変更
スウェーデン・クラフトサム（電気事業連合）理事長
K．－A．エディン

スイスのエネルギー政策と原子力の将来
スイス連邦エネルギー局長
E．キーナー

〈パネル討論〉

スウェーデン・クラフトサム（電気事業連合）理事長
K．－A．エディン

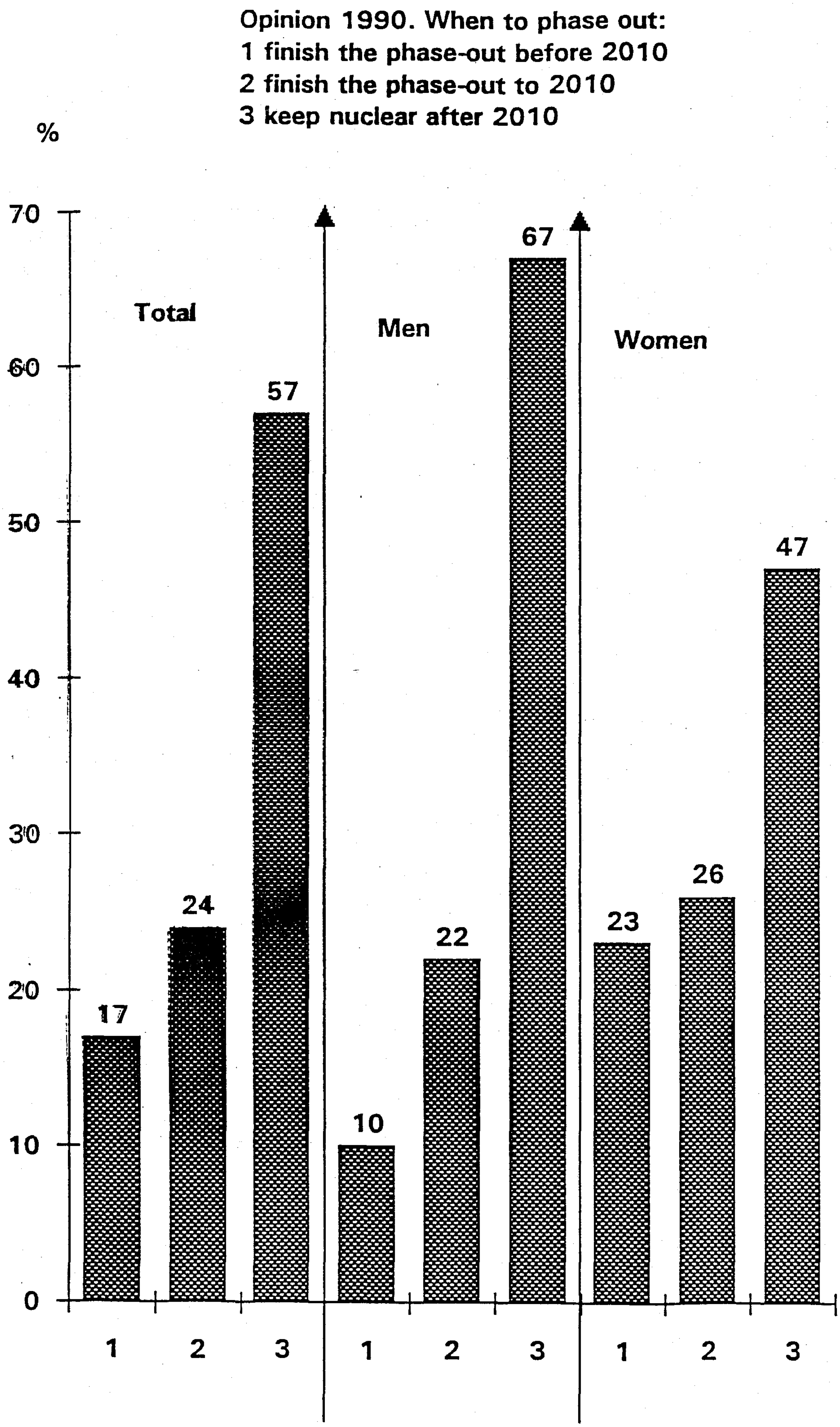
スイス連邦エネルギー局長
E．キーナー

スウェーデン産業大臣エネルギー顧問
P．オーセル

スイス原子力協会事務局長
P．ヘーレン

東京大学教授
茅　陽一

東京電力（株）副社長
依田　直


Opinion 1990. When to phase out:
1 finish the phase-out before 2010
2 finish the phase-out to 2010
3 keep nuclear after 2010
%
70
60
50
40
30
20
10
0
Total
Men
Women
17
24
57
10
22
67
23
26
47
1
2
3
1
2
3
1
2
3

1 Sweden has abolished the plans to start the phase out of nuclear power in the 1990's. In pratice also the plan to finish the phase-out by 2010.

2 Public acceptance of nuclear power has steadily increased since Chernobyl.

3 Swedish nuclear power har performed well with respect to

* Safety and Economy

4 We have developed a politically approved mothod for permanent storage of spent nuclear fuel

5 All nuclear power plants now have a filter against uncontrolled radioactive release

6 We have experienced the worst possible accident in our neighborhood without severe consequences

Karl-Axel Edin, Kraftsam, April 2, 1991

7 Swedish industry would be hurt by the increase is the price of electricity that would follow a phase out nuclear

8 The public is well aware that the only realistic alternative to nuclear power is fossil fuel power. They are also aware of the drawback of fossil fuel power

9 The political interest in the climatic effects of fossil fuel burning has increased the acceptance of nuclear power

10 Two political parties have tried to use the nuclear issue to attract new groups om anti-industrial and green voters. Both failed.

11 It has proved impossible to make the political decision to phase out sufficiently credible for industry to invest in new power plants to replace the nuclear plants to be decommissioned.

Karl-Axel Edin, Kraftsam, April 2, 1991

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MINISTRY OF INDUSTRY
Peter Åsell
political adviser

1991-04-05

ENERGY POLICY IN SWEDEN

A presentation of the Government's bill presented to Parliament the 14th of February 1991.

- Key note speach for panel discussion at the JAIF 24th Annual Conference in Tokyo, April 9th 1991.

First of all I want to express my gratitude for having been invited here in order to present the Swedish energy policy, with special emphasis on our decision to phase out nuclear power. I hope I will be able to answer the questions that you might have concerning our policy. But let me start with a short background to make you understand the Swedish situation.

BACKGROUND.

Sweden is a large country. Our area is 10% larger than Japans. Our population, however, is very small. Total number of inhabitants are 8.5 millions; much less than 10% of the Japanese population.

Our country is situated far north and we suffer from a hard climate, although it is not as hard as in Siberia, since Sweden is a maritime country between the Baltic sea and the Atlantic ocean.

Geologically Sweden is very different from Japan. Our bedrock is extremely old and therefore our mountains are flattened out and most of our country is rather flat. Our climate and soils, however, makes most part unsuitable for agriculture but well suited for coniferous forests. Therefore forestry and forest industry have always been our primary source of prosperity.

Our bedrock is also rich of metallic minerals, which has made metal mining and metal production our <u>second</u> source of prosperity.

Our gently sloping mountains are also well suited for hydro power production. Until 15 years ago, hydro power gave us 70% of our electric power. Still our capacity of 70 TWh give us 50% of our power supply. Hydro power is often mentioned as our <u>third</u> source of prosperity.

These resources have made Sweden technically and industrially highly developed with a high standard of living. Consequently our prosperity is based on heavy, energy-demanding industry, such as iron and metal mining, steel and metal production, and paper production.

Our combination of hard climate and heavy industry make us very dependent on energy supply, especially electric power. Our consumption of electric power per capita is more than 17 000 kWh/year, which is three times as high as the Japanese per capita consumption.

NUCLEAR POWER.

Sweden started early with commercial use of nuclear power. The first full scale Swedish commercial nuclear plant was taken into operation 1972. Intensive anti-nuclear feelings in large groups of population also developed early. Nuclear power developed into the most infected political issue in modern Swedish history: 15 years ago the social democratic party was thrown out of government for the first time since 44 years. In 1980 a public referendum was held about nuclear power. As a result a decision was taken that nuclear power shall be used during a transition period, but is to be phased out at the latest by the year 2010.

And so the subject for my presentation, **GOVERNMENT'S BILL ON ENERGY 1991:**

During last year intensive political negotiations was pursued between the governing Social Democrats and the opposing Liberals and Centre party. The opposing Conservatives, Environmentalists and Communists were <u>not</u> invited to these negotiations.

A three party agreement bridging formerly deep political gaps was met in January this year. Government's bill, presented less than two months ago, is based on this broad political agreement.

This is the main content of the bill:

1. Start of nuclear phase-out will depend on success for energy conservation and for new sources of energy. Let me quote from the translation:

"The juncture at which the phase-out of nuclear power can begin, and the rate at which it can proceed will hinge on the results of electricity conservation measures, the supply of electricity from environmentally acceptable power production and the possibilities of maintaining internationally competitive electricity prices".

In short, this means that the <u>earlier</u> decision to start phasing-out 1995 is to be changed.

2. The decision of final phase-out by 2010 is <u>not</u> changed.

3. The former strict ceiling for release of CO_2 is to be replaced by a policy where all kinds of climate affecting gases are to be taken into consideration and where the international approach will be central. This will give some space for fossil fuels as a result of the phasing out of CFCs. CFC is a very potent climate affecting gas.

4. A large 5-year program for intensified energy conservation.

5. A large investment support program for introducing technology that is "near commercial", such as biomass Combined Heat and Power production (CHP), medium sized wind power and solar heating.

6. Redoubled efforts for further technical development of large scale wind power and large scale biomass-power.

7. Turning surplus agriculture land into ethanol-fuel production.

These measures during the nearest 5 years, and similar measures later on, are estimated to give possibilities to fulfil the phase-out process as planned.

To ensure that this will also be the case, the parties concerned have agreed that the government (regardless of what party is in power) shall continuously evaluate the development and each year (in the budget) present the results and suggest such additional measures that might be called for. This political formula will every year give the parliament full information, and every single member of parliament a possibility each year to express his view on the Government's way of action and demand alternative measures.

What are then the **POTENTIAL FOR SUCCESS?**
Doubts have been expressed, as to whether it will be possible to fulfil the phase-out without sacrificing our prosperity. Of course nobody can give exact forecasts of what will happen during the next 19 years, but I will at least show the potentials we are working with.

1. Energy conservation has demonstrated great progress. Especially this is the case in domestic heating, which is a very important factor for Swedish total energy consumption, as well as for our power consumption (more than 1/3 of our nuclear power is used for domestic heating). New metods for insulation, ventilation and for window construction have led to the fact that modern houses consume just a small fraction of the energy needed 15 years ago. Since houses have a long technical life the results are showing only gradually. A fact is that the energy need for domestic heating is today diminishing and will continue to diminish.

The result of energy conservation is that total demand for energy is curbed. I can not today tell if it will ever turn downwards, or just stay level.

2. Renewable energy.
Beeing a large country with small population, Sweden has a theoretical potential to replace nuclear with biomass, large scale wind power (on-shore as well as off-shore) and solar heating. Costs are today prohibitive but the potential for technical development is large. Within a ten year period costs and availability will be substantially raised. But of course, today it is not possible to give certain forecasts about that future development.

3. Fossil fuels are to be avoided as far as possible. But natural gas is still an open question. At least during a transition period it will probably be necessary. Since our phasing-out of CFCs is very successful we will be able to introduce substantial amounts of natural gas without raising our release of climate-affecting gases. And under any circumstances our contribution will stay far below the level from countries whith a fossil-fuel based power production.

– Conclusion.

Let me conclude by declaring that:

Sweden will fulfil the phasing-out of nuclear power, and there are good reasons to trust that we will do it by the year 2010. And please trust, that we will not allow the process to create environmental damage to ourselves, nor to the world.

We are however, fully aware that this is no easy task. We know that we need to fulfil a hard struggle that will cost us substantial resources. But we are not going to accomplish it with such a speed that it will create unemployment and poverty.

Session Ⅱ-3　依田　直 (S.Yoda)

世界の新しい国際秩序の形成に向けて

……エネルギー利用の観点から……

3－3－29

1.エネルギー問題は、文明の問題

○　エネルギーがなければ、経済発展も文明の発展も不可能であり、そうした意味では、エネルギー問題は文明の問題（エネルギーは文明進歩の基礎）といえる。

○　現在の文明の発展は、エネルギー多消費の上に成り立っている。

2.エネルギー問題と世界経済

○　世界経済は、各面で発展、競争が行なわれてきた。

- o　資本主義や共産主義が発展してきたのも、エネルギーと無関係ではない。
- o　共産主義もエネルギーが基本にある。
  - ・　ソ連共産党宣言の最初の部分に、エネルギー問題が展開されている。
- o　ソ連は世界最大の産油国でありながら、現在エネルギー危機に直面している。
- o　東欧諸国は、ソ連からの安いエネルギー（石油）供給を前提に、ワルシャワ条約機構の枠内にしばられてきた。

  ソ連のエネルギー危機のもとで、ワルシャワ条約機構の維持も困難に直面していたと見ることが出来よう。
  - ・　ワルシャワ条約機構の軍事機能は、1991年 3月31日をもって解体、活動を停止した。

○　共産主義体制が、資本主義体制との経済競争において、エネルギー面から敗北したと見ることが出来る。

3.世界のエネルギー利用の問題点

○　資本主義体制をとる西側諸国も、経済競争において一応の勝利をおさめたが、資源論的に見て、必ずしもエネルギーの効率的利用を行なっているとはいえない。

- o　西側諸国は、エネルギー源の多くを化石燃料に依存している。

/

○　資源利用論、資源経済論からみて、果たして化石燃料に全面依存していってよいのかどうか、後の世代のことも考え有限性の制約を越えたエネルギーの創出、利用を考えなければならない。

o　化石燃料を資源論的にみた時、有限性があり、その克服をどうするかが重要な問題となる。

・　石油　　天然ガス　　石炭

オイルシェール　　タールサンド　など

o　資源論的にみた時、エネルギー源の世代間の利用の在り方を考える必要がある。

o　石油は、第一次、および第二次石油ショックの頃の政治的商品・戦略的商品から、時代的変遷のもとで現在、一般商品並み・市場的商品に変わりつつあり、石油を含むエネルギー利用秩序を再構築していかなければならない。

○　エネルギーの利用にあたって重要なことは、経済成長と環境との両立をはかっていかなければならない、ということである。

o　化石燃料の燃焼に伴い排出されるＳＯx,ＮＯx ,(ＣＯ2)は森林に悪影響を及ぼし、ひいてはＣＯ2 の問題に悪影響を及ぼすことになる。

o　我々は環境問題で後世代に責任を持たねばならず、そのため環境問題をいかに解決するかは、現代人に課せられた重要な課題である。

・　米国、ソ連、中国における化石燃料の燃焼によるＣＯ2 排出量は、世界全体の排出量の約半分を占めている。

これは熱利用効率の悪いことに原因があり、日本並の効率を達成できれば、現在のＣＯ2 排出量の1/3 を減少することが可能となる。

o　エネルギー問題の解決には、即南北問題が関係してくる。

・　南の発展途上国は、今後の経済発展のために石炭などの化石燃料を多く使用し、結果的にＣＯ2 の排出量の増加が予想されるため、先進諸国としては自らがＣＯ2 排出量を削減することにより世界全体の排出量をおさえる努力をするのはもちろん、ＣＯ2 排除技術などエネルギーの効率的利用技術を南の諸国にトランスファアーするなど、経済発展と資源利

用の在り方の面で寄与することが重要である。そうしないと後世代の人達が苦しむことになる。

・ 特に、今後中国が経済発展をとげていくためには石炭を利用することになろうが、中国の経済発展と環境問題の解決にむけて日本としてどう協力するかは、大事な問題である。

○ 人類のエネルギー利用の歩み、資源論的にみても原子力を評価せざるを得ない。

o 資源論的にみると、現在、全世界のエネルギー消費の６～７割を人口10億人の先進諸国で使用し、残りの３割ないし４割を発展途上国の40億人が使用している。

・ 発展途上国のエネルギーの将来における利用チャンスを先進諸国が奪っているという見方も出来る。こうした状況からみて、発展途上国のエネルギー利用の機会を増大するためには、日本をはじめ先進諸国は原子力を取りこまざるを得ない。

o 原子力エネルギーを使う前提としてセーフティ・カルチャー、安全に対する高い文化を持つかどうかが重要である。

（セーフティ・カルチャーの確立している国しか原子力エネルギーを利用できないのではないか。）

・ 原子力大型炉は、高度の安全機構の集積が必要であり、多重防護の思想を取り入れている。

一方、原子力小型炉としては、パッシブ・セーフティ炉の研究・実用化を進めている。

（比較：飛行機……大型機と小型機）

4.世界の新しい秩序形成に向けて（日本の役割）

○ エネルギー問題の中には、東西問題、南北問題が含まれている。それを解決できるのは先進国以外にない。

○ 世界のエネルギー供給の安定を考えた時、依然として中東に依存せざるを得ない。

o 中東は、アラブとユダヤ、イスラムとキリスト教、イスラム内のスンニ派と

シーア派の対立など不安定構造の中にあり、中東問題を考える時、民族的、文化的、宗教的基盤を踏まえなくてはならない。

○ 湾岸戦争後の新秩序は、従来のものとは違うものとなろう。

o 東西対立は崩壊し、世界に秀でた軍事大国、経済大国もない。

o 経済力のある日本、ドイツが、経済大国から後退しつつある米国を支えることになろうが、ドイツは吸収した東ドイツへの対応に苦慮しており外に向かう余裕は少ないため、結局のところ日本の役割が重要性をもってくる。

○ その場合、国連を踏まえた行動が必要になろう。

o 国連機構は第二次世界大戦の戦勝国中心のものである。

o 戦後的遺物ともいえる機構をこわし、再構築し、あたらしい態勢で、南北問題、エネルギー問題などにあたらねばならない。

（エネルギーから見た新秩序を構築することは、緊要の課題である。）

日本としては、今から、そのための準備に着手しなければならない。

○ 日本のエネルギー戦略は、世界史的な視野にたって、広く世界の国々の立場、日本の置かれている状況を考えながら環境問題を含め地球規模のグローバル戦略として確立していくことが大切である。

以　上

世界の新しい国際秩序形成に向けて

――エネルギー利用の観点から――

平成３年 3月22日

Ⅰ．世界の新しい秩序形成にむけた課題

１　湾岸戦争後の世界情勢

o　世界経済のパワー構造に地殻変動的な変化が発生

冷戦構造の崩壊、南北問題の激化、ＥＣ・米加自由貿易地域といった地域主義の高まり、民族のアイデンティティ追及と自己主張、日米間の摩擦、社会主義経済体制崩壊後の開発や発展をめぐる先進諸国間の競争など

o　各国間の経済発展を広く国際的な立場から秩序づけていく枠組みの設定が時代の急務

２　新しい世界新秩序形成の方向

o　政治的秩序　……　平和的秩序
　　　　　　　　　　民主的秩序

o　経済的秩序　……　自由主義市場秩序

o　社会的秩序　……　文化的秩序
　　　　　　　　　　・宗教的共生
　　　　　　　　　　・民族的共生

平和の配当――平和の負担

（国連機構の再編成）

Ⅱ．エネルギーの視点からみた世界新秩序の形成

１　世界のエネルギー問題

２　世界のエネルギーを取り巻く制約

o　エネルギー開発　……　膨大な資金需要

o　環境問題　……………　CO_2 発生状況

o　セキュリティ

３　米国のエネルギー戦略

４　エネルギー新秩序形成の方向

以　　上

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１．　世界のエネルギー需要の推移 ……………………………… １頁

２．　ＩＥＡの世界エネルギー需要の展望 ………………………… １

３．　ＩＥＡの世界石油供給の展望 ……………………………… １

４．　１人当たりエネルギー消費の国際比較－－（1988年）……… ２

５．　化石燃料の燃焼によるCO_2排出量 ………………………… ３

６．　各国のCO_2排出量 ………………………………………… ３

７．　ＤＡＣ諸国のＯＤＡ（1989年） …………………………… ４

８．　米国におけるエネルギー別将来予測 ………………………… ５

９．　米国における原子力発電の将来予測 ………………………… ６

1. 世界のエネルギー需要の推移

（年平均伸び率　単位：%）

	第一次石油危機 69年　　73年		第二次石油危機 79年	石油価格下落 86年　　88年
先進国	４．２	１．１	▲０．３	２．８
途上国	６．３	５．９	４．３	５．７
うち東南アジア	１１．１	８．０	４．２	１０．７
共産圏	５．８	４．８	２．２	３．１
世界	４．８	２．８	１．１	３．３

出典）ＢＰ統計（1989.6）

2. ＩＥＡの世界エネルギー需要の展望

（年平均伸び率　単位：%）

	1987年 ──→ 1995年	──→ 2005年	1987 → 2005年
先進国	(51%)　１．４	１．３　(41%)	１．３
途上国	(17)　４．５	４．１　(24)	４．３
共産圏	(32)　２．７	３．２　(35)	３．０
世界	(100)　２．４	２．４　(100)	２．４

注）（ ）内は世界のエネルギー需要に占める割合
出典）ＩＥＡ事務局シナリオ（1989.6）

3. ＩＥＡの世界石油供給の展望

（単位：%）

	１９８８年	１９９５年	２００５年
中東	２４	２９	３３
非中東	７６	７１	６６
ＯＥＣＤ	２６	２１	１５
共産圏	２４	２２	２１
非中東途上国	２４	２６	２９
その他	２	２	２
世界	１００	１００	１００

注）第一次石油危機（1973年）当時の中東依存度は３６%
　　第二次石油危機（1979年）当時の中東依存度は３４%

出典）ＩＥＡ事務局シナリオ（1989.6）

４．１人当たりエネルギー消費の国際比較――（1988年）

	エネルギー消費		一人当り消費量（t／人）	人口		GNP当りエネルギー消費量（kg/ドル）	2025年人口年央推計中位推計値（百万人）
	石油換算（百万ｔ）	構成比（％）		年央推計（百万人）	構成比（％）		
先進国計	5,871.3	74.8	4.8	1,224.0	23.8	0.30	—
アメリカ	1,935.9	24.6	7.9	246.0	4.8	0.39	300.7
ソ連	1,389.9	17.7	4.9	286.4	5.6	—	351.5
日本	402.4	5.1	3.3	122.6	2.4	0.16	128.6
西ドイツ	268.8	3.4	4.4	61.0	1.2	0.24	54.0
カナダ	245.9	3.0	9.4	26.1	0.5	0.57	32.1
イギリス	207.9	2.6	3.7	56.9	1.1	0.29	57.5
フランス	197.1	2.5	3.5	55.8	1.1	0.23	60.4
イタリア	151.9	1.9	2.6	57.5	1.1	0.20	54.9
その他（含む東欧）	1,071.5	13.6	3.8	311.7	6.1	—	—
発展途上国計	1,982.7	25.2	0.5	3,923.0	76.2	0.70	—
中国	616.2	7.8	0.6	1,094.7	21.3	1.76	1,492.6
インド	172.2	2.2	0.1	816.8	15.9	0.62	1,445.6
その他（アジア，アフリカ，南米諸国）	1,194.3	15.2	0.6	2,011.5	39.1	—	—
世界計	7,854.0	100.0	1.5	5,147.0	100.0	—	8,466.0

地域	使用量	石油	天然ガス	石炭	原子力	水力
世界合計	(100)	37.7	20.2	30.1	5.4	6.6

（出典）　ＢＰ統計（1990年），　世界銀行「World Development Report」（1990年）
Handbook of Economic Statistics　（1989年）

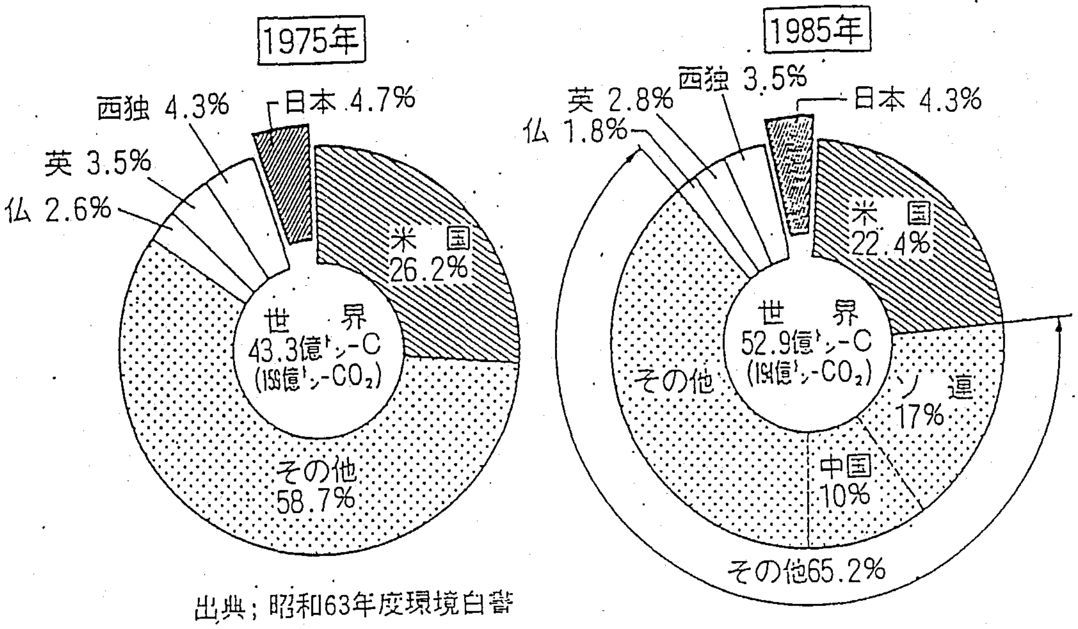
o一人当りエネルギー消費は，世界平均で１．５ｔ（石油換算）／人である。

oエネルギー多消費国であるアメリカ(7.9t)，カナダ(9.4t)は別格として，先進国は世界平均の２～４倍（日本は２．２倍）となっている。

o中国(0.6t)及びインド(0.1t)が世界平均のエネルギーを使用するようになると，ソ連やアメリカに匹敵するエネルギー消費国となる。

（中国の場合：1,095 百万人×1.5t≒1600百万ｔ
１６００百万ｔ／７８５４百万ｔ≒２０％）

5. 化石燃料の燃焼によるＣＯ₂ 排出量



出典；昭和63年度環境白書

6. 各国のＣＯ₂ 排出量

	ＣＯ２排出量（１９８５年）	ＧＮＰ（１９８７年）	人当たり１９８７年）	ＧＤＰ当たり（１９８７年）
	億トン（　%）	1000億ドル（%）	t／人	t／1000ドル
アメリカ	１１．８　(22.4)	４５．３(24.4)	５．１	０．３０
ソ　連	９．０　(17.0)	２３．８(12.8)	――	――
中　国	５．３　(10.0)	３．０(1.6)	――	――
日　本	２．３　(4.3)	２４．０(12.9)	２．４	０．１８
西ドイツ	１．９　(3.5)	１１．２(6.1)	３．１	０．３０
イギリス	１．５　(2.8)	６．９(3.7)	２．７	０．３２
フランス	１．０　(1.8)	８．８(4.8)	１．８	０．１８

出典）昭和６３年度環境白書
国連エネルギー統計、ＩＭＦ統計等

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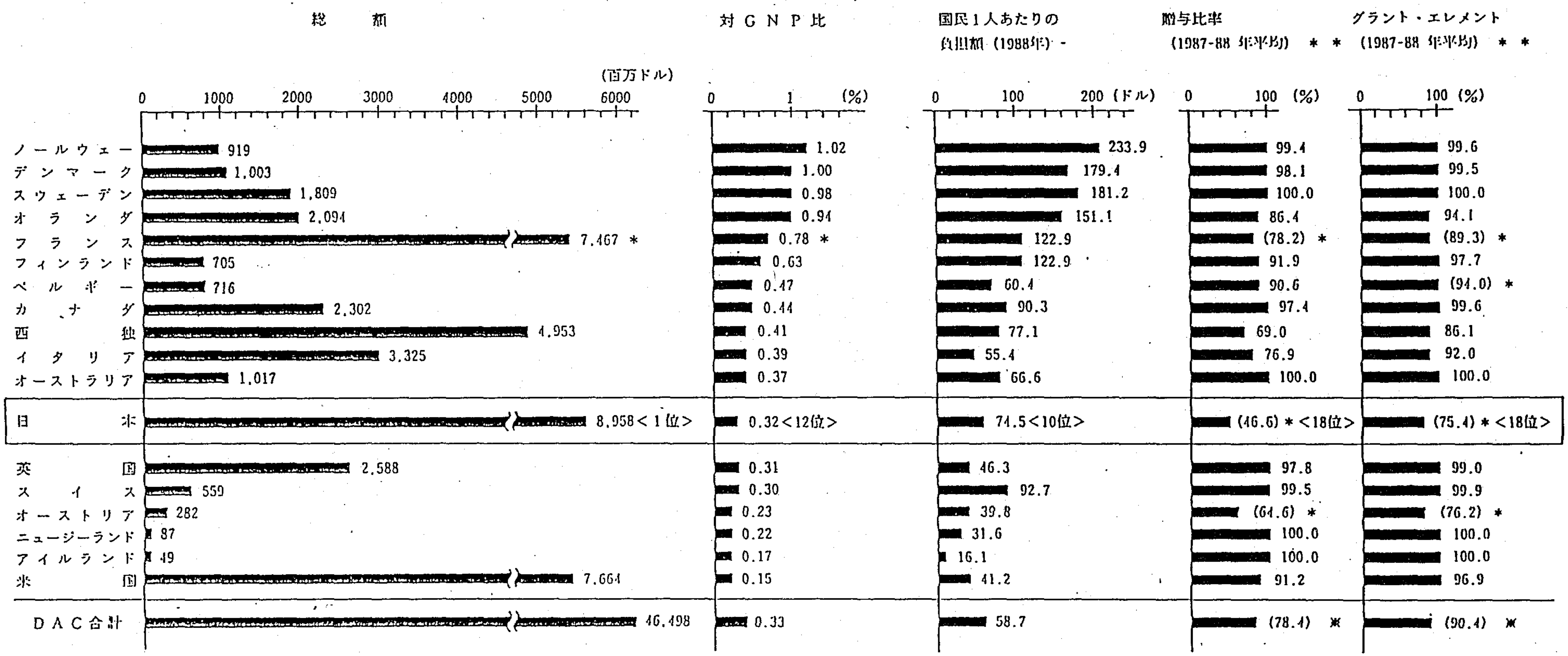
7. DAC諸国のODA（1989年）

［量］　　　　　　　　　　　　　　　　　　　　　　　　　　［質］



＊海外領土、海外県分を含む。
但し、右を除く場合フランスの
ＯＤＡ総額は 5,140百万ドル

（日本の額は、その後8,965に修正された）

＊海外領土、海外県分を含む。
但し、右を除く場合フランスの
対ＧＮＰ比は0.54 ％

＊1987年の数値
（我が方計算によれば我が国の
87-88 年平均は40.9％）

＊1987年の数値
＊＊ 債務救済を除く
※ 暫定値

（出典：ＤＡＣ議長報告）

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8．米国におけるエネルギー別将来予測

（％）は現在比増減率

	現　　在	2010年 （現状政策ケース）	2010年 （ＮＥＳ採用ケース）
国内石油・天然ガス生産	900万バーレル／日	680万バーレル／日 （－24.4%）	1,060万バーレル／日 （＋17.8%）
石油消費量	1,740万バーレル／日	2,260万バーレル／日 （＋29.9%）	1,920万バーレル／日 （＋10.3%）
石油輸入量	760万バーレル／日	1,480万バーレル／日 （＋94.7%）	780万バーレル／日 （＋ 2.6%）
石炭消費量	9億トン （＝19×10^{15} Btu）	15.5億トン （＋72.2%）	28×10^{15} Btu （＋43.4%）
原子力発電量	5,000億kWh	5,940億kWh （＋18.8%）	6,500億kWh （＋30.3%）
天然ガス消費量	18.5×10^{12} cf	22.5×10^{12} cf （＋21.6%）	22.5×10^{12} cf （＋21.6%）
水力発電量	3.2×10^{15} Btu （=7,500万kW）	3.4×10^{15} Btu （＋ 6.3%）	8,700万kW （＋16.0%）
電力需要	2.7兆kWh	4.5兆kWh （＋66.7%）	4.0兆kWh （＋48.2%）

（※ＮＥＳ中の数値をもとにワシントン・インターナショナル・エナジー・グループが推計）

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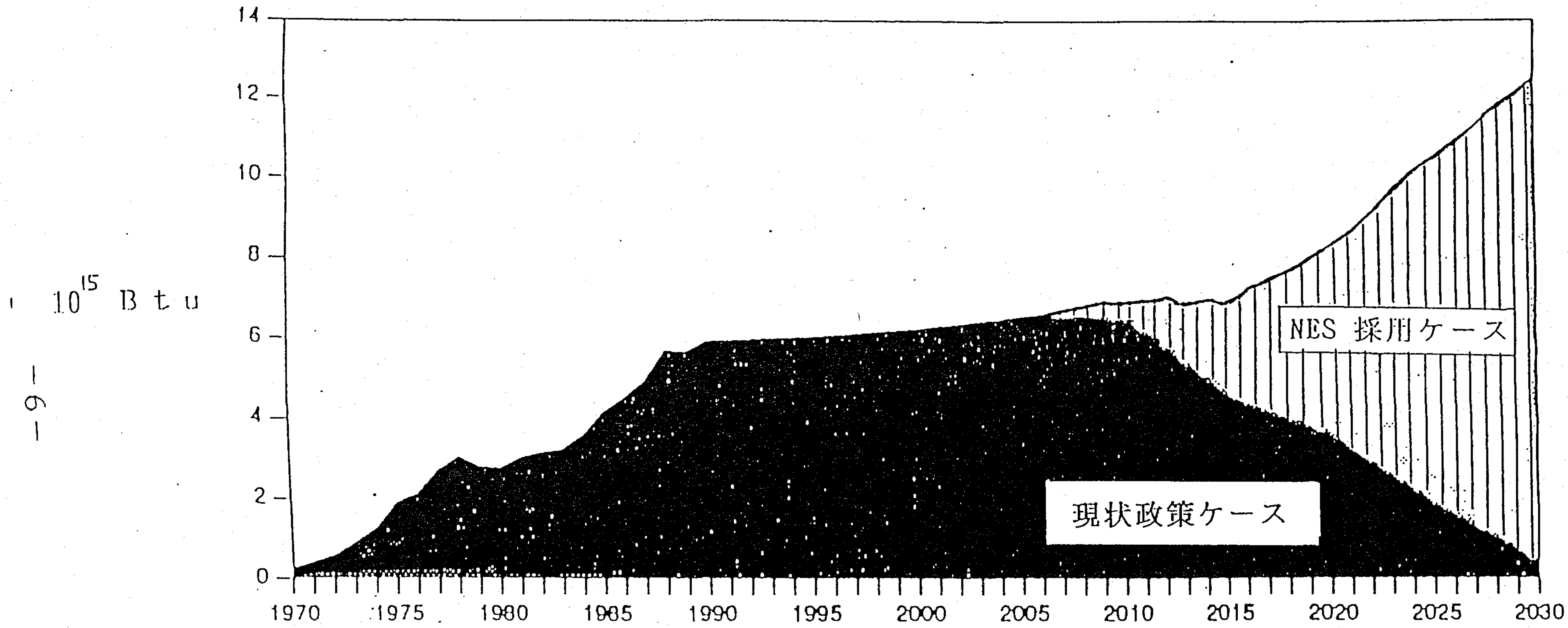
9. 米国における原子力発電の将来予測



（出典　NES）

/2

Early phase of nuclear abolished in Sweden

Karl-Axel Edin, Kraftsam, Sweden

March 26, 1991

Basic facts about Sweden

There are 8 million inhabitants in Sweden. Its gross national product (GNP) is 25 000 US dollars (roughly 3 milj JPY) per inhabitant. The annual total consumption of electricity is 140 TWh or 17 000 kWh per capita, which is the fourth highest in the world. This is due to a high proportion of electricity intensive industry like pulp and paper industry and extensive use of electricity for heating. The use of electricity increased at about 6 percent per year for several decades up to the middle of the 1970's. The increase then slowed down and is expected to be 2 percent per year in the coming decade.

Hydro power and nuclear power account for almost all electricity production in Sweden. The capacity in hydro is 65 and in nuclear power 70 TWh per year. Of the 12 reactors in use 9 are of the boiling water type of Swedish (ABB_atom) design and 3 are pressurized water type of Westinghouse design. There is about 10 TWh capacity in combined heat/steam and power plants and about 10 TWh in oil condensing power. There are no large coal condensing power plants but some smaller coal combined heat and power plants. Thus Sweden has almost no coal based power production and very little production based on oil.

The energy supply in Sweden is mostly in the hands of private companies. There is a state agency who is responsible for about 50 percent of the production of electricity. This agency is now being transformed into a corporation and may also be privatized soon. The rest of the electricity is produced by private companies. The local distribution of electricity is managed by a large number of local companies that mostly are independent from the producers. They can buy power from any producer. The producers of electricity therefore are competing with each other. They are also free to set the prices. The price for transporting electricity on the grid is regulated by the state.

There is a special law for the construction of nuclear plants. A permit is required from the government in order for a new nuclear power plant to be built. Before the plant is taken into operation the government has to approve of the method devised for the permanent storage of spent nuclear fuel. The nuclear power companies are responsible for the disposal of spent fuel and for the decommissioning. They pay the equivalent of 0,5 JPY per kWh electricity produced in nuclear power to a fund to cover the cost of disposing of spent fuel and decommissioning of the reactors in the future.

Swedens nuclear history

Sweden was one of the first countries outside the super powers to realize the potential of peaceful nuclear power. As early as 1945 a build-up of scientific competence in nuclear physics was begun. In the 1950s a state company was created to develop a Swedish heavy-water nuclear reactor.

In the 1960's the course was changed when the government and private industry jointly set up a new company, ASEA-Atom (now ABB-Atom), for the rapid development of a light-water reactor.

Since the beginning of the century up to the 1960's electricity generation had been expanded almost solely by utilizing Swedens abundant hydro power resources. However, in the 1960's it became obvious that Swedens rapidly increasing demand for electricity could no longer be met by hydro power. During the proceeding decades demand had doubled every ten years and the demand was expected to grow fast also in the future. In the choice between the conventional coal or oil power technology and the new nuclear power technology the Swedish parliament decided to choose the nuclear alternative. The decision was on the whole taken in political unity, without much debate.

The first commercial reactor was taken in operation in 1972 and the last in

1985. However the time between the first and last reactor was dramatic.

After a long debate within the political parties parliament in 1975 took a decision to go ahead with a total of 13 reactors. The ruling Social Democratic party, the Moderate (Conservative) party, and the Liberal party supported the plan. The Center party and the Communist party opposed the plan.

By that time the nuclear issue had became more and more controversial. In the campaign before the general elections in 1976 the Center party, the leading opposition party at that time, made their resistance to nuclear power the main issues. This was a strategic decision by the Center Party. I had its base among the farmers and wanted to attract new groups to the party. Therefore it tried to attract young people in the anti-industrialist movement that swept over Sweden and other industrial countries in the beginning of the 1970's and for which nuclear power was becoming the symbol of the evils of the industrial society. Also in the other parties the anti-industrial and anti-nuclear sentiments gained support.

When the non socialist parties for the first time after 44 years of socialist rule in 1976 formed a government, the nuclear question became a major problem. After only two years of rule the non socialist coalition government was dissolved because of differences on this issue. The political society was shocked that an issue such as nuclear power, that was considered a rather technical matter, could have such political consequences.

The referendum

After the Three Mile Island accident in 1979 the nuclear question became an even bigger political problem. The political parties became more and more divided internally over the nuclear issue. In a move to solve the political difficulties caused by the nuclear question the parties agreed on referendum on nuclear power. This was a quite extraordinary measure since the institute of referendum is very seldom used in Sweden. The purpose was to once and for all let the people decide on which course to follow and in that way remove the nuclear issue from the political agenda.

At the time of the nuclear referendum, which took place in 1980, Sweden had 6 reactors in operation and another 6 were either under construction or planned. The voters were given two alternatives (formally there were three but two were almost identical).

One alternative was to stop at the 6 reactors in operation and phase them out within 10 years. The other alternative was to continue to build a total of 12 reactors, but no more. All the reactors would eventually be phased out after their technical life time. There was no alternative to expand nuclear with more than 12 reactors. In the campaign for both alternatives the prospects for renewable energy as a replacement for both nuclear and fossil-fueled based energy supply were said to very good. The difference was more a question of timing. The anti-nuclear campaign argued that renewables would be realistic alternatives already during the 1980's, while the other campaign argued in favor of renewables but emphasized that they would not be economically acceptable until after one or two decades. Therefore the nuclear phase out would have to wait until the next century.

The result of the referendum was that the first alternative, the anti-nuclear, got about 40 percent and the other about 60 percent of the votes. Parliament later confirmed the result. The 12-reactor program should be completed. But parliament added that all reactors should be decommissioned by the year 2010. This part of the decision by parliament actually was not based on the result of the referendum, where nothing in the winning alternatives was said about any definite final date for nuclear power. It was also only a principal decision. For such a decree to have any legal status it must take the form of a law, that forbids the use of nuclear reactor after a certain future dates. No such law has yet been proposed to parliament. This is essential. There is yet, more then 10 years after the referendum, no legal decision to phase out nuclear power in Sweden.

After the referendum the construction of the remaining six reactors could continue. The anti-nuclear movement on a whole accepted the result of the referendum and the opposition to nuclear power diminished in strength. The nuclear issue was no longer on the top of the political agenda.

It is important to give this background to the Swedish situation. The referendum was to a large extent a way to solve a political problem by removing an issue that threatened to paralyze the political decision making in Sweden.

The Chernobyl accident

However, the respite only lasted for some years. After the accident in Chernobyl the nuclear issue made a come-back as an political issue. Sweden was one of the countries outside the Soviet Union which was most affected by the Chernobyl accident. The radioactive cloud from the accident drifted in the direction of the Baltic Sea. When it reached the middle of Sweden it began to rain and the rain released radioactive material over land. The radioactive cloud continued over the north of Sweden, releasing radioactivity on its way. For several months the newspapers were covered with headlines about the consequences and reports on high level of radioactivity on the ground and in food.

Compared with the reaction after Three Mile Island the established political parties reacted with restraint. The government (Social Democratic) reacted fast. It prepared for a thorough investigation. The government made it clear that they took the Chernobyl accident very seriously and that they were prepared to reconsider the Swedish nuclear program. It wanted to achieve the highest possible unity among all the political parties on any decision on the future of nuclear power in Sweden.

Safety in the Swedish reactors

On the issue of safety the report prepared by the government pointed out that the conditions at the Chernobyl plant differ from those at Swedish nuclear power plants on the following points.

The procedures for safety review and for the performance of experiments, shows that safety consciousness at the Chernobyl plant was generally poor. With the strict operating and testing procedures in the Swedish nuclear reactors the sequence of events which caused the Chernobyl accident could not have happened.

The type of graphite moderated reactor used at the Chernobyl plant can become physically unstable under certain conditions (i.e. the reactor can "run away"). The Swedish light-water reactors like other reactors of this type does not have this inherent instability and are designed to be far more self-stabilizing in the event of power surges.

The containment in the Chernobyl reactor offers poor protection against large radioactive releases into the environment in case of severe accidents involving extensive overheating of the fuel. The Swedish reactors have strong containments. Analyses of hypothetical severe accidents in Swedish reactors indicate that Swedish reactor designs offer much better protection against major releases of radioactive material than the Chernobyl type of reactors.

All Swedish reactors will be equipped with filters which will absorb 99.9 percent of the radioactivity in case of an accident and in case the containment cannot withhold the pressure.

The government report concluded that **the accident at Chernobyl had not brought to light any previously unknown safety issues of a technical or other nature which have not been addressed in earlier safety analyses.**

Radiation consequences in Sweden from Chernobyl

The goal in radiation protection is that no-one should receive more that 5 mSv per year and that the average dose received over a fifty-year period should be less that 1 mSv/year.

The largest contribution to the radiation dose from Chernobyl is expected to come from direct radiation from radioactive substances on the ground and not from the intake of food, which the public has feared most. Calculations made so far indicate that the most exposed individuals in Sweden will get at total dose over a fifty-year period of at most ten times the above figure for the most exposed individuals. This is far below the doses at which immediate injury can occur. On average the dose received by a Swede in 1986 from the accident is estimated to be 1 mSv. This is equivalent to the dose received in a normal X-ray of your stomach.

Consequences of a phase-out of nuclear power in Sweden

There were also made several studies of the economic consequences of a phase out of nuclear power in Sweden. Most studies showed that the use of electricity would increase also in the future, although at a slower rate that previous decades. That means that if nuclear power was to be phased out all the generating capacity in nuclear would have to be replaced. Today nuclear and hydro power each account for about half of the generating capacity in Sweden. There is very little fossil fuel based power production. The studies also concluded that the only economically feasible alternatives to nuclear is coal and natural gas power. This contrasts with the information given before the referendum, when people were given the impression that renewable energy could replace nuclear.

The cost per kWh of producing electricity in the present system, with half hydro and half nuclear, is low compared to the cost of building and operating new power stations. Therefore a phase out of nuclear power would radically increase the productions cost and also prices. This would have severe consequences for the big electricity intensive industries in Sweden. This last issue would become a major issue in the following debate.

A phase out of nuclear would also increase the emissions of sulfur and nitrogen oxides and, most importantly, the emissions of carbon dioxide.

Early start of phase out

Despite the conclusion by the government that the Chernobyl accident had no relevance for the safety of Swedish nuclear power the government in 1987 decided to propose that the phase of nuclear power should begin in 1995/96 by taking the two oldest and smallest reactors out of operation. This decision came as a surprise, but must be seen in light of the political situation at that time.

The green movement was on the offensive, gaining support among young people. Like the corresponding movement in the 1970's the movement was generally against the industrial society for which nuclear power was a special symbol. The green movement had formed a political party that had a good chance to enter parliament in the coming election. The governments surprising decision to favor an early start of the nuclear phase out can be seen as a way of attracting young voters away from the Green Party.

Parliament in 1988 voted in favor of an early start of the phase out. But at the same time parliament on another issue decided that the emissions of carbon dioxide in Sweden would not be allowed to increase in the future. This decision was in an unholy coalition between by those parties that were against an early start of nuclear phase out and by greens in parliament. The parties in favor of nuclear power knew that it would be impossible to phase out nuclear power without increasing the emissions of carbon dioxide. Therefore a decision to put a ceiling on carbon dioxide would make it impossible to phase out nuclear. The "green" members of parliament supported the carbon dioxide ceiling because they were as much against fossil fuels as nuclear power. Also this came to play an important role in the coming events.

The efforts by the established political parties to attract "green" people did not stop the Green Party to gets seats in parliament in the 1988 election.

Increasing opposition to early phase out

The decision on an early nuclear phase out start came under increasing opposition from industry and labor union s. The main line of the arguments was 1)that the realistic alternatives to nuclear, namely fossil fuels, were environmentally worse then nuclear power and 2)that a nuclear phase out would threaten the core of Swedish industry. They also argued that the two decisions to phase out nuclear and restrict the emissions of carbon dioxide were incompatible. The opposition was supported by reports that many Swedish pulp- and paper and other electricity intensive industries were about to halt further investment in Sweden and instead invest in other countries.

The actions from the labor unions put the traditionally close relation between the unions and the ruling Social Democratic Party under big stress. Opinion polls also showed increasing public acceptance of nuclear power and that a majority of people were opposed the idea of an early phase out start. The prime minister eventually felt forced to change course. He appointed a man from the labor union as new energy minister and declared that the whole issue of nuclear phase out and carbon dioxide would be reconsidered. He also declared that he would seek a solution with greatest possible political support in parliament.

Early phase out plan abolished

As a result of this effort the government in February 1991 proposed to parliament that the earlier plan to start the nuclear phase out in 1995 be abolished. This proposal has the support of 90 percent the members of parliament. There is no new confirmation that all nuclear power should be phased out by the year 2010. This means that even the earlier commitment to a total phase out by the year 2010 has eroded and now has little actuality. It seems that the nuclear issue now permanently has been removed from the political agenda.

On the issue of carbon dioxide it is proposed that some increase of emissions must be accepted in the short run. The Swedish efforts should be directed to accomplish reduction in the long run in a context of international agreements. Also on the carbon dioxide issue there is prospects for a big and stable political consensus.

Lessons from Sweden

It thus seems that the sometimes paralyzing controversy over nuclear power in Sweden has come to an end. There are several important factors behind this development.

1 Swedish nuclear power has performed well, both with regard to safety and economy. The letter is very important. It would have been much less difficult for people to accept nuclear power if it had performed badly from an economic point of view.

2 The public acceptance is now higher than before Chernobyl, despite of the fact that Sweden was one of the countries outside the Soviet Union that got the highest radioactive fall-out. One possible explanation is that people found out that a worst possible accident, like that in Chernobyl, after all did not have more severe consequences. It will be impossible to attribute any case of death or even sickness in Sweden to the accident.

3 There have also been some important actions taken by the nuclear power companies and the government. One such action was to develop a method för permanent storage of spent nuclear fuel. There is now a politically approved method of permanent storage of spent nuclear fuel. This has probably contributed to the public acceptance of nuclear power since in most peoples mind it is the nuclear waste problem that is the most important drawback of

nuclear power, not the risk of accidents.

4 Another important decision taken jointly by the nuclear power companies and the government was to equip the all nuclear-power plants with filters as a last barrier to uncontrolled radioactive emissions.

5 The public is better informed about the drawbacks of the alternatives to nuclear power production, due partly to active information campaigns from the industry. At the time of the referendum it was a common attitude that renewable energy would soon replace both nuclear and fossil fuel energy. There is now widespread insight that the prospects of renewable energy sources are remote and that the only economically alternatives for a long time will be fossil fuels.

6 Since nuclear power accounts for about half of the electricity production, the other half being hydro power, a nuclear phase out would lead to much higher electricity prices. The plans to phase out nuclear power had already adversely affected the investment in the traditionally electricity intensive Swedish industry long before the actual phase out would take place. This aroused the labor unions and industry.

7 The decision by government directly after the Chernobyl accident to seriously consider its implication for Swedish nuclear power was also important. Peoples confidence in politics increased.

8 The discussions of the incompatibility of the decisions to phase out nuclear power and restrict the emissions of carbon dioxide shows that this aspect is important, not only in Sweden. Restrictions on carbon dioxide in individual countries or worldwide will have important consequences for the public

acceptance of nuclear power.

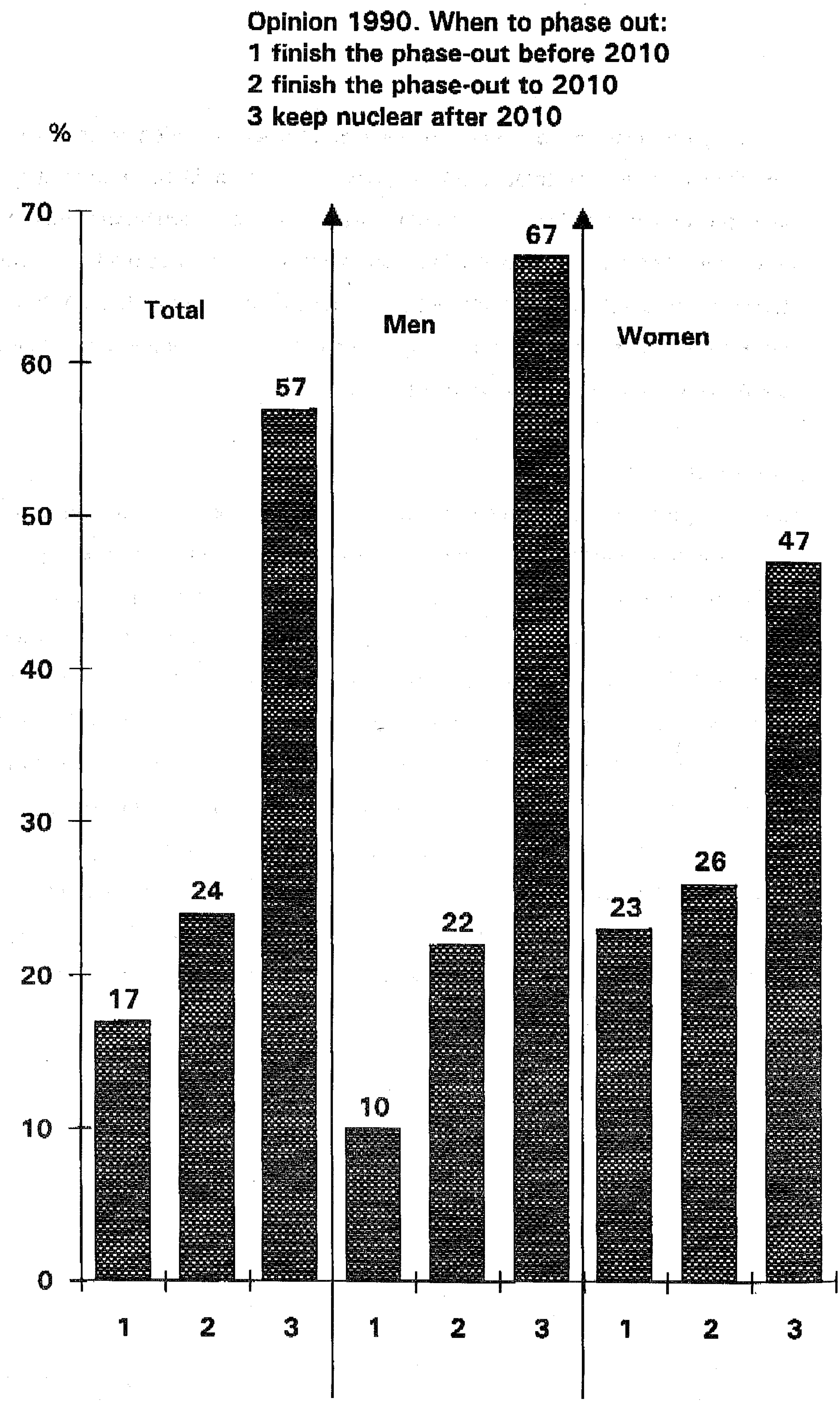
9 At two times nuclear power has been used strategically to attract people in the anti-industrial and anti-nuclear movements to the established parties. The first time was in 1976 and the second time in 1987, when the Social Democratic party tried to stop the progress of the Green Party. In hindsight both these efforts failed. In the later case the Green Party got into parliament. But it has so far failed to play any important political role. As its counterparts in other European countries it has found it very difficult to combine its original ambitions with the practical political work i parliament. The established political parties on their side have found that it is difficult to combine its ambitions to take responsibility for the practical ruling of a country with the "green rhetoric" they feel obliged to use in order to appeal to green voters. Since the anti-industrial sentiments among people now are giving away for more pro-industrial sentiments many people have lost confidence in those parties who flirted most with the anti-industrialists.

10 The political decision on nuclear power in Sweden has two components, one is to stop new nuclear power plant to be built and the other to phase out nuclear power some time in the future. The first decision has worked, so far. Although it has not in practice been tested, since there is no need as yet to increase generating capacity, it would not have been possible to construct new nuclear power plants beyond the 12.

It has, however, become increasingly clear that it is very difficult to take a political decision to take operational production units out of operation if the government does not, as is the case in Sweden, have full control of the power industry. The public and industry have never ben completely sure that the plans to phase out nuclear power would be effectuated in the end. It therefore turned out to be impossible to make the political decision sufficiently credible to convince private companies to take the risk, under the political uncertainty, of investing in new power production that must be in place when nuclear reactors are to be taken out of operation. With the big investments needed they would face devastating losses if they made the investment to make the phase out possible and it at the end turned out that the decommissioning of nuclear plants would not be realized or postponed.

Concluding remark

Sweden has gone through almost all phases of nuclear development. It started with the early euphoria over nuclear power that would give us almost free energy for indefinite times and from domestic uranium sources. Sweden implemented the dream through an ambitious nuclear program doubling of the total generating capacity within just more then a decade. It has experienced the opposite to the euphoria when a large part of the public turned against nuclear power, culminating in the referendum 1980. What we are experiencing now is that people are adopting to a more normal attitude to nuclear power, similar to their attitude to other technologies. There is a great deal of skepticism but also a feeling that the technology must be judged by good it produces in terms of cheap electricity and by its ability to cope with safety standards that people demand. If the technology performs well in these two respects the Swedish nuclear history will not end in 2010 or any other date.



Opinion 1990. When to phase out:
1 finish the phase-out before 2010
2 finish the phase-out to 2010
3 keep nuclear after 2010
%
70
60
50
40
30
20
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Total
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17
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Early phase-out of nuclear abolished in Sweden

Karl-Axel Edin, Kraftsam, Sweden

March 26, 1991

Sweden's nuclear history

Sweden was one of the first countries outside the super powers to prepare for the peaceful use of nuclear power. As early as 1945 a build-up of scientific competence in nuclear physics was begun. In the 1950s a state company was created to develop a Swedish heavy-water nuclear reactor.

In the 1960's the course was changed when the government and private industry jointly set up a new company, ASEA-Atom (now ABB-Atom), for the rapid development of a light-water reactor.

Since the beginning of the century up to the 1960's electricity generation had been expanded almost solely by utilizing Sweden's abundant hydro power resources. However, in the 1960's it became obvious that Sweden's rapidly increasing demand for electricity could no longer be met by hydro power. During the proceeding decades demand had doubled every ten years and the demand was expected to grow fast also in the future. In the choice between the conventional coal or oil power technology and the new nuclear power technology the Swedish parliament decided to choose the nuclear alternative. The decision was on the whole taken in political unity, without much debate.

The first commercial reactor was taken in operation in 1972 and the last in 1985. However, the time between the first and last reactor was dramatic.

After a long debate within the political parties parliament in 1975 took a decision to go ahead with a total of 13 reactors. The ruling Social Democratic party, the Moderate (Conservative) party, and the Liberal party supported the plan. The Center party and the Communist party opposed the plan.

By that time the nuclear issue had became more and more controversial. In the campaign before the general elections in 1976 the Center party, the leading opposition party at that time, made their resistance to nuclear power the main issue. This was a strategic decision by the Center Party. I had its base among the farmers and wanted to attract new groups to the party. Therefore it tried to attract young people in the anti-industrialist movement that swept over Sweden and other industrial countries in the beginning of the 1970's and for which nuclear power was becoming the symbol of the evils of the industrial society. Also in the other parties the anti-industrial and anti-nuclear sentiments gained support.

When the non socialist parties for the first time after 44 years of socialist rule in 1976 formed a government, the nuclear question became a major problem. After only two years of rule the non socialist coalition government was dissolved because of differences on this issue. The political society was shocked that an issue such as nuclear power, that was considered a rather technical matter, could have such political consequences.

The referendum

After the Three Mile Island accident in 1979 the nuclear question became an even bigger political problem. The political parties became more and more divided internally over the nuclear issue. In a move to solve the political difficulties caused by the nuclear question the parties agreed on referendum on nuclear power. This was a quite extraordinary measure since the institute of referendum is very seldom used in Sweden. The purpose was to once and for all let the people decide on which course to follow and in that way remove the nuclear issue from the political agenda.

At the time of the nuclear referendum, which took place in 1980, Sweden had 6 reactors in operation and another 6 were either under construction or planned. The voters were given two alternatives (formally there were three but two were almost identical).

One alternative was to stop at the 6 reactors in operation and phase them out within 10 years. The other alternative was to continue to build a total of 12 reactors, but no more. All the reactors would eventually be phased out after their technical life time. There was no alternative to expand nuclear with more than 12 reactors. In the campaign for both alternatives the prospects for renewable energy as a replacement for both nuclear and fossil-fueled based energy supply were said to very good. The difference was more a question of timing. The anti-nuclear campaign argued that renewables would be realistic alternatives already during the 1980's, while the other campaign argued in favor of renewables but emphasized that they would not be economically acceptable until after one or two decades. Therefore, the nuclear phase-out would have to wait until the next century.

The result of the referendum was that the first alternative, the anti-nuclear, got about 40 percent and the other about 60 percent of the votes. Parliament later confirmed the result. The 12-reactor program should be completed. But parliament added that all reactors should be decommissioned by the year 2010. This part of the decision by parliament actually was not based on the result of the referendum, where nothing in the winning alternatives was said about any definite final date for nuclear power. It was also only a principal decision. For such a decree to have any legal status it must take the form of a law, that forbids the use of nuclear reactor after a certain future dates. No such law has yet been proposed to parliament. This is essential. There is yet, more then 10 years after the referendum, no legal decision to phase-out nuclear power in Sweden.

After the referendum the construction of the remaining six reactors could continue. The anti-nuclear movement on a whole accepted the result of the referendum and the opposition to nuclear power diminished in strength. The nuclear issue was no longer on the top of the political agenda.

It is important to give this background to the Swedish situation. The referendum was to a large extent a way to solve a political problem by removing an issue that threatened to paralyze the political decision making in Sweden.

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However, the respite only lasted for some years. After the accident in Chernobyl the nuclear issue made a come-back as an political issue. Sweden was one of the countries outside the Soviet Union which was most affected by the Chernobyl accident. The radioactive cloud from the accident drifted in the direction of the Baltic Sea. When it reached the middle of Sweden it began to rain and the rain released radioactive material over land. The radioactive cloud continued over the north of Sweden, releasing radioactivity on its way. For several months the newspapers were covered with headlines about the consequences and reports on high level of radioactivity on the ground and in food.

Compared with the reaction after Three Mile Island the established political parties acted with restraint. The government (Social Democratic) responded fast. It prepared for a thorough investigation. The government made it clear that they took the Chernobyl accident very seriously and that they were prepared to reconsider the Swedish nuclear program. It wanted to achieve the highest possible unity among all the political parties on any decision on the future of nuclear power in Sweden.

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The goal in radiation protection is that no-one should receive more that 5 mSv per year and that the average dose received over a fifty-year period should be less that 1 mSv/year.

The largest contribution to the radiation dose from Chernobyl is expected to come from direct radiation from radioactive substances on the ground and not from the intake of food, which the public has feared most. Calculations made so far indicate that the most exposed individuals in Sweden will get at total dose over a fifty-year period that on average is well below 1 mSv/year. This is far below the doses at which immediate injury can occur. On average the dose received by a Swede in 1986 from the accident is estimated to be 1 mSv. This is equivalent to the dose received in a normal X-ray of your stomach.

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There were also made several studies of the economic consequences of a phase-out of nuclear power in Sweden. Most studies showed that the use of electricity would increase also in the future, although at a slower rate that previous decades. That means that if nuclear power was to be phased out all the generating capacity in nuclear would have to be replaced. Today nuclear and hydro power each account for about half of the generating capacity in Sweden. There is very little fossil fuel based power production. The studies also concluded that the only economically feasible alternatives to nuclear is coal and natural gas power. This contrasts with the information given before the referendum, when people were given the impression that renewable energy could replace nuclear.

The cost per kWh of producing electricity in the present system, with half hydro and half nuclear, is low compared to the cost of building and operating new power stations. Therefore a phase-out of nuclear power would radically increase the production cost and also prices. This would have severe consequences for the big electricity intensive industries in Sweden. This last issue would become a major issue in the following debate.

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Early start of phase-out

Despite the conclusion by the government that the Chernobyl accident had no relevance for the safety of Swedish nuclear power the government in 1987 decided to propose that the phase-out of nuclear power should begin in 1995/96 by taking the two oldest and smallest reactors out of operation. This decision came as a suprise, but must be seen in light of the political situation at that time.

The green movement was on the offensive, gaining support among young people. Like the corresponding movement in the 1970's the movement was generally against the industrial society for which nuclear power was a special symbol. The green movement had formed a political party that had a good chance to enter parliament in the coming election. The government's surprising decision to favor an early start of the nuclear phase-out can be seen as a way of attracting young voters away from the Green Party.

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Lessons from Sweden

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1 At two times nuclear power has been used strategically to attract people in the anti-industrial and anti-nuclear movements to the established parties. The first time was in 1976 and the second time in 1987, when the Social Democratic party tried to stop the progress of the Green Party. In hindsight both these efforts failed. In the later case the Green Party got into parliament. But it has so far failed to play any important political role. As its counterparts in other European countries it has found it very difficult to combine its original ambitions with the practical political work i parliament. The established political parties on their side have found that it is difficult to combine its ambitions to take responsibility for the practical ruling of a country with the "green rhetoric" they feel obliged to use in order to appeal to green voters. Since the anti-industrial sentiments among people now are giving away for more pro-industrial sentiments many people have lost confidence in those parties who flirted most with the anti-industrialists.

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the government. One such action was to develop a method för permanent storage of spent nuclear fuel. There is now a politically approved method of permanent storage of spent nuclear fuel. This has probably contributed to the public acceptance of nuclear power since in most people's mind it is the nuclear waste problem that is the most important drawback of nuclear power, not the risk of accidents.

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It has, however, become increasingly clear that it is very difficult to take a political decision to take operational production units out of operation if the government does not, as is the case in Sweden, have full control of the power industry. The public and industry have never been completely sure that the plans to phase-out nuclear power would be effectuated in the end. It therefore turned out to be impossible to make the political decision sufficiently credible to convince private companies to take the risk, under the political uncertainty, of investing in new power production that must be in place when nuclear reactors are to be taken out of operation. With the big investments needed they would face devastating losses if they made the investment to make the phase-out possible and it at the end turned out that the decommissioning of nuclear plants would not be realized or postponed.

Concluding remark

Sweden has gone through many phases of nuclear power development. It started with the early euphoria over nuclear power. It would give us almost free energy for indefinite times and from domestic uranium sources. Sweden implemented the nuclear potential through an ambitious nuclear program. It doubled the total generating capacity within just more than a decade by investing in nuclear power stations. It has experienced the opposite to the euphoria when a large part of the public turned against nuclear power, culminating in the referendum 1980. What we are experiencing now is that people are adopting to a more normal attitude to nuclear power, similar to their attitude to other technologies. There is a great deal of scepticism but also a feeling that the technology must be judged by the good it produces in terms of cheap electricity and by its ability to cope with safety standards that people require. If the technology performs well in these two respects the Swedish nuclear history will not end in 2010 or any other date.

SWISS ENERGY POLICY AND THE FUTURE OF NUCLEAR POWER

Lecture by Dr. Eduard Kiener, Director of the Federal Office of Energy, Berne (Switzerland), given on the occasion of the annual conference of the JAPAN ATOMIC INDUSTRIAL FORUM, April 8 to 10, 1991, in Tokyo.

To begin with, I wish to thank the JAPAN ATOMIC INDUSTRIAL FORUM for giving me this opportunity to describe the nuclear energy situation in Switzerland. It is an honour for me to be able to speak before you today. I also look forward to being able to acquaint myself with the development of electricity supply, and in particular of nuclear energy, in your nice and fascinating country.

In Switzerland, nuclear energy has experienced an eventful development. In particular, it has increasingly entered into the area of political tension, and several attempts have been made to combat it by means of national referenda. I hope, for the sake of Japanese electricity production, that it will be spared such difficulties.

1. Swiss Energy Policy

I would like to begin by talking about "Swiss Energy Policy". I shall have to limit myself here to several significant aspects. It should first be noted that the situation regarding Swiss energy policy corresponds to that of Japan in a number of ways. The most important element is the high import dependence. At the consumer level, Switzerland's dependence on energy importations is approximately 85%. The most important domestic source of energy is hydroelectricity (12%); then there is wood with 1.5%, and waste and district heat with approximately 2%. Switzerland also has a very small, insignificant natural gas source; oil, gas, coal and uranium all have to be imported.

The high degree of dependence on oil represents a particular problem. It has been possible to reduce this from 80% in 1973 to 65% today. Substitution primarily was achieved with natural gas and nuclear power. This substitution process by electricity practically came to a standstill, however, a few years ago. Although less heating oil is being consumed, fuel consumption nevertheless continues to increase.

A crucial problem also concerning energy policy is that of environmental pollution. Whilst the energy problem was primarily seen to be one of security of supply following the energy crisis of 1973/74, environmental pollution is regarded today as a considerably more significant aspect. Energy policy and environmental protection policy are very closely interwoven. The measures applied by both policy sectors correspond in their objectives to a certain extent; this applies, for example, to energy conservation and the promotion of new renewable energies. But conflicting objectives also arise, such as the use of hydroelectric power. Here, on a political level too, the interests of energy policy (optimum utilization of hydroelectric power) and of landscape and water protection (preservation of undisturbed landscapes), often conflict. The most significant opposition to new infrastructures, and not just in the energy sector, is generally brought about by environmental organisations (World Wildlife Fund, Greenpeace, and others).

The most important postulate of Swiss energy policy is the rational use of energy (energy conservation). In this respect certain results have been achieved, but we are still a long way away from the exhaustion of even just the economic saving potential. It should be noted that the Swiss economy is not especially energy intensive; the whole national economy's energy costs are about 5.5% of the gross national product.

The second postulate is the substitution of oil. Its proportion of the energy supply is still dropping slightly, but the actual consumption of oil again has been increasing slightly for a number of years. The fact that the substitution process by electricity has come to a standstill can mainly be attributed to the political problems associated with electricity generation in our country.

Finally, the third postulate is research and development. This encompasses all important fields of energy technology. Research in the nuclear energy sector is more or less at a constant level, whilst non-nuclear energy research is continually being intensified.

The Federal Government has been active for a considerable time in the field of energy policy, since it exercises authority in the fields of electricity, nuclear energy, hydroelectricity and pipelines for fossil energy. Extensive and comprehensive measures in all sectors, in particular to promote the rational use of energy and new energy technologies, have not been possible to date. It was only in September 1990 that the necessary constitutional basis for such measures was established. Up till then, legal measures in the field of energy conservation had been mainly the responsibility of the cantons. (Note that this sharing of tasks between the central government [the Swiss Confederation] and the governments of the cantons is characteristic for the whole political structure of Switzerland).

The Swiss Confederation, i.e. the central government, is not directly involved in energy production and distribution. Electricity companies belong to the extent of 72% to the cantons and municipalities, and 28% to private entities. Oil is entirely in the hands of the private economy (primarily multinational groups); gas is mainly controlled by the municipalities.

In addition to regulations and incentives, market-oriented measures are also being considered at present. The Swiss government is examining taxes to reduce demand; the main consideration is a CO_2 tax, whose revenue would partly be used to promote energy and environmental policy measures.

2. Electricity Supply

There are at present five light-water reactors in operation in Switzerland; in 1990, these contributed 41% to Swiss electricity production. Operational experience has been very good; the plants have shown a very high degree of availability (1990: 86.6%).

Hydroelectricity remains the backbone, with 57%, of electricity production. Conventional thermal electricity production is only 2%; this is both economically and ecologically beneficial. There is only one significant conventional thermal power plant with an installed capacity of slightly less than 300 MW; in addition, a little electricity is also produced in solid waste incinerator plants and district heating systems. Combined heat and power production and photovoltaic production still remain insignificant. Wind can only be used to a very limited extent and at very few selected sites.

Hydroelectricity is extensively developed. It is possible to increase production by approximately 10% to 15% by means of renovation and expansion of exisitng plants and some new projects. The expansion of existing plants, and in particular the building of new ones, are meeting with fierce opposition, however, mainly due to the effects on the landscape and on rivers. A law governing the protection of water, which the Swiss Parliament has recently passed, will in fact limit the effectively usable water resources and thus give rise to reductions in output in the longer-term future.

Electricity consumption is continually increasing. Since the middle of this century, only one slight drop has been noted, and that was in 1975, a year in which there was a recession. During the past ten years, the average growth rate of electricity consumption has been 3% per annum - in 1990 it was 2.4%.

In spite of these increases in consumption (for which not only trade and industry, but also private households, and thus individual consumers, are responsible), nuclear energy, which is the only source of electricity which can cover these additional requirements, is becoming ever more controversial.

Given the current growth rates, it would be necessary for one new nuclear power plant of the 1000 MW category to be commissioned every four to five years, in order to ensure security of supply. The last large-scale nuclear power plant to be commissioned was Leibstadt, and that was in 1984. The projects developed after Leibstadt (Kaiseraugst and Graben) were abandoned just as other, still less advanced, projects.

In view of the increasing consumption of electricity, and of the impossibility of building new domestic nuclear power plants, Swiss electricity companies have made use of the opportunity of buying supply rights from French nuclear power plants. These rights will increase to a total of 2,550 MW up to the year 2000, which means they will then be almost equivalent to the domestic nuclear power output of 3,000 MW. As a result of the impossibility of producing the required amount of electricity in its own country, Switzerland will therefore have transferred investments amounting to billions, as well as countless jobs, outside its boundaries.

It is fortunate for Switzerland that, as a country situated in the centre of

Europe, it is also at the heart of the western Europe's electricity network. For this reason, Switzerland has a well-developed transmission network which, at least for the time being, enables it to import electricity produced abroad. But it should be noted that construction of new transmission lines also meets with political and environmental opposition.

3. The Legal Situation Regarding Nuclear Energy in Switzerland

In Switzerland, nuclear energy is subject to Federal Government legislation. Any organisation intending to build an atomic plant (e.g. a nuclear power plant, a provisional storage site, a definitive storage site, etc.), requires a general licence from the government, which must be approved by Parliament. All other licences (such as building licence, operating licence, etc.) are granted by the government.

A general licence can only be granted, according to the law, based on the necessity for the plant, as well as on the proof of the safety and of the feasibility of waste disposal.

Operators of atomic plants have to accept causal and unlimited liability for all damages. The insurance sum is 1 billion Swiss francs, and its coverage is through a private insurance pool as far as possible. At present, this pool covers 500 million Swiss francs. For the remaining 500 million, the Federal Government acts as insurer; the operators pay a premium on this amount.

To cover the future costs of decommissioning, a fund has been established in compliance with legal provisions; this fund is financed by plant operators. In this way it is intended to ensure that by the time of the anticipated decommissioning of a nuclear power plant, sufficient funds are available to cover its disposal.

The law assigns the responsibility for the disposal of radioactive waste to those producing it. As far as waste arising from research, industry and medicine is concerned, it is the Federal Government which is responsible. All other waste is the responsibility of nuclear power plant operators. The latter have set up a cooperative ('Nagra' - National Cooperative for the Storage of Radioactive Waste) in collaboration with the Federal Government, and this organisation has been entrusted with the task of searching for definitive waste storage sites.

Supervision over atomic installations is the responsibility of the Main Division for the Safety of Nuclear Installations (The Swiss nuclear safety Inspectorate). This division is part of the Federal Office of Energy. There is also an advisory committee which has been set up by the government (the Federal Commission for the Safety of Nuclear Plants), including members from the scientific, industrial and nuclear technology sectors. This committee deals primarily with fundamental questions, but also comments on the opinions expressed by the Main Division.

The Federal Office of Energy is responsible for the preparation and excecution of Swiss energy policy in its entirety (with the exception of the preparation of emergency measures). We therefore carry out all procedures regarding licencing nuclear projects. This is an immense task, since not only do the security authorities have to state their point of view, but the cantons, too, have to be consulted, and each individual citizen is entitled to raise objections. The procedures, and thus the main documentation (applications, expert reports, statements of position, objections, etc.), are public.

In addition to the supervision of safety of nuclear plants (including research reactors), the Federal Office of Energy is also responsible for the observance of the Non-proliferation Treaty, which means supervision of the fuel cycle and of international trade in relevant equipments.

The tasks in the nuclear sector, i.e. nuclear energy policy, the carrying out of various procedures, plus supervisory tasks, mean that more than half of the activities carried out at the Federal Office of Energy concern nuclear energy, in spite of the fact that nuclear energy only covers 8% of the overall demand for energy in Switzerland.

Switzerland also has a Centre for Nuclear Energy Research. The former Federal Institute for Reactor Research (EIR) was merged with an Institute for Particle Physics a few years ago. Within the Paul Scherrer Institite (PSI), there is now one division active in the field of atomic energy research. The main emphases here are safety (particularly in connection with light-water reactors); waste disposal; and, to a lesser degree, tasks for advanced reactor systems. The distribution of funds for atomic energy research is a continual subject of dispute; we permanently have to defend it, since at a political level demands are continually being put forward to withdraw funds for atomic energy research and to reassign them to research on other forms of energy. The proportion of atomic energy research (fission) is now about 20% of overall government energy research.

4. From the Ideal Energy Source to Political Issue

Nuclear energy is now not only the most controversial source of energy, it is also one of the most disputed political issues in Switzerland today. The project for a nuclear power plant in Kaiseraugst, near Basle - which has since been abandoned - turned out to be the most disputed infrastructure project in Switzerland in recent decades.

But the situation has not always been like this. Nuclear energy was originally widely welcomed.

In the 1960s, it became apparent that the hydroelectricity potential was virtually exhausted. New power production plants had to be planned. Originally, the electricity companies envisaged the construction of three large-scale oil-fired power plants, and it was planned to go nuclear later on.

But the Minister of Energy at that time was sufficiently farsighted to persuade electricity companies to build nuclear power plants straight away rather than oil-fired plants. Already at that time, economic and ecological arguments were put forward in favour of nuclear energy.

So electricity companies subsequently only constructed one oil-fired power plant in the vicinity of a refinery, to burn heavy fuel oil.

The first nuclear power plants (Beznau, 2 x 350 MW, and Mühleberg, 324 MW), were constructed in a very short time and without political resistance. The two plants at Beznau were commissioned in 1969 and 1971 respectively, after a construction period of only three-and-a-half years, and Mühleberg was also commissioned in 1971 after a four-year construction period. The two subsequent larger plants took a longer time to build, partly for political reasons, but also as a result of difficulties with the project development. Gösgen (940 MW) was commissioned in 1978 after a five-year construction period, and Leibstadt (990 MW) was commissioned in 1984 after a nine-year construction period. No notable opposition developed against these plants. They were in fact welcomed by the majority of people. There was only one sizeable demonstration against the commissioning of Gösgen. These plants are still widely accepted locally today in their municipalities, which have always voted in favour of nuclear energy at the various national referenda that have been held.

Opposition against nuclear energy began in the second half of the 1960s. Private individuals, first, and grassroot committees and civil movements began to speak out against the construction of new nuclear power plants. More and more regional organisations were formed, and before long, they began gaining the support of environmental organisations.

To begin with, the nuclear issue was not a matter of party politics. But with time, the left and green parties began to oppose nuclear energy. Bourgeois politicians and voters have also supported this opposition. Today, the left parties are strictly against nuclear energy, while parties on the extreme right are pronouncedly in favour of nuclear energy. The remaining bourgeois parties consider nuclear energy to be a necessity, but are also not unconditionally in favour of it. Party politics has never been in the foreground of the nuclear energy issue. But nuclear energy has always been a welcome issue in election campaigns.

The real focus of nuclear opposition proved to be the project at Kaiseraugst. This plant was planned to be constructed after the commissioning of the Leibstadt plant.

The local population originally wanted this nuclear power plant, since it was to be built on the same site as a projected oil-fired power plant. The residents of the muncipality of the project voted clearly in favour of the plant in the sixties. But this changed in the course of time; opposition came up following the decision of the Swiss government to demand a cooling tower instead of a flow cooling system, in view of the risk of excessive warming of the Rhine.

But opposition against the project came primarily from the nearby city of Basle. The inhabitants of this city, subject to a high level of pollution from industry and traffic, were not prepared to accept any additional risks. They therefore showed their opposition against the Kaiseraugst project by demonstrating, and by launching political initiatives. In terms of both extent and intensity, this resistance went way beyond all other previous forms of opposition against any individual project in Switzerland. It even led to the occupation of the site in 1975 - an act of resistance which never occurred before in Switzerland, in terms of either type or extent. Acts of terrorism were also committed. The occupation was only terminated several months later, after the Swiss government had promised to talk at the highest political level with the anti-nuclear organisations.

But the Kaiseraugst project nonetheless continued to be pursued. Following a series of referenda, to which I shall come back later on, the Swiss government granted the general licence in 1981; this was approved by Parliament in 1985 after four years of discussion. Thus the path seemed clear, at least at the political level, for the realisation of the project. It could be assumed that the Kaiseraugst nuclear power plant would go ahead and be built. Certain well-informed persons felt that the population of the area had finally come to terms with the project. So the project was relaunched by a procedure of requesting new quotes.

And then came the Chernobyl accident. The degree of acceptance of nuclear energy among the Swiss population dropped to a new low level; two new people's initiatives were launched. It became more and more apparent that it would no longer be possible to complete the Kaiseraugst nuclear power plant after this accident. The project was abandoned in 1988 following moves in the Federal Parliament. The Swiss state paid 1/4 of the total accrued costs of 1.4 billion Swiss francs. Two years later, it was decided to abandon the Graben project, too, in the canton of Berne. Therefore, there is at present no nuclear power plant either in the planning phase or under construction in Switzerland, nor is there likely to be in the foreseeable future.

5. **Developments at Constitutional and Legislative Levels**

In Switzerland, which is structured federally, the central government needs a specific constitutional basis for each competence. Every amendment to the constitution requires a national referendum. This was also the case with the introduction of nuclear energy; in 1957, the Swiss electorate voted for its introduction by an overwhelming majority, and simultaneously authorised the central government to grant licences and to exercise supervision. The Atomic Energy Law, which was then passed in 1959, contained the necessary security provisions as well as liability stipulations; careful attention was paid to the fact, however, that the introduction of nuclear energy was in no way hampered.

Here it is necessary to sidetrack for a moment and take a look at the Swiss right to take initiatives and referenda. As I have already mentioned, all amendments of the constitution require a national referendum. Amendments of the constitution can be proposed not only by the government or directly by Parliament, but also by 100,000 citizens entitled to vote, who can demand amendments of the constitution by means of an initiative, which has to be voted on. This means that on average, Swiss citizens are called upon to vote on national referenda three or four times a year; referenda are also held to decide on cantonal and municipal issues. So government politics continually faces the threat of initiatives and referenda.

Switzerland's citizens have voted on a total of eight energy policy issues in five national referenda during the past twelve years. Five of these concerned nuclear energy directly, the other three indirectly. The campaigns leading to these national referenda were always conducted with a high degree of emotion in view of the controversial nature of the issue. They were considerably more intensive than most other national referenda.

A first people's initiative, which was submitted as a result of the occupation of the Kaiseraugst site, was rejected in 1979 (i.e. prior to the Harrisburg incident!) by a surprisingly close count (49%). This initiative would have rendered the building of new nuclear plants practically impossible as a result of a complicated regional voting procedure.

The events surrounding the Kaiseraugst nuclear power plant had made it clear that the rights of the population to participate in decision making needed to be enhanced; at the same time, the authority to grant licences was transferred from the government to Parliament. The provision to prove the need of the project was introduced. A nuclear power plant can only be constructed if its need is established. Regulations governing waste disposal were also introduced. This tightening of atomic energy legislation was also put forward as an indirect counter-proposal to the above-mentioned atomic energy initiative; and in 1979, this more stringent law was accepted by the electorate.

But this did not satisfy the opponents of nuclear energy. In order to prevent the construction of further nuclear power plants, and in particular Kaiseraugst, they launched two further people's initiatives at the beginning of the 1980s, which were somewhat more clearly rejected, in 1984, than the first initiative in 1979. Nuclear energy had now gained more acceptance again, as the Harrisburg incident receded into the past. This development was to reverse itself drastically, however, following the Chernobyl accident. The political situation proved to be favourable for further people's initiatives.

In 1987 already, two new initiatives were submitted. One of these demanded a ten-year stop (or moratorium) to licence new nuclear power plants, and the other called for a nuclear phase-out. The national referenda were held in September 1990. The moratorium initiative was accepted, which means that no further licences can be granted for new nuclear power plants until the year 2000. The phase-out initiative, on the other hand, was rejected, albeit by a relatively narrow margin. At the same time, an energy article in the federal constitution was accepted by the electorate by a clear majority. This means that the central government can introduce measures to use energy more rationally and to promote renewable energy.

How can these results be evaluated? The first point is that the Swiss population is only prepared to accept as much nuclear energy as is absolutely necessary. But they are apparently prepared to accept legal energy conservation measures. Secondly, no new nuclear power plants are to be built in Switzerland for the time being. Thus there appears to exist a hope that it will prove possible, thanks to energy conservation measures and the promotion of new energies, and in particular of new renewable energies, to do without additional nuclear power plants. And thirdly, it would appear that the Swiss citizen has come to the conclusion that Switzerland cannot renounce nuclear energy in spite of the widespread scepticism regarding it. The five existing nuclear power plants remain in operation. Care must now be taken that their security, their later decommissioning, and the disposal of radioactive waste, are ensured.

In Switzerland, nuclear technology has been forced more and more into an ever tighter corner, partly due to internal political developments, but also as a result of incidents elsewhere (Harrisburg, Chernobyl). At present, it is not possible to build new nuclear power plants for constitutional reasons. The existing plants continue to be a subject of dispute at a political level. And waste disposal, too, meets with political opposition, and sometimes even with physical resistance, wherever geological research is carried out.

6. The issues in the Nuclear Energy Debate

Opposition against nuclear energy has steadily increased in Switzerland. The issues which are debated have been the same as those in many other countries. The nuclear energy scene is not merely international on the side of experts, but on that of its opponents too. Most of the arguments raised came into Switzerland from the USA via Germany - as, for example, the slogan "small is beautiful".

In Switzerland, it is the political struggle through people's initiatives and by the full exploitation of all legal potentials which is in the foreground. There are many possibilities here, thanks to the federal structure of Switzerland, which is divided into three levels (federal government, cantons, municipalities). In Europe, nuclear energy suffered for a long time from the fact that its first use was in the form of the atomic bomb. This connection is hardly ever made nowadays, at least not in Switzerland.

It would be going too far to deal with all the individual issues in the nuclear energy debate in detail. These have constantly changed as time has gone by. Some of the most crucial only are:

- Safety and radiation protection were not given much attention for a long time, but following the incidents at Harrisburg, and particularly the Chernobyl accident, these became a focal point of discussion again.

- The lack of definitive sites for the storage of radioactive waste remains a weak point of nuclear energy, and many citizens regard it as such even if they otherwise do not necessarily reject nuclear energy from the outset. The reprocessing of spent fuel is a further matter of dispute.

- The question of expenditure on nuclear energy research is one which is constantly being raised, for it is often claimed that nuclear energy would not be necessary at all, or only to a minor extent, if the funds which had been spent on nuclear energy research had been used for research on alternative energies and technologies.

More and more new arguments were introduced in the course of time. No sooner had one point been debated and reservations proved to be unfounded, than the next issue was raised:

- The large quantities of waste heat were criticised.

- It was claimed that nuclear energy would inevitably give rise to the evolution of a police state, due to the risks of sabotage and proliferation.

- Nuclear energy, as a major technology, would give rise to a centralism contradictory to the structure of our society.

- Nuclear energy is too costly, not necessary at all, and in any case, the uranium reserves would not last long.

- Finally, questions regarding liability were raised, though these have now been dropped since the introduction of more progressive legal regulations.

The nuclear energy debate has gone beyond the boundaries of energy issues and given rise to discussion on the evaluation of technological hazards in general. For example, themes such as chemistry and biotechnology have been included.

We continue to note, to a growing extent, the existence of an inconsistent assessment of risk. The hazards of nuclear energy, which, as is well known, are clearly acknowledged by specialists, are viewed by the general public in quite a different manner from those of our other daily activities. In Switzerland, no one has ever lost his life as a result of the peaceful use of nuclear energy; but on our roads, some thousand persons die each year. Nonetheless, the hazards of nuclear energy are debated far more than the dangers of the motor car.

In the field of technology, we are accustomed to defining risk as a product of the potential damage with probability. This definition is no longer accepted everywhere. It is often insisted that activities should not be carried out if the potential damage is very big, even though the probability may be low. This discussion has by far not reached its conclusion, and it will become particularly significant in the course of the general revision of the Atomic Energy Law which will need to be carried out in the next years.

Ten years ago I anticipated that nuclear energy would be accepted once and for all following a lengthy period to get used to nuclear energy during which the public would have learned to come to terms with it. But this proved not to be the case. Opponents of nuclear energy have not given up their activities. It is particularly those incidents and problems which the media are so keen to report on, whether these be genuine or invented, which have had such an effect on public opinion. Against such incidents as Windscale, Harrisburg, Chernobyl, the Nukem affair, and even routine emergency shutdowns, all the explanations and information campaigns of the authorities and specialists have had no effect. Nuclear energy stumbles over its own errors and weaknesses time and again. The degree of acceptance of nuclear energy has gone down, even though the public, too, surely has to admit that we are dependent on this form of energy.

The discussion on climate change, which has also been carried out intensively in Switzerland, has again emphasised the advantages of nuclear energy; but this has only had a very minor influence on its degree of acceptance. However, the construction of large-scale fossil-thermal plants is unlikely to be possible either.

7. An attempted Analysis of Opposition against Nuclear Energy

Is it really the risks that have given rise to opposition against nuclear energy? For the general public this is probably the case, but not for the nuclear opposition. For the latter, it is sociopolitical issues which are most important. The political opposition against nuclear energy knows that electricity as a key form of energy is vital for the development of the economy. As a result of a shortage of electricity, trade and industry, as well as individuals, shall be forced to reduce electricity consumption. In this way, the transition from a quantitative to a qualitative economic growth shall be achieved. The Swiss government, too, is in favour of this transition from quantitative to qualitative growth; but it rejects the idea of such a drastic remedy as an artificial reduction of supply would represent. It intends to reduce the consumption of electricity by measures to promote its rational use, so that as few power stations as possible would be required.

The opposition against nuclear power plants in Switzerland is politically dishonest as long as electricity continues to be imported from foreign nuclear power plants.

Thus we come to the fundamental problem facing Swiss energy policy: the contradiction between increased demand on the one hand, and the rejection of the necessary infrastructure on the other hand. It is not only nuclear power plants that are being rejected, but also hydroelectric power plants and transition lines. But at the same time, the consumption of electricity continues to increase.

And it is not only power plants that are controversial. Practically every new type of infrastructure, such as railways, roads, waste disposal plants, etc., are the subject of controversy. This rejection is the expression of a widespread public scepticism and fear of the continuation of a development which has not only brought benefits, but also hazards and problems. It is understandable that only advantages are accepted and soon taken for granted, while the unavoidable drawbacks are readily rejected and passed on to others. The widespread opposition against technology, which became apparent a few years ago, has more or less been overcome today. For the electricity consumer, though, the idea still seems to apply that "we don't need nuclear power plants - we've got plugs already."

So nuclear energy has also become a victim of the spirit of the times, following an economic development without precedent. The opposition against infrastructure is partly the expression of a saturated society. What we have today is what is referred to in Switzerland as a 'consternation democracy'. Many citizens oppose new plants and projects which they feel may affect them or even be a hazard to them, without paying attention to their paramount advantages for the community as a whole. Lack of space plays a major role in this connection. It is very much as a result of the relatively broad extent of building development throughout Switzerland, with a high percentage of rural population, that it is no longer possible to erect nuclear power plants or install waste disposal sites that would not be situated in the vicinity of residential areas.

8. The Consequences of the Moratorium

The ten-year moratorium that was accepted on the occasion of the national referendum in September 1990 means that for this length of time no new nuclear reactors can be granted licences. This does not apply to disposal sites. So licences can still be issued for provisional and definitive storage sites.

The moratorium will in practice have an effect far beyond the deadline of the year 2000, however. Due to the possibility that another anti-nuclear initiative could be launched, the electricity companies will probably not be prepared to risk launching any new projects before the moratorium expires. As a result of the lengthy licencing procedures involved, and of the time required for construction, any possible new nuclear power plant would hardly reach completion before 2020. The moratorium, and thus the period during which the nuclear energy sector will have to tread on the spot - a period which in fact commenced with the commissioning of the Leibstadt nuclear power plant in the mid-eighties - will not be just 10 years, but rather almost 35 years.

The moratorium will give rise to the fact that Switzerland, which in the past had traditionally been an electricity exporting country, is going to turn into a net importer to an ever increasing extent, to begin with during the winter months, but later on during the summer too. Our electricity supply will depend ever more on France. On a shorter and medium term basis, this will in fact be very economical, since for the time being at least, electricity from French nuclear power plants is cheaper than that from new Swiss nuclear power plants. But whether this will apply to the more distant future remains to be seen.

But one point is certain: our security of supply has decreased, in spite of the loyalty of supplies from Electricité de France. Switzerland continues to have large peak load reserves from its storage power plants, though these are only available for a limited period of operation. The problem facing Switzerland's electricity supply is not its capacity, but the total power supplies during the winter months.

Mr. Mori, your Executive Managing Director, asked me about the advantages and disadvantages of the moratorium. And indeed, the decision by referendum in favour of the moratorium does not only have disadvantages. Together with the clear acceptance of the energy article, it has indicated that the political basis for an effective energy conservation policy apparently exists. The moratorium is a political mandate to stabilise the consumption of electricity, and energy consumption in general. Its acceptance has at least partially eased the tension on the political scene in Switzerland, and has to some extent softened up the various fronts. Discussion between advocates and opponents of nuclear energy can now begin again, if at first in a cautious vein.

But the disadvantages are significant. I have already pointed to the growing supply problems. The electricity situation in general is becoming more acute.

Given the supplies already contracted, the increase in consumption can be covered up to approximately the year 2000. Additional hydro potentials are limited. Renewable energies are being promoted, but they cannot be expected to provide any significant contribution to electricity production in the foreseeable future. The potential of combined heat and power production is significant, but this would mean that electricity would be produced using fossil energy, and this would be questionable from an environmental point of view. What is more, all of these potential non-nuclear methods of electricity production are more costly than nuclear energy for the base load generation required in Switzerland. The moratorium is therefore disadvantageous for the energy sector and the general economy, as well as from an ecological point of view. And this would especially apply, of course, to a nuclear phase-out.

9. Political Conclusions

The acceptance of the moratorium is not least a consequence of the fact that the electricity sector has not succeeded in convincing the general public of the advantages of nuclear energy and of the need for additional nuclear power plants. Since a certain time, many electricity companies promote the more economic use of electricity in very progressive ways. But these efforts have not been sufficiently acknowledged by the general public.

Only if it proves possible to convince the population that all possible and rational efforts to use energy more rationally and to promote new sources of energy have been made, will it be possible to establish and strengthen the acceptance of nuclear energy. Otherwise there is the danger that new people's initiatives against nuclear energy will be launched, and will also succeed.

The battle against nuclear energy is being fought at a political level. And when political questions are asked, political answers must be given. Experience has shown that in Switzerland, the fears, the changing ideas of social development, and exaggerated hopes placed in alternative energies, cannot simply be answered through rational argumentation. Those who feel threatened by the presence of a nuclear power plant in their vicinity are not going to be appeased with information on kilowatt hours or with arguments regarding the high availability of the plant. And those who are afraid of a final storage site for radioactive waste because of the long half-life period, are not going to be reassured by hydrogeological expansion models or hazard estimates.

This clearly indicates the difficulty of the nuclear energy debate. Whilst opponents fight at an emotional level, advocates of nuclear energy have, as a rule, to counterattack with rational arguments. They cannot act otherwise, and are thus in a highly uncomfortable position. The opponents of nuclear energy not only master the dialectics of confrontation more proficiently, they are also at an advantage from the outset in this discussion carried out at different levels.

The credibility of the position of the energy sector, as well as of the governmental policy, must therefore be brought about by increased efforts in the field of the rational use of energy and new renewable energies. What is required is a proof of action. This is the reason why the Swiss government has launched a special programme called "Energy 2000", which includes not only endeavours at all three (central, cantonal and communities) levels, but in the economy as well. In addition to many other participants, the energy sector and its opponents, environmental organisations, have declared their readiness to contribute to this programme. Should this programme succeed, then it may be possible to free the energy sector from the deadlock of a trench war that has been waged for so long, and thus to at last achieve visible progress by means of political discussion and firm policies. Who knows - it may even be possible to de-emotionalise the debate on nuclear energy in this way.

10. **Concluding Comment**

I hope that my statement has succeeded in providing you with an impression of the ever-increasing difficulties concerning nuclear energy in our country. I am aware of the fact that this form of energy is also coming under increasing pressure in Japan, and that it is by no means easy to erect new nuclear power plants in your country either, just as it is now barely possible to develop new sites. I very much hope, both for yourselves and for Switzerland, that the Japanese electricity sector will be able to succeed in using and expanding nuclear energy. The difficulties experienced by one country tend to spread to others too. Successes achieved by nuclear energy opponents in one country will encourage their sympathisers elsewhere. I therefore wish you every success for your application of nuclear energy, which this planet simply cannot do without, and hope you will not have to face the same problems Switzerland has experienced.

MINISTRY OF INDUSTRY
Peter Åsell
political adviser

1991-04-05

ENERGY POLICY IN SWEDEN

A presentation of the Government's bill presented to Parliament the 14th of February 1991.

- Key note speach for panel discussion at the JAIF 24th Annual Conference in Tokyo, April 9th 1991.

First of all I want to express my gratitude for having been invited here in order to present the Swedish energy policy, with special emphasis on our decision to phase out nuclear power. I hope I will be able to answer the questions that you might have concerning our policy. But let me start with a short background to make you understand the Swedish situation.

BACKGROUND.

Sweden is a large country. Our area is 10% larger than Japans. Our population, however, is very small. Total number of inhabitants are 8.5 millions; much less than 10% of the Japanese population.

Our country is situated far north and we suffer from a hard climate, although it is not as hard as in Siberia, since Sweden is a maritime country between the Baltic sea and the Atlantic ocean.

Geologically Sweden is very different from Japan. Our bedrock is extremely old and therefore our mountains are flattened out and most of our country is rather flat. Our climate and soils, however, makes most part unsuitable for agriculture but well suited for coniferous forests. Therefore forestry and forest industry have always been our primary source of prosperity.

Our bedrock is also rich of metallic minerals, which has made metal mining and metal production our second source of prosperity.

Our gently sloping mountains are also well suited for hydro power production. Until 15 years ago, hydro power gave us 70% of our electric power. Still our capacity of 70 TWh give us 50% of our power supply. Hydro power is often mentioned as our third source of prosperity.

These resources have made Sweden technically and industrially highly developed with a high standard of living. Consequently our prosperity is based on heavy, energy-demanding industry, such as iron and metal mining, steel and metal production, and paper production.

Our combination of hard climate and heavy industry make us very dependent on energy supply, especially electric power. Our consumption of electric power per capita is more than 17 000 kWh/year, which is three times as high as the Japanese per capita consumption.

NUCLEAR POWER.

Sweden started early with commercial use of nuclear power. The first full scale Swedish commercial nuclear plant was taken into operation 1972. Intensive anti-nuclear feelings in large groups of population also developed early. Nuclear power developed into the most infected political issue in modern Swedish history: 15 years ago the social democratic party was thrown out of government for the first time since 44 years. In 1980 a public referendum was held about nuclear power. As a result a decision was taken that nuclear power shall be used during a transition period, but is to be phased out at the latest by the year 2010.

And so the subject for my presentation, **GOVERNMENT'S BILL ON ENERGY 1991:**

During last year intensive political negotiations was pursued between the governing Social Democrats and the opposing Liberals and Centre party. The opposing Conservatives, Environmentalists and Communists were not invited to these negotiations.

A three party agreement bridging formerly deep political gaps was met in January this year. Government's bill, presented less than two months ago, is based on this broad political agreement.

This is the main content of the bill:

1. Start of nuclear phase-out will depend on success for energy conservation and for new sources of energy. Let me quote from the translation:

"The juncture at which the phase-out of nuclear power can begin, and the rate at which it can proceed will hinge on the results of electricity conservation measures, the supply of electricity from environmentally acceptable power production and the possibilities of maintaining internationally competitive electricity prices".

In short, this means that the earlier decision to start phasing-out 1995 is to be changed.

2. The decision of final phase-out by 2010 is not changed.

3. The former strict ceiling for release of CO_2 is to be replaced by a policy where all kinds of climate affecting gases are to be taken into consideration and where the international approach will be central. This will give some space for fossil fuels as a result of the phasing out of CFCs. CFC is a very potent climate affecting gas.

4. A large 5-year program for intensified energy conservation.

5. A large investment support program for introducing technology that is "near commercial", such as biomass Combined Heat and Power production (CHP), medium sized wind power and solar heating.

6. Redoubled efforts for further technical development of large scale wind power and large scale biomass-power.

7. Turning surplus agriculture land into ethanol-fuel production.

These measures during the nearest 5 years, and similar measures later on, are estimated to give possibilities to fulfil the phase-out process as planned.

To ensure that this will also be the case, the parties concerned have agreed that the government (regardless of what party is in power) shall continuously evaluate the development and each year (in the budget) present the results and suggest such additional measures that might be called for. This political formula will every year give the parliament full information, and every single member of parliament a possibility each year to express his view on the Government's way of action and demand alternative measures.

What are then the **POTENTIAL FOR SUCCESS?**
Doubts have been expressed, as to whether it will be possible to fulfil the phase-out without sacrificing our prosperity. Of course nobody can give exact forecasts of what will happen during the next 19 years, but I will at least show the potentials we are working with.

1. Energy conservation has demonstrated great progress. Especially this is the case in domestic heating, which is a very important factor for Swedish total energy consumption, as well as for our power consumption (more than 1/3 of our nuclear power is used for domestic heating). New metods for insulation, ventilation and for window construction have led to the fact that modern houses consume just a small fraction of the energy needed 15 years ago. Since houses have a long technical life the results are showing only gradually. A fact is that the energy need for domestic heating is today diminishing and will continue to diminish.

The result of energy conservation is that total demand for energy is curbed. I can not today tell if it will ever turn downwards, or just stay level.

2. Renewable energy.
Beeing a large country with small population, Sweden has a theoretical potential to replace nuclear with biomass, large scale wind power (on-shore as well as off-shore) and solar heating. Costs are today prohibitive but the potential for technical development is large. Within a ten year period costs and availability will be substantially raised. But of course, today it is not possible to give certain forecasts about that future development.

3. Fossil fuels are to be avoided as far as possible. But natural gas is still an open question. At least during a transition period it will probably be necessary. Since our phasing-out of CFCs is very successful we will be able to introduce substantial amounts of natural gas without raising our release of climate-affecting gases. And under any circumstances our contribution will stay far below the level from countries whith a fossil-fuel based power production.

- Conclusion.

Let me conclude by declaring that:

Sweden will fulfil the phasing-out of nuclear power, and there are good reasons to trust that we will do it by the year 2010. And please trust, that we will not allow the process to create environmental damage to ourselves, nor to the world.

We are however, fully aware that this is no easy task. We know that we need to fulfil a hard struggle that will cost us substantial resources. But we are not going to accomplish it with such a speed that it will create unemployment and poverty.

午 餐 会

通商産業大臣所感
通商産業大臣
中 尾 栄 一

〈特別講演〉
「日 本 の 美」
東京芸術大学学長
平 山 郁 夫

所　感

一．通商産業政務次官の中曽根弘文でございます。

本日は、第２４回日本原子力産業会議年次大会にお招きにあずかり、原子力の開発・利用に長年携わってきた皆様と、親しくお話しできる機会を得ましたことに対し、まずもって御礼申し上げます。

二．本年次大会は今回で２４回を迎えることになり、まさに、我が国の原子力開発と、歩みを共にしてきたわけですが、最近では、特に原子力に関する有数の国際会議の一つというべき感があり、毎年、実りある成果をおさめてきております。

今回は「９０年代のエネルギー・原子力に何を期待するか」というテーマが設定され、原子力を取り巻く最近の状況を真摯にとらえつつ、原子力エネルギーの更なる開発・利用を進めるためには何が必要なのか、あるいは、逆に脱原子力政策のゆくえはどうなのか等の問題が国際的視野に立って議論されると伺っています。今後の原子力政策の在り方を考えていく上で極めて有意義であると期待しています。

本大会の開催に尽力された生田委員長及び日本原子力産業会議の皆様に心から敬意を表したいと存じます。

二．さて、昨今のエネルギーを巡る諸情勢を見てみますと、皆様御承知のとおり、地球環境問題への各国を挙げての取組みの重要性が認識されています。また、湾岸戦争を契機として石油依存度の低減の重要性が再認識されるところとなりました。一方、エネルギー需要は、今後発展途上国を中心に益々増加していくことが見込まれており、これらに対応し、地球環境と調和を図りつつ、エネルギーの安定供給を確保することが国際的にも求められているところであります。このような中で、石油代替エネルギーの中核である原子力の開発・利用を推進することは、今後のエネルギー政策を考えるにあたって不可欠であり、ヒューストンサミット経済宣言においても、地球環境問題の観点からその有効性が謳われております。

四．かかる状況を踏まえ、２０１０年までの２０年間で約４千万キロワットの原子力発電所の増設を図ることを内容とした石油代替エネルギー供給目標が昨年１０月に閣議決定されました。この目標は我が国が、エネルギーを巡る国際的な課題に積極的に応えていくためにも是非達成が必要なものであり、政府といたしましても、安全性の確保を大前提に原子力の開発・利用を進めていく所存であります。そのためには、国民の間に依然として存在している原子力に対する不安を解消し、今後とも国民各層の幅広い理解と協力を得ていくことが不可欠となっております。

五．このような中で、本年２月に我が国において発生した関西電力美浜発電所２号炉の蒸気発生器伝熱管損傷につきましては、環境に影響を与えることはなかったものの、非常用炉心冷却装置が実作動するに至ったことは極めて遺憾なことであり、今後、原因の徹底究明を図り、それに基づいて、万全の対策を講じて参りたいと思っております。

六、原子力に携わっている方々におかれましては、原子力に対する国民の理解・協力を得ていくためには、原子力発電所における安全運転の実績を積み重ねていくことが第一であることを十分御認識の上、安全性の確保を大前提にした原子力の開発・利用への更なる御尽力をされますようお願い申し上げます。

七、最後に、本大会が我が国はもちろん、世界各国における原子力に対する理解の増進に大きな役割を果されんことを祈りつつ、皆様の一層の御発展を祈念いたしまして、私の御挨拶といたします。

セッション３

チェルノブイリ事故後の放射線影響

チェルノブイリ事故による放射線影響

（財）放射線影響協会理事長
熊　取　敏　之

〈パネル討論〉

（財）放射線影響協会理事長
熊　取　敏　之

京都大学名誉教授
菅　原　　努

読売新聞社論説委員
中　村　政　雄

ほか１～２名

チェルノブイリ事故被災者救援調査団に参加して

野口邦和

はじめに

９０年２月、ベロルシア共和国最高会議および同国閣僚会議はチェルノブイリ事故による被災について、国際的に救援を呼びかける声明を発表した。この声明がベロルシア対外友好文化交流協会を通じて民間の日ソ協会に届けられ、これに応じて日ソ協会は救援の募金運動に取り組むことを決めた。その際、どのような救援をすることが最も有効なのかが問題になり、その実情を調査するためベロルシア共和国に調査団を派遣することになった。こうして組織されたのが「チェルノブイリ事故被災者救援調査団」（以下「調査団」と略称する）であった。

９０年１０月初旬、ベロルシア対外友好文化交流協会の招きにより、「調査団」の一員として私はベロルシア共和国を訪問した。「調査団」の報告の概要は『汚染地帯からの報告』としてリベルタ出版から今月中旬に刊行されるので、ここではベロルシア共和国を訪問中に得た私個人の断片的な見聞録に類することを述べる。

「調査団」の日程

「調査団」の日程は以下のとおりである。

９月２９日	午後	成田発　モスクワ着
９月３０日	午後	モスクワ発　ミンスク着
１０月　１日	午前	ベロルシア対外友好文化交流協会での歓迎集会（同共和国最高会議チェルノブイリ事故対策委員長、保健大臣らと懇談） 小児血液学センターを訪問
	午後	科学アカデミー放射線生物学研究所を訪問 保健省放射線医学研究所付属病院を訪問
１０月　２日	午前	血液学輸血センターを訪問
	午後	ミンスク発　ゴメリ着
１０月　３日	午前	ゴメリ発　ホイニキ着 避難地域などへの立入調査
	午後	ホイニキ市中央病院で同病院医療関係者との対話集会 ホイニキ発　ゴメリ着 ゴメリ州庁舎で同州執行委員長らと懇談
１０月　４日	午前	ゴメリ発　ミンスク着
	午後	ベロルシア対外友好文化交流協会で同共和国関係者と最終意見交換
１０月　５日	午前	ミンスク発　モスクワ着
	午後	モスクワ発
１０月　６日	午前	成田着

汚染状況の把握

放射能汚染状況の把握は事故直後からヘリコプターを利用して行われており、８６年５月には汚染地図が作成されていた。その後、さらに正確な汚染地図を作成するため、ヘリコプターの外に自動車なども利用して、８７年以降毎年２回ずつ更新された汚染地図が作成されている。汚染地帯では都市部で２００メートル間隔、農村部で４００メートル間隔で空間線量率の測定を行うとともに、土壌試料を採取してセシウム137 の深度分布を考慮して、単位面積当たりのセシウム137 の放射能が求められている。これらの測定データはベロルシア共和国水文気象センターで集約され、各種の汚染地図が作成されている。

汚染状況

1) チェルノブイリ事故で環境に放出された希ガス以外の放射性核種の約70%がベロルシア共和国に降下した。1キュリー/平方キロメートル以上のセシウム137 汚染地域に27市町および2697村が含まれ、ここに全人口の20%に相当する約220万人が住んでいる。農地面積の18%以上に相当する162万3000ヘクタールの農地と森林面積の約20%に相当する128万6000ヘクタールの森林が汚染された。
2) セシウム137 が5~15キュリー/平方キロメートルの汚染地域は「定期監視地域」と呼ばれ、20万6000人が住んでいる。また、セシウム137 が15キュリー/平方キロメートル以上の汚染地域は「厳重監視地域」と呼ばれ、住民の健康診断が定期的に行われ、395町村の10万2000人が住んでいる。
3) 汚染地域は大きくは「南部汚染地域」と「北部汚染地域」に分けられる。「南部汚染地域」はチェルノブイリ原発周辺数十キロメートルの範囲内の汚染地域で、セシウム137 の外にストロンチウム90、プルトニウム239 などが主要な放射性核種である。「北部汚染地域」はチェルノブイリ原発から150~250キロメートル離れたロシア連邦共和国ブリャンスク州に接する汚染地域で、セシウム137 が主要な放射性核種である。

都　市	マイクロレントゲン/時
ミンスク	10~ 15
ヴィレイカ	12~ 14
ソリゴルスク	12~ 13
ゴメリ	12~ 39
チェチェルスク	62~ 69
モズイリ	21~ 23
レリチツィ	26~ 29
ブラーギン	207~217
ナロヴリャ	192~200
ホイニキ	60
コルマ	23~126
ヴェトカ	125~182
エリスク	60~ 62
ペトリコフ	13
ロガチェフ	15~ 19
カリンコヴィチ	14
マギリョーフ	10~ 16
ゴルキ	12~ 15
スラブゴロド	49~ 51
コスチュコヴィチ	16~ 17
クリチェフ	17
ボブルィスク	12
チェリコフ	25~ 30
ブイホフ	20~ 41
ブレスト	10~ 14
ルニネツ	12~ 52
バラノヴィチ	12~ 15
ピンスク	18
グロードノ	12~ 14
ヴィテブスク	12~ 15
センノ	12~ 14
オルシャ	13~ 14

4) 放射線生物学研究所の土壌放射化学研究室のスタッフの話によると、90年10月時点でも13ミリレントゲン/時の汚染地域が30キロメートル汚染ゾーン内にあるという。『チェルノブイリをめぐる最近の状況』(原産会議)によれば、最も汚染したはずのチェルノブイリ原発敷地内でさえ除染により3~4ミリレントゲン/時の空間線量率であるというが、ベロルシア共和国側の30キロメートル汚染ゾーン内は除染されずに事故当時のまま放置されている地域がかなり残っていると考えた方がよい。
5) 事故直後にはミンスクで、窓際に置いた粘着紙にホット粒子が検出されたことがある。一般の病気や交通事故で亡くなったミンスク市民の肺から20~30個のホット粒子が検出されたこともある。

避難状況および今後の避難計画

1) チェルノブイリ事故直後の数カ月間に、ゴメリ州ブラーギン地区、ナロヴリャ地区、ホイニキ地区内の107町村から2万4700人が避難した。避難した人々には住居・食料・仕事が与えられたが、避難先が汚染していたために再び避難しなければならなかった人々もいた。
2) セシウム137 が15キュリー/平方キロメートル以上の地域の住民は全員が避難の対象であるが、当面の計画としては40キュリー/平方キロメートル以上の地域の住民は全員が避難、15~40キュリー/平方キロメートルの地域では14歳以下の子どもまたは妊婦のいる家族のみが避難する、とベロルシア共和国政府は決定している。

3) この決定によれば、112町村の1万7000人以上の人々は直ちに避難しなければならない。そのため、90年中に87町村から1万1600人を避難させる。残る25町村からの避難は検討中である。続いて91～92年には62町村から4700人を避難させる計画である。さらに95年までに、「定期監視地域」内の352町村から9万5000人の避難が必要になるかもしれない、と共和国政府は考えている。
4) 中央政府保健省の決定した生涯線量限度350ミリシーベルトは全く評判が悪く、ベロルシア共和国の科学者は生涯線量限度70ミリシーベルトを主張していた。

住民の甲状腺異常

1) ベロルシア共和国は水・土壌中のヨウ素濃度が通常よりかなり低く、そのためチェルノブイリ事故以前からヨウ素の不足に原因する代償性甲状腺腫が成人の10％に見られる程であった。したがって、事故により環境に放出された放射性ヨウ素を、ベロルシアの人々は甲状腺に取り込みやすい状態にあったと考えてよい。
2) チェルノブイリ事故後ヨウ素剤を子どもに最初に投与したのは5月1日であった。事故から5日以上もたっており、ヨウ素剤の投与は遅すぎて役に立たなかった。ヨウ素剤の投与が遅れたのは事故情報が全くなかったからである。原発の大事故といった人々が注視している問題に対しては、必要な範囲で適切な情報を早急に発表することの重要性をあらためて実感させられた。
3) 事故10日目の5月6日に、子どもの甲状腺の体外計測を初めて行った。500マイクロレントゲン／時以上の線量率を示した子どもは入院させた。ミンスクの病院は一般の患者を締め出し、入院中の患者は一時帰宅させ、1000人以上の子どもの甲状腺・消化管・呼吸器を2カ月間にわたり検査した。
4) 事故1カ月後には甲状腺腫の子どもが増えて、甲状腺機能はサイロキシン過剰症を示したが、事故6カ月後には正常化した。現在は機能低下を示す慢性甲状腺炎や自己免疫性甲状腺炎の患者が多い。
5) 血液学輸血センターのイワノフ教授によれば、組織学的に確認された12例の甲状腺ガン患者が最近現れたという。甲状腺ガンは事故以前にはほとんど認められなかったので、これは事故の影響であると考えているという。また、放射線医学研究所のアスタホワ副所長によれば、同研究所付属病院では21例の甲状腺ガン患者が事故後現れたという。

住民の健康状態

1) チェルノブイリ事故による急性の放射線障害は、一般人にはほとんど現れていない。
2) 事故以前と事故後の住民の疫学調査を行っている。白血病発生率は成人、子どもともに増加傾向にあるが、統計学的には有意な差ではない。現在の時点で結論を述べることはできない。91～93年、さらに将来増加するという予測もあり懸念している。
3) 白血病以外の腫瘍性疾患については、発生率が汚染地域だけでなく非汚染地域でも増加しており、現在までのところ放射能レベルとは関係がない。
4) 子どもたちに重くはないが貧血が認められる。造血機能は副腎や甲状腺などの内分泌機能とも関係があるが、生鮮食品の供給不足と放射能恐怖症による偏食が主要な原因である。この外に、精神的ストレスからくる疾患が成人、子どもに増加している。

病院および研究施設の印象

1) チェルノブイリ事故による唯一の被災者のための病院はミンスクの放射線医学研究所付属病院（ベッド数は成人用、子ども用100床ずつ）だけであった。この病院には医師が50人いるが、受け持っている患者数に比べると医師が50％不足しているという。同様の訴えは小児血液学センターや血液学輸血センターでも聞いた。

2) どの病院も医療機器・医療薬が絶対的に不足していた。たとえば、放射線医学研究所付属病院では3台ある超音波診断装置の2台は甲状腺患部にあてるプローブが壊れ使用不能で、残りの1台もプローブ先端部分がすりへっていて、あみめ模様が見える程であった。「調査団」の小林千恵子医師によれば、日本ではこんなになるまで使うことは絶対にないという。「日本で不要になった中古の医療機器をもらえないか」と恥を忍んで援助を訴えていた放射線医学研究所のアスタホワ副所長の言葉がいまも私の頭に残っている。また、甲状腺機能低下の治療に使うホルモン剤のι－サイロキシンなどの安価な薬も不足しており、必要な患者全員には使っていなかった。

その他

1) ミンスクの病院で会った医師は放射線障害に関する知識もあり素人目ながらも優秀な医師たちであるとの印象を受けた。しかし、ホイニキ市中央病院の医療関係者との対話集会では「赤ワインやウォッカは放射能に効くか」、「日本の商社はソ連でワラビを買い占めていると聞くが、ワラビで放射能に効く薬をつくっているのではないか」などの質問が続出した。一般の医療関係者の放射能や放射線障害に関する知識水準はあまり高くないとの印象を受けた。また、一般人についても放射線や放射能に関する知識水準は日本と比べてかなり劣ると感じた。

2) 「ココムの規制により放射線測定器が輸入できない。代金は払うから、あなたの持参した放射線測定器を譲ってほしい」と公衆衛生省腫瘍学医療放射線学研究所のシチコフ副所長から話しかけられた。一般人ではなく彼のような科学者、それも行政と深くかかわっていると思われる科学者が私の持参した1台の放射線測定器を求めているところに、放射線測定器の絶対的な不足をかいま見た思いがした。しかし、私の持参した放射線測定器はある研究機関の借り物であったため、譲渡は丁重に断わった。

3) ホイニキ市中央病院の医療関係者との対話集会での討論から、現在のソ連社会では科学者があまり信用されていないとの印象を受けた。事故関連の情報が89年4月まで秘密にされていたことや、これまでのソ連社会における科学者のあり方と大いに関係があると感じた。

4) 広島・長崎の原爆被害を経験した日本人の医師や科学者に対する期待は大変に大きいとの印象を受けた。急性放射線障害の治療経験という意味では、広島・長崎の原爆被害よりもビキニの水爆被害の時の治療経験が役に立つと思うが、ビキニ事件のことを言うソ連の医師や科学者には1人も会わなかった。

5) ソ連国内では放射線測定器や医療機器・医療薬がほとんど入手できないので、現金で援助してもあまり役に立たない。現物での援助が有効であると実感した。また、現金・現物だけでなく、医療関係者のトレーニングなどの面での援助も重要であると感じた。

6) チェルノブイリ事故から5年しかたっていないことや事故以前の疾病統計の不備などを考えると、甲状腺異常を除けば、現れている疾病と事故（あるいは放射線被曝）との因果関係に結論を出すのは全くの早計である。それよりいま必要なことは、避難先を見つけ、そこでの住居・食料・仕事を確保し、高汚染地域の住民を早急に避難させることである。そして、汚染地域の住民を中心に、今後とも注意深く住民の健康状態を監視していくことである。

7) チェルノブイリ事故による汚染の損害だけで、ベロルシア共和国の年間予算の8年分に相当すると聞いた。国家としては破産状態にあるのと等しい。

8) 「ペレストロイカ」という言葉は日本では「改革」などと翻訳されているが、ベロルシア共和国では「経済的混乱」という意味で受け止められていた。「ペレストロイカによる経済的混乱とチェルノブイリ事故でわれわれはひどい目に会っている」という意見をあちこちで聞いた。

セッション4

原子力の安全と理解－何が必要か

原子力開発利用とパブリック・アクセプタンス
科学技術庁原子力局長
山　本　貞　一

原子力安全と社会的認識
東京大学教授
近　藤　駿　介

〈パネル討論〉

評論家
上　坂　冬　子

評論家
木　元　教　子

東京女子大学教授
広　瀬　弘　忠

読売新聞社編集局次長
松　井　義　雄

電気事業連合会広報部長
桝　本　晃　章

米国エネルギー啓発協議会（ＵＳＣＥＡ）副理事長
アン・ビスコンティ

原子力開発利用とパブリック・アクセプタンス

科学技術庁原子力局長

山　本　貞　一

１．これまでの動向

１９７９年の米国スリーマイル島原子力発電所事故及び１９８６年のソ連チェルノブイル原子力発電所事故は、我が国の原子力に対する国民世論に大きな影響を与え、特にチェルノブイル事故は、大規模な事故の実際の発生が、身近な話題として国民に受けとめられるようになった。さらには、チェルノブイル事故を題材に原子力の危険性を訴える書物が相次いで刊行されたこともこの流れを助長した。このため、都市部の若年層や主婦層などをはじめとするかなりの人々が、原子力に対して「不安」を感じるようになっている。

１９８８年２月には、四国電力伊方原子力発電所で出力調整試験が行われた。この試験自体は技術的には問題のない試験であったが、地元を中心に、この試験がチェルノブイル事故と同様の事故につながるとの誤解を生じて大きな反対運動が巻き起こり、これを契機に全国的に原子力反対運動が広がった。この時期には、１９８８年４月に東京日比谷で開催された「原発とめよう！１万人集会」のように、各地で大規模な反対運動が行われた。また、テレビにおいて原発討論が行われたのも１９８８年７月であり、一部の運動家の主張が社会的に注目され、原子力発電について議論することが一種のブームのような状況となった。１９８９年に入ると、統一的なスローガンに基づいて組織的な反対運動を行う動きが見られ、その代表的な例として、運転中、建設中、計画中の原子力発電施設及び核燃料サイクル施設をすべて廃止すること等を内容とする「脱原発法制定のための１千万人署名運動」があった。

こうした原子力反対運動の動きは、１９８９年７月の参議院選挙にまで大きく

影響を与え、脱原子力発電のみならず地球環境問題への対応などを訴えるミニ政党がいくつも結成され、候補者を擁立した。結果的に当選者を出すには至らず、また反対運動自体も、この頃から大規模な運動はやや小康状態へと移行した。先に述べた「脱原発法制定のための１千万人署名運動」については、昨年４月に国会に請願が提出されたが、集まった署名は２５０万人にとどまった。しかし、目標には遠く及ばなかったものの、２５０万人の人が脱原子力発電を目指して署名をしたのも事実である。

２．原子力に対する世論

次に、現在の国民の原子力に対する意識を、世論調査の結果から見てみることとする。総理府は、昨年１２月、９月に実施した世論調査結果を発表したが、その結果を一言で言い表すとすれば、「不安も高いが期待も高い」ということになろう。

まず、原子力の必要性に対する意識については、「今後のエネルギー需給等から見て原子力発電が必要である」との意見についてどのように思うか聞いたところ、「そう思う」と答えた人が６５％と、「そう思わない」と答えた人の２１％を大きく引き離した。また、今後１０年間で主力となっている電源を聞いたところ、原子力５１％、太陽光１３％、石油１２％、水力５％などとなり、原子力とした人が最も多いとの結果が得られた。これを現在の発電の主力に対する回答と比較したものが図１である。これを見ると、石油への将来の期待は薄く、それに対して、原子力への期待、さらに太陽光への期待が大きいことがわかる。さらに、原子力発電の増減の是非については、「積極的に増やしていくほうがよい」５％、「慎重に増やしていくほうがよい」４４％、「これ以上増やさないほうがよい」３０％、「現在より減らしていくほうがよい」９％、「現在動いているものも止めたほうがよい」３％などとなり、「積極的」と「慎重に」を合わせて、全体の約５割が「増やしていくべき」としている。

一方、原子力の安全性に対する意識を見てみると、「全く安全ではない」８％、「あまり安全ではない」３９％を合わせて、「安全ではない」と答えた人が４７％おり、「非常に安全だ」２％、「まあ安全だ」４２％を合わせた「安全だ」と答えた人４４％を若干上回る結果となった。「安全ではない」と答えた人にその理由を聞いたところ、「日本でも実際に故障やトラブルが起こっている」、「実際に海外で事故が起きている」などをあげた人が多く、「安全だ」と答えた人は「日本の技術は優れている」、「日本では十分な安全対策がとられている」などを理由にあげた人が多かったようである。また、原子力について不安に思うことがあればどのような理由からかを複数回答形式で聞いたところ、図２に示されている様に、「放射線（能）が人体や子孫に影響を与えるから」をあげた人が４３％と最も多く、以下、「事故や故障などで放射線（能）が漏れるから」３９％、「放射性廃棄物の管理や処理処分などから」３９％、「事故や故障などの状況をよく知らされないから」３１％などの順となっている。つまり、国民が何らかの理由で原子力に対して不安を感じているとしても、ここに何らかの判断が加わって安全性に対する見解が二つに分かれており、その判断材料として、先に述べた「日本の技術は優れている」、「日本では十分な安全対策がとられている」などの理由が含まれている。その一方で、国民の中に一旦醸成された原子力に対する不安を直ちに払拭することは容易ではなく、むしろ「努力によって安全は確保されている」という意識を持ってもらうことを目標とすべきであろう。そのためには、「安全確保の実績を着実に積み重ねる」ことに尽きるし、それが先に述べた「安全だ」と思う様々な判断材料へとつながっていくと考えられる。

３．原子力ＰＡ活動の現状と課題

言うまでもなく、原子力の開発利用を進めるにあたっては、国民の理解と協力を得ることが重要である。この観点から、我々は、原子力ＰＡ活動を①原子力施設立地地域のみならず全国を対象に、②一方的に情報を提供するのではなく、直

接対話により草の根的に、③対象に応じて提供すべき内容、方法等を工夫し、分かりやすく、を基本方針として実施している。
具体的には、これまでも行ってきたマスメディアを通じた広報、パンフレットの配布といった活動を、内容をより分かりやすく工夫し、これを拡充していくとともに、各地で開催される市民レベルの勉強会に、その要請に応じ、会の趣旨にあった専門家を講師として派遣する講師派遣を行っている。そのほか、自然放射線の存在を実際に測ることによって楽しみながら認識してもらい、放射線に対する理解を深めてもらうことを目的とした簡易放射線測定器「はかるくん」の貸し出し、放射線利用の身近な例を展示したフェアの開催、地域のオピニオンリーダーを対象とした施設見学会、情報提供とそれに基づいた質問に答え、またユーザー同士の議論の場の提供のために、パソコン通信局「ＳＴＡビレッジ」を開局・運営する等、幅広い活動を行っている。

これらの活動がどのくらい国民に届いているのか、またどのくらい信頼されているのかということについて、再び世論調査の結果を見てみると、原子力に関する知識を得たものを複数回答形式で聞いてみたところ、図３のように、「テレビ・ラジオの番組や報道」、「新聞の記事」をあげた人が最も多くそれぞれ７９％、６４％であった。次いで「雑誌・週刊誌の記事」１９％、「電力会社のパンフレットなど」１２％と続き、国関係では「政府広報・企業広告など」が７％、「国・地方自治体のパンフレットなど」が５％という結果で、いわゆるマスコミから情報を得る人がほとんどであり、なかなか直の声は届いていないようである。次に、原子力に関する説明が比較的信用できると思うものを複数回答で聞いてみたところ、「テレビ・ラジオなどの報道」をあげた人が３９％と最も多く、以下、「学者・専門家」３５％、「新聞・雑誌などの報道」３１％と続き、「国・地方自治体」は１２％との結果であった。一般的に言えば、情報を得るのはほとんどの場合マスコミを通じて行われることが量的に非常に多く、原子力の場合も、その機会が多いこと、そしてマスコミに対して一般的に信頼が高いことから、その

マスコミを通じた情報そのものへの国民の信頼度も高いと考えられる。このような調査結果を見ると、国が提供する情報に直接触れてもらう機会をできる限り増やすとともに、信頼感の向上に今後とも最大限の努力を払っていく必要性を痛感する。事故やトラブルが生じた時だけ国民が情報に触れるではなく、原子力の必要性、安全確保の方策等について平素から情報提供する努力が必要不可欠と言える。国としても、もちろん努力しなければならないが、国民と直に接している電力会社のさらなる努力も望まれるところである。

また、原子力については、ＰＡなどかけ声だけで何もやっておらず、国と電力が勝手に推進しているという指摘を受けることがあるが、国としては、従来から情報の提供には懸命に取り組んできており、どうしても原子力について科学的に正確な情報を提供しようとすると技術的、専門的になりがちで、普通の方が容易に理解できるような形での情報提供が十分ではなかったことは否めない。また、原子力ＰＡ事業についても様々な努力をしてはいるが、正確な理解をしてもらおうとすると、専門家と膝を交えて対話をしてもらうことが重要である。しかしながら、直接対話では、その対象がある程度限られたものにならざるを得ず、講師派遣でもこれまでの実績で１万４千人程度となってしまうことも事実である。従って、受け手の立場に立ったＰＡというものを考えると、対象に応じて提供すべき内容、方法等を工夫し、わかり易さに留意していくことが重要と考えられる。情報の提供については、パソコン通信等の新しい工夫をしてはいるものの、さらに国民に直接私どもの情報が届くよう努力していくとともに、国の情報や各種原子力ＰＡ活動へのアクセスも含めて身近な形でアピールしていくことにより、国への信頼感をより一層増進することも重要である。原子力について、正しく理解する為には、そのバックグラウンドとなる基礎的な情報が必要である。具体的には、我が国のエネルギー供給構造、国民生活・経済とエネルギーの関係、省エネルギーの現状、新エネルギーの開発動向、核分裂の仕組み、放射線の特質等の情報である。このような情報は、エネルギーが文明社会に必要不可欠なことを考慮

すれば、全ての国民の方々に十分知ってもらうことが重要と考えている。このため、可能であれば小さい頃から様々な形で学習してもらえるよう努力することが重要である。このような姿勢を評価してもらえば、原子力への評価も変わってくるのではないか。原子力を含め、エネルギー、地球環境等の重要の問題については、子供の頃から関心を持ち正しい理解を深めることが特に重要であると考えており、このため科学館等の展示物の整備、青少年向けパンフレットや教育用副読本の作成等、子供達が正しい知識を身につけられるような環境を整備することが重要であると考える。

4．まとめ

現在、エネルギーは現代文明を支える上で、また人類の繁栄を図る上で必要不可欠なものとなっている。昨年の夏以来の湾岸情勢、地球温暖化、酸性雨をはじめとする地球環境問題の顕在化等最近のエネルギーを巡る情勢に鑑みれば、エネルギーの安定供給は世界的な課題であると言える。

子々孫々にわたる人類の繁栄を図り、資源問題、環境問題等を将来への禍根として残さないためにも、科学技術により生み出され、供給安定性、経済性、環境影響等の面で優れる原子力の開発利用を今後とも着実に推進していくことが重要である。

このような原子力の開発利用を進めていく上で、国民の理解と協力を得ることが重要だということは再三述べているとおりである。このための原子力ＰＡについて様々と述べてきたが、国民にとって一番わかりやすいＰＡは、安全確保の実績を着実に積み重ねていくことであろう。本年２月に発生した関西電力美浜原子力発電所２号炉の蒸気発生器伝熱管損傷は、環境への影響はなかったものの、世論に対する影響は大きく、国民の不安感を増大したことは否めない。今後このようなことがないよう万全の対策を講じることが重要であり、また、些細な故障・トラブルについても、徹底的に原因を究明し、その結果を踏まえた措置を講じることにより、安全確保に万全を期し、国民の信頼感の一層の増進を図ることが重

要と考える。

原子力開発利用の推進に当たっての大前提は、安全の確保である。国民に「努力によって安全は確保されている」と思ってもらうためには、安全確保の実績を着実に積み重ねていき、その上で推進している国や電力会社を信頼してもらうよう努力していくことが基本であると考える。

原子力安全と社会的認識

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1．はじめに

我が国の原子力発電は、社会的リスクの統計的分析結果をみるまでもなく、「公衆の過剰被曝の発生頻度を十分小さく保つ」というその安全確保の目標を達成している。また、現在世界で主として使われている軽水炉について、幾人かの研究者がKW年あたりの電力発生に伴う公衆ならびに従業員／関係者の健康影響を石油石炭火力と比較する研究を報告しているが、これが太陽発電を含む他の方式と比較して優れているとする研究が多い。[1]

にも拘らず、原子力安全をめぐる公衆の意見は大きく分裂し、これを反映して政治の場でもこれが争点になっている。これに関して我が国では、これの安全性が実証されていないとしてこれを支持しないとする政党が、上のどのリスク研究も原子力よりはるかにリスクが大きいとする石炭火力を支持したり、「原子力は万一の事故の際の被害が大きいことに問題がある。」としながら、原子力発電所では百万炉年に一度といえども発生するとは解析されていない１万人以上の死者を毎年出している交通戦争を巡っては、誰もこれほどの激しい政治論争を挑もうとはしていないという不可思議な現象が見られる。

このような社会的安全確保に係わる政治資源の配分が発生している所以を分析することは政治学や社会学的観点から興味深いと考えられ、実際米国等ではリスク分析学会等で議論が交わされているが、我が国でこの問題を分析しようとする政治学者、社会学者は限られている。我が国の当該学界のこうした姿自体興味ある現象であるが、それはさておき、本研究は工学研究者である我々が幾つかの文献とアンケート調査を踏まえて、こうした現象の背後にあると考えられる公衆の原子力安全感の分析を行い、この分析を通じて得られた知見に基づき、社会的安全レベルの向上を目指す観点から幾つかの提言を行なっているものである。以下、第２章では議論の前提となる我が国の原子力安全確保の考え方を要約し、ついで第３章で公衆の安全感に関する調査結果を整理し、４章でこの知見に基づいて若干の提言を行なう。

２．原子力安全確保の考え方

我が国における産業ならびに公共施設の安全確保の原点は、「すべて国民は健康で文化的な最低限度の生活を営む権利を有する。国は公衆衛生の向上および増進に努めなければならない。」とする憲法２５条にあり、社会における様々な安全基準等はこ

れに基づき定められている。原子力施設の安全確保についてもこれは例外ではなく、国はこの国民の権利を尊重しその責務を履行するため、従業員や公衆の過剰な放射線被曝の発生を不安全な事態と認識し、その発生を極力防止すること、言換えればその発生頻度を十分小さくすることを目的として規制を行っている。

この目的は、「異常や故障を起こさない施設を設計・建設・運転する」という投資家（設置者や消費者）好みの状態を実現できれば自ずと達成されるはずであるが、「人は誤り、機械は故障する」という人類の知恵に基づけば、このことのみによってこの目的を達成することを計画するのは現実的ではない。そこで、原子力施設の安全確保にあたっては、第一に発電に必要な原子炉設備を大きな安全余裕や固有の安全特性を有するものとし、さらにその品質を高い目標のもとで管理して異常・故障の起き難いものにするのは当然としても、上の知恵の教えるところに従い、そうしたとしても異常・故障は完全には排除できないと考え、第二の手段として異常・故障時に有効な緊急炉停止系や非常用炉心冷却系等を設置している。そして、その上さらに、何か人智の及ばない理由でこれらの安全装置が動作せず、燃料から大量の放射性物質が放出されることあるべしとして、この時でも公衆の過剰被曝を防止できるよう格納容器等を安全確保の第三の手段として付加している。この安全確保の考え方は「厚い守り」あるいは「深層防護」の考え方と呼ばれているものであり、[2] この考え方を採用すれば、たとえ異常・故障が発生して発電の信頼性が損われることがあっても、なお上の目的が損われることはない。言換えれば、この考え方では、安全確保を発電信頼性確保より一段高い目的としており、結果としてこの信頼性確保を安全確保の目的を達成する手段の一つに格下げしているのである。

ところで、このような方針があるからといって、現実の設計、建設、運転においてこの方針が自動的に隅々まで行き渡るという保障があるわけではない。そこで、現実のプラントについて上の目的が達成されていない可能性を体系的に調査分析する、いわゆる確率論的安全評価（ＰＳＡ）が重要になり、各国で多くのプラントについてこれが実施され、この方針の行き渡っていることが確認されてきている。我が国においてもこの種評価により、国内の代表プラントについてはこの方針が貫徹されていることを確認している。[3]

３．公衆の安全意識

（財）エネルギー総合工学研究所では、このようなＰＳＡによるリスクの評価に基づく安全性の確認が可能であるとした場合、社会的に受入れられる安全（リスク）目標を定量的に定められるのではないかと考え、これを検討する作業の一部として、３年ほど前から公衆のリスク感覚や原子力発電の安全性に対する認識を探るアンケート調査を行なってきている。この研究はなお進行中であり、結論を得るには至っていないが、これまでの調査結果を暫定的に要約すると以下のようになる。

(1) 公衆はリスクという言葉についてあまりなじみがなく、この言葉を聞いたことがあるとする人々の間でもその解釈はまちまちである。これは、この言葉に対応する日本語がないことからも予想されたことであるが、我が国社会でリスクコミュニケーションが困難である原因の一つとして認識されるべきであろう。

(2) リスクの論議には発生頻度が用いられるが、これについても知らない人が多く、従って一万年に一度という表現に対する態度も図１に見られるように多様である。これもこうしたデータをもとにリスク管理に関する合意を形成していく習慣がなかったためで、今後こうした表現を含んだ安全（リスク）目標について合意形成していくためには公衆安全教育の内容から設計していく必要性があると思われる。

(3) 原子力発電のリスクについては、ＴＭＩ事故の程度のものですらその発生頻度は一万運転年に一度以下であるというのが最近の専門家間における共通認識であるのに対して、図２に示すように半数以上の公衆はこの頻度の事故として一万人以上の被害が発生するものを、さらに東京で３０％弱、立地点でも２０％強の人はこの頻度の事故として１００万人以上の被害が発生するものをイメージしている。このことは、上に述べたように、土木・建築その他の基準作りにおける専門家の議論でしばしば使われている定量的なリスク情報／意志決定のポイントが公衆にはほとんど伝えられていないこと、原子力発電所のリスクプロフィルに至っては、これを見聞したことのある公衆はほとんど皆無であることを示している。

(4) 継続調査によれば、表１に示すように、事故等の報道の前後でも態度を変えずに原子力発電を今後とも利用していくべきとする公衆の割合は東京で30％強、立地点で40％弱であるのに対して、逆にこれを今後廃止していくべきとする態度を維持し続ける人は東京では公衆の20％程度、立地点では10％程度であり、一貫した中立派は10～15％であること、一方、状況により推進と中立の間を揺れ動くのが10～15％、中立と反対の間を揺れる人が５～10％となっている。このことは最近の美浜２号機の事故発生後に行なわれた電話調査で、大都市でこの事故で原子力発電に対する態度を大きく変えたとする人が３～６％、やや変えたという人が20～25％という結果が得られていることとも符合する。[5]

(5) 公衆にとって原子力発電は、平均的には他の技術と比較して特異な存在ではない。ただし、技術を有用感／安心感の次元で分類すると、図３に示すようにこれに賛成する人々は一部の技術を除いて技術一般を有用感／安心感の高いものとしてとらえ、さらに原子力をこのカテゴリーに属するものとしているのに対して、反対する人々は賛成派に比較して技術一般に対して低い有用感／安心感を感じているのみならず、原子

力を他の幾つかの技術とともに例外的に有用感／安心感ならびに制御可能性の低いものとみなしている。

(6) 原子力を疑問とする理由については、表２に示されるように、とにかく怖い、事故被害が甚大、廃棄物処分技術が未確立、巨大事故発生確率をゼロにできない、新省エネルギー技術のほうが優れている、安全確保技術／努力／制度が不足不備、情報公開の不足、などの提示項目を30％以上の人々が選択している。ただ、この技術に対する賛否が異なるグループ間では、各項目の選択率に明確な差がある。

(7) 原子力発電の有用感／必要性に係わる態度は、エネルギーの観点から見た生活スタイルの選択、エネルギー需給動向に対する認識、ならびに供給力の維持向上手段としての原子力の評価によって決定される傾向がある。

(8) 原子力の安全性に係わる判断は、社会システム、原子力安全関係者、そして原子力技術への信頼度によって決定される傾向があり、我が国では安全感は安心感の言換えになっている面が多いようである。

(9) 事故情報は公衆の態度決定に大きなインパクトを有する。一般的な傾向としては、事故情報に接した場合、関係者への信頼感を減少させ、技術の制御可能性への疑問を増大させ、不安感を増大させる。最近の事故に関する調査[5]では 公衆の37％（女性ならびに40才以上の人々では40％以上、立地点では49％）が強い不安を感じ、45％がやや不安を感じたとし、この非常に不安を感じた人々の半数以上は情報不足を感じ、電力会社の説明に疑念をもったとし、原子力に対する態度を変えたとしている。

(10)公衆は、こうした態度決定に必要な原子力安全に関する情報の大部分をマスコミならびに口コミから得ている。特に事故情報に関してはテレビが圧倒的に大きな担い手となっている。一方、信用できる情報源ということでは、図４に示されるようにＮＨＫの信頼度が高く、全国紙、民放がこれに続いている。態度決定に資する情報と言う点では、図５に見られるように、ＮＨＫは安全情報、危険情報のいづれもを提供しているのに対して、民放、新聞、一般雑誌、口コミ等は危険情報をより多く提供して否定的態度の形成に役立っているようである。立地点の公衆は安全情報と不安全情報の両方に接しているが、東京人の多くは不安全情報により多く晒されているようである。極端な不安全情報は、地元では政党の発する安全情報と同様インパクトがないが、東京では口コミルートにのってそれなりのインパクトをもつようである。

(11)全体として、豊かな時代環境を反映して、人々の欲求はマズローの階層を上昇し、

生存の保障から安全確保、さらには自らの手で確かめることの出来ること、具体的には「知る権利」や「選択の自由」を求めるようになってきていることが感じられる。

4．公衆の原子力安全認識の収斂のために

これらの結果は、我が国社会における安全性確保に係わる政治的意志決定のあり方ならびに原子力安全に係わる情報交流の抱える問題について多くの示唆を与えるが、取り敢えず以下の点が重要と考える。

(1) 人々の欲求階位が上方に遷移していることに合せて、公衆安全に係わる情報、特にリスク管理に関する考え方を積極的に公開し、議論の共通の土俵を形成するべきである。土木、建築、防災、食品添加物、その他に係わる基準の決定には、多くの場合社会的安全目標とそれに基づくリスク管理システムとも呼ぶべきものの決定が伴っている。従来、これらについては、時々裁判の場で明らかにされることがある程度で、あまり報道されることもなかった。しかし、国際化時代を迎えてこれらが外交交渉で論議されることがあることを考えても、こうした議論のポイントについての認識を国民共通のものとしておくことは重要である。

(2) 原子力安全に関しては、規制当局は平常時に当局としてのリスク管理の考え方を公衆に伝える努力を充実し、異常報告の公表の際に当該異常事象のリスク管理上の評価を公衆と共有できるようにしておくべきである。同様に、設置者ならびに設計者も、原子力施設におけるリスク管理の考え方と実情を公衆に正しく伝える日常的な努力を強化すべきである。現在、他産業よりはるかに軽微なレベルまでの異常・故障が、安全規制行政の妥当性検証のために設置者により国に報告されるが、その報告内容が安全確保の目的との関係を示すことなく即座に公表される結果、安全目的の達成度合いに関して当事者と公衆の間に大きな認識ギャップが生じている。事故故障評価尺度の導入はこのギャップを埋める努力の一つであるが、なお不十分である。

(3) マスコミはリスクコミュニケーションに重要な役割を担っている。従って、公衆安全に係わる報道の実相について分析検討を行ない、主催者と意見交換を行なっていくことは有益であろう。現在の公衆安全に関係する報道状況をリスク分析者の目から見ると、公衆安全の維持向上に寄与するという観点からは報道資源が効果的に使われているとは思えない。ニュースバリューの決定要因として、新規性、トレンドへの適合性、事象と公衆の距離の適切さ、否定的メッセージの豊富さ、非難されるべき存在の明確さなどが指摘されており、[6] 競争下にある企業として営業政策上そうした点を大事にすることは理解できるが、限られた紙面や放送時間のなかで、過剰被曝防止という安全確保の目的がまだ損われていない原子力施設の異常事象に関する報道を、

例えば実際に貴重な生命の喪失を引起こした交通事故の報道よりも詳細かつ大々的にしかも継続的に行い、結果として例えば年間一万人を超える死者を出している交通戦争という重大な社会的不安全要因の軽減にその影響力を発揮していないのは、いかなる企業倫理あるいはその基盤にあるべき生命倫理によってのことなのだろうか。

(4) 全米研究評議会のリスクコミュニケーションに関する委員会報告（８９年度版）は、このコミュニケーションを「個人やグループあるいは組織間の情報や意見のやりとりの中で成立していくべきもので、この間でリスクの性質のみならずこれに係わる法律や組織に対する関心や意見、それらの動きに対する反応が交流されて、人間や組織として相互認識が深まって行く時、成功しているとされるべきもの」としている。[7] しかしながら、原子力広報は、商品広報と違って聞きたくない人にも聞いて貰わねば意味がないにも拘らずそのための有力な手段を有しておらず、一方その内容に「資源論」、「厚い守り」などの固い論理を含み保護者の説教という感じになり易い。そして、上に述べたニュースバリューの観点から反権力問題提起型あるいは説教調の報道を行いたがるマスコミは、こうした広報のチャンネンルとなることを拒否するのみならず、こうした広報主体の失敗を格好の詮索対象としがちである。原子力関係者がこの困難な状況においてとり得る一つの方策は、公衆と原子力利用推進の目標である人類の福祉向上へ共同作業を行うべく、共生と未来を共有する心をもって自らコミュニケーションを深めていくいわゆる草の根運動を地道に進めていくことであろう。

参考文献

1. A.F. ﾌﾘｯﾁｪ:発電システムの健康リスク、原子力資料 No. 238 & 239(1990).
2. 米国原子力委員会：原子力安全性ﾊﾝﾄﾞﾌﾞｯｸ、産報（1975）。
3. S. Kondo and T. Tobioka: "Probabilistic Arguments in Nuclear Safety Regulation in Japan, "PSAM at Bevery Hills, Calif., Feb. 1991.
4. T. Taniguchi and H. Shimooka: "Transition of Public Attitudes toward Nuclear Power from 1988 to 1989 in Japan," Int'l Conf. on Risk Analysis, SanFrancisco, Calif. Oct. 1989. なお季報「ｴﾈﾙｷﾞｰ総合工学」13-3 参照。
5. 私信：日本原子力産業会議（April, 1991）.
6. Malcom Peltu: "Mass Media and Major Accident Hazard: The Role and Responsibilities of Journalists and Experts," in H.B.F. Gow and H. Otway (Ed.): Proc. CEC Conf. on Communicating with the Public about Major Accident Hazards, Elsevier Applied Science (1990).
7. Committee on Risk Perception and Communication, National Research Council, Improving Risk Communication, National Academy Press (1989).

Underlying logic of the scale

(Criteria given in matrix are broad indicators only)

LEVEL/ DESCRIPTOR	CRITERIA: OFF-SITE IMPACT	ON-SITE IMPACT	DEFENCE-IN-DEPTH DEGRADATION
7 MAJOR ACCIDENT	MAJOR RELEASE: WIDESPREAD HEALTH AND ENVIRONMENTAL EFFECTS		
6 SERIOUS ACCIDENT	SIGNIFICANT RELEASE: FULL IMPLEMENTATION OF LOCAL EMERGENCY PLANS		
5 ACCIDENT WITH OFF-SITE RISKS	LIMITED RELEASE: PARTIAL IMPLEMENT-ATION OF LOCAL EMERGENCY PLANS	SEVERE CORE DAMAGE	
4 ACCIDENT MAINLY IN INSTALLATION	MINOR RELEASE: PUBLIC EXPOSURE OF THE ORDER OF PRESCRIBED LIMITS	PARTIAL CORE DAMAGE ACUTE HEALTH EFFECTS TO WORKERS	
3 SERIOUS INCIDENT	VERY SMALL RELEASE: PUBLIC EXPOSURE AT A FRACTION OF PRESCRIBED LIMITS	MAJOR CONTAMINATION OVEREXPOSURE OF WORKERS	NEAR ACCIDENT - LOSS OF DEFENCE-IN-DEPTH PROVISIONS
2 INCIDENT			INCIDENTS WITH POTENTIAL SAFETY CONSEQUENCES
1 ANOMALY			DEVIATIONS FROM AUTHORIZED FUNCTIONAL DOMAINS
0 /BELOW SCALE			NO SAFETY SIGNIFICANCE

問：１万年に１回起こるかもしれないという事故（例えば有名なオランダの堤防は１万年に１回発生する様な高潮で決壊する、と言われています）について、あなたはどう思いますか。（ひとつだけ○をつけてください）

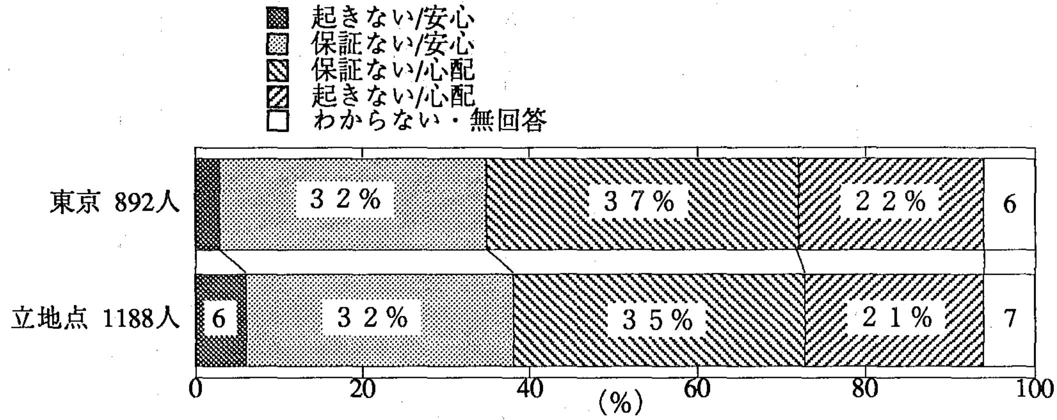

図１． １万年に１回起こるかもしれないという事故に対する態度（１９８８年１２月）

問：わが国の原子力発電所で１万年に１回程度の事故が起きた場合、死亡またはそれに相当するような重大な影響（がん・遺伝的影響）を受ける人の数はどの程度だと思いますか。（ひとつだけ○をつけてください。）

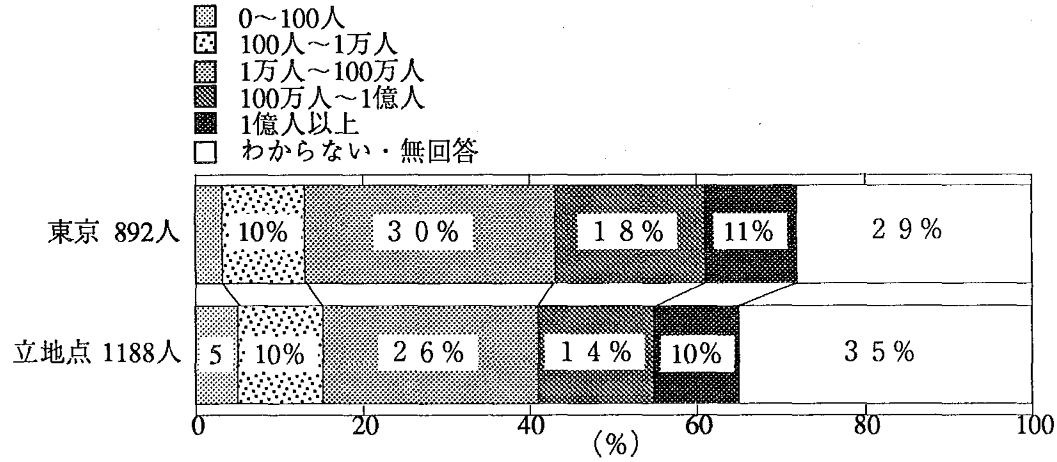

図２． １万年に１回程度の原子力発電所事故の想定（１９８８年１２月）

表１．原子力発電に対する推進－廃止の態度変化の割合

問：あなたは、原子力発電を今後も利用していくべきだと思いますか。（ひとつだけ○をつけてください）

	東京（%）				立地点（%）		
2回＼3回	推進	中間	廃止		推進	中間	廃止
推進	３１	5	4		３７	9	3
中間	9	１４	4		１６	１１	4
廃止	5	9	１９		5	4	１０

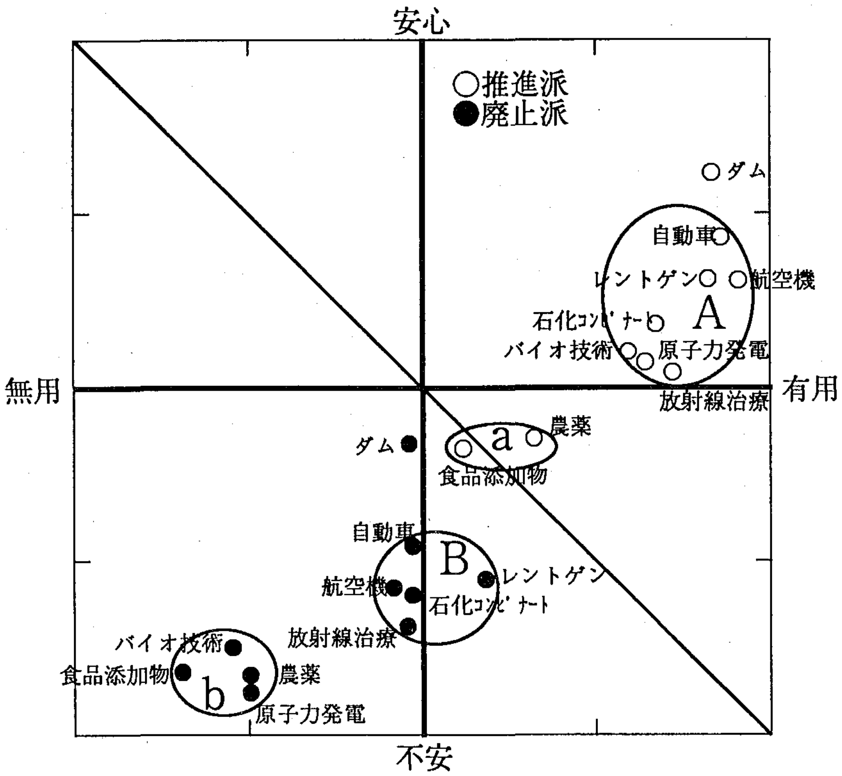

図３．推進派－廃止派別の各技術に対する態度の平均値
（有用感×安心感）（東京／１９８８年１２月）

表２．推進派－中間派－廃止派別の原子力発電を疑問と考える際の重要な理由
（東京／１９８９年１０月）

問：原子力発電に疑問があるとしたら、何が最も大きな理由だと思いますか。前問（Ｑ１９）のア～タの項目の中からとくに重要な理由と思われるものを選んで、番号に○をつけてください。（いくつでも○をつけてください）

	推進派（５０３名）	中間派（３２９名）	廃止派（３００名）
1	とにかく怖い　（４７）	とにかく怖い　（５１）	被害が甚大　（６３）
2	被害が甚大　（４３）	被害が甚大　（４５）	処分技術は未確立（６３）
3	処分技術は未確立（３９）	処分技術は未確立（４３）	とにかく怖い　（５３）
4	情報公開の不足　（２６）	新省エネの優先　（２２）	新省エネの優先　（４５）
5	安全システム不信（１７）	情報公開の不足　（２０）	事故可能性０要求（３４）
6	安全確保努力不足（１７）	事故可能性０要求（１８）	情報公開の不足　（３１）
7	事故可能性０要求（１５）	安全システム不信（１７）	安全システム不信（３１）
8	新省エネの優先　（１３）	安全確保努力不足（１２）	安全確保努力不足（２５）

注）（　）内の数字は重要な理由であると答えた人の割合（％）

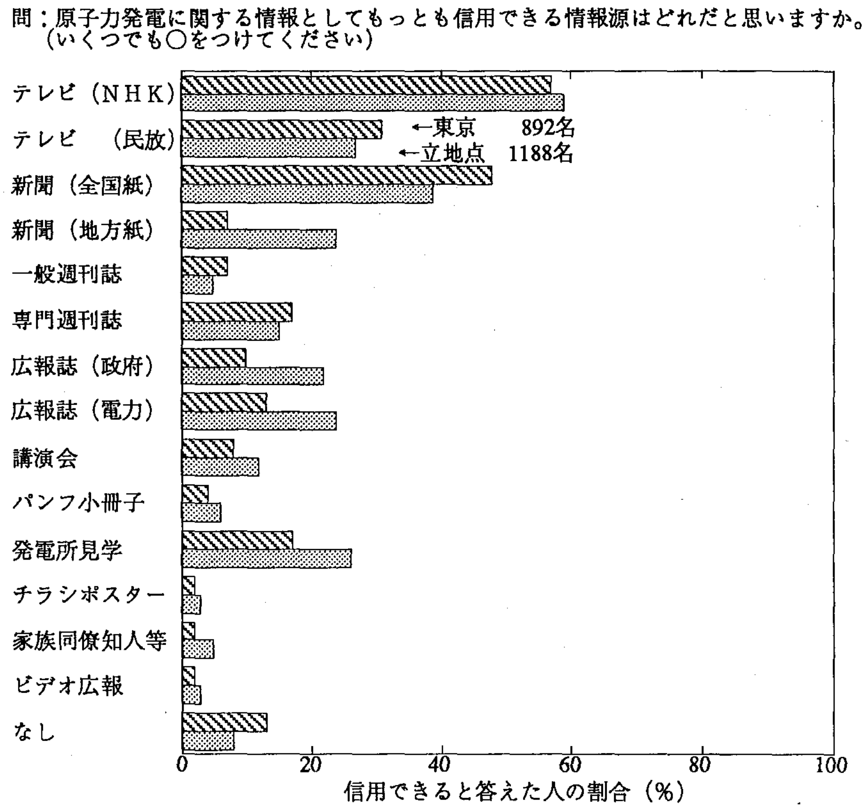

図４．原子力発電に関しての信用できる情報源（１９８８年１２月）

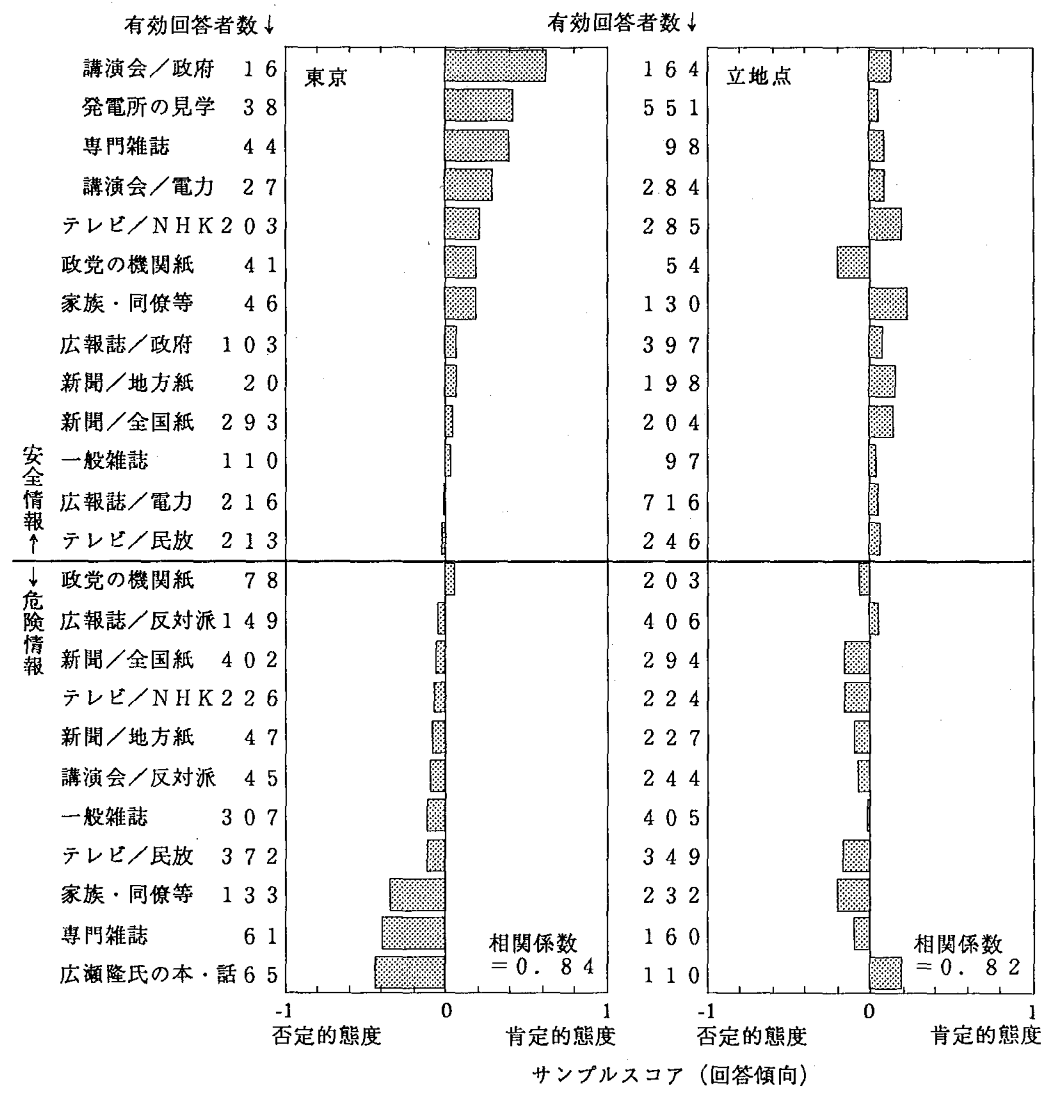

図５．原子力発電に関する情報源に接触した人の原子力発電に対する態度の傾向
（１９８８年１２月）

Nuclear Safety and Public Understanding — What is Necessary

A Commentary

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Vice President, Research and Program Evaluation

In many countries of the world the public holds misperceptions, misunderstandings, and concerns about nuclear energy. Yet people live with nuclear energy; they accept it. Why is that so? What does that tell us about increasing comfort with the technology?

Public opinion research worldwide shows that people make tradeoffs between perceptions of need and benefits and any concerns they may have about safety. Greater awareness of need and benefits reduces the weight given to safety concerns. This session's emphasis on building public understanding of nuclear energy's role in maintaining and improving the quality of life fits what we have learned from social science research about increasing the acceptability of nuclear energy. Because both sides of the issue are important, I shall comment on both — first on social science research lessons regarding the communication of the need for nuclear energy and its benefits and second on safety communications.

Communicating Need and Benefits

Need for nuclear energy may be characterized and perceived in different ways, including need for existing plants, need for more nuclear energy sometime in the future, and need to build more plants now. In the United States, as in several other countries, there is broad recognition of the first two kinds of need, but not the third. In our country, 80% believe that nuclear energy will play an important role in meeting the nation's electricity needs in the years ahead, and 76% say that the need for nuclear energy will increase. (CR/RI, February 1991) However, only 22% think that any new electricity plants will be needed in their area in the next 10 years. (CR/RI August 1990) Absent a sense of urgency, Americans tend to support the status quo; as of February 1991, only 32% favored building more nuclear energy plants, but only 15% said that existing plants should be shut down. The numbers for the other baseload option, coal, are practically the same.

Public opinion about nuclear energy plants has changed over the past year. Between May 1990 and February 1991, the number in favor of building more nuclear energy plants increased eight points (from 24 percent to 32 percent). Those who favored shutting down nuclear energy plants dropped four points, from 19 percent to 15 percent — the lowest level recorded in the eight years that Cambridge Reports has asked that question.

Accelerating this positive trend will depend on clear consistent statements of need for more baseload electricity by our leaders both at the national and local levels -- as well as from the electric utilities, when they believe that more baseload electricity is needed in their area. On their own, the public will demand new electricity plants only if their lifestyles are immediately threatened.

To gain public understanding of the <u>choice</u> of nuclear energy plants over other ways of providing electricity, communicating <u>benefits</u> is the key. I once heard Mr. Masumoto in a speech refer to the planting of good seeds in well-cultivated soil. I refer to that metaphor often. As I see it, the well-cultivated soil is the awareness of need for more electricity, and the good seeds are the new ideas about nuclear energy's specific benefits — long-term cost-savings, less foreign oil dependence, clean air. These are the most effective messages for mass communications because they are influential and easily understood.

One of nuclear energy's most important benefits internationally is environmental. Nuclear energy plants emit no carbon dioxide, no sulfur oxides, and no nitrogen oxides. One need only compare the air quality of France with that of Eastern Europe to understand the major contribution nuclear energy can make to a clean environment. In the United States, where environmental concerns are strong and growing, 74% of the public agree to using more nuclear energy "if that will cut greenhouse gas emissions and air pollution" (Gallup, July 1990) Currently, only half the public are aware of this benefit, so there is ample room for increasing awareness and support.

Communicating Safety

Communicating about safety is more difficult than communicating about benefits. Many people are uneasy about nuclear energy but are not really involved in the issue. They want to be reassured that nuclear energy is safe, but they do not want to know all the technical details of plant operations. The same is true for most technologies. For instance, most airplane passengers do not want to know about the aircraft design and safety features. They want to know that the company has a reputation they can trust and that there is a real human being flying the plane. Most of all, they feel comfortable when they are cared for by smiling, confident flight attendants. That is why airplane advertising is more likely to feature smiling flight attendants than the excellent safety features of the airplane.

Similarly, in the case of nuclear energy, comfort is greatly dependent on trust and good relationships established by the electric companies. Excellent performance of existing plants can help, but performance is not sufficient because bad performance appears to hurt more than excellent performance helps. Excellent performance is not news. So communications and community relations are very important. Trust–building can result from everyday activities that, on the surface, appear unrelated to nuclear energy, like being a good neighbor and showing concern and caring for customers. Trust can be built by activities that increase familiarity with the plant, put a human face on nuclear energy, and demystify the technology. Examples of such activities are bringing people to visitors centers, involving the community in plant activities, and preparing people who work at the plant to become effective spokespersons in the community.

In the United States, we find that familiarity seems to breed favorable attitudes. In March 1991, 59% of those who thought they lived near a nuclear energy plant said the plants are operated safely, and only 12% said that they are not operated safely; the remainder did not have an opinion. (Bruskin) In February 1991, 39% of those living near a nuclear energy plant favored building more such plants, compared with 26% of those not living near a nuclear energy plant; few in either group wanted to shut plants down. (CR/RI)

Scientists understandably want to correct misperceptions by communicating the relatively low risks of nuclear energy. Unfortunately, the concept of relative risk is not easily understood. Even raising the issue of risk may increase uneasiness, especially with unattentive audiences.

The same difficulty exists even when risk is only implied. A new study by Gallup for USCEA on ways to communicate with the public on the subject of radiation found, as expected, that the order of effectiveness was:

Level 1: (Most Effective)	<u>**Benefits**</u> of radiation — e.g. it is used in medicine (such as treating Barbara Bush's thyroid problem) and in other technologies.
Level 2:	<u>**Controls**</u> -- e.g. it is scientifically understood, easily detected, and precisely measured.
Level 3: (Least Effective)	<u>**Risk comparisons**</u> — amounts of radiation from nuclear energy plants vs. other sources.

<u>Conclusion</u>

Above all, the acceptability of nuclear energy plants appears to be influenced by the extent to which perceptions of need and benefits outweigh concerns. There is some risk in all forms of energy production. There is some risk in all our life activities. No risk is acceptable without some benefit. These benefits are easiest to understand when the public feels that they or their local leaders are involved in the decision-making and, therefore, the risks they assume are voluntary. The largest challenge in building acceptability of nuclear energy plants is answering the question, "What's in it for me?"

セッション5

エネルギー・原子力政策に何が求められるか

〈パネル討論〉

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与謝野　　馨

日本社会党衆議院議員
伊　藤　　茂

公明党衆議院議員
近　江　巳記夫

日本共産党政策宣伝委員会責任者
聴　濤　　弘

民社党

大会のまとめ

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生　田　豊　朗