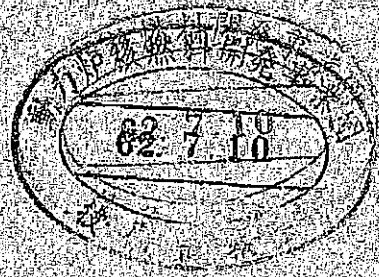
PNC TN2450 87-001

配付限定

本資料は2001年 1月 30日付けで
登録区分変更する。［技術展開部技術協力課］

日欧情報交換会議報告書

昭和62年 2月



高速増殖炉研究開発
運営委員会事務局

目　　次

〔Ⅰ〕 概 要 報 告

1. 日　程

62年1月20日～23日

日　　程		日独仏レビュー会議	日欧情報交換会議
15日（木）		成田着，ＰＮＣ車にて 水戸へ	
16日（金）		大洗工学センター訪問 京都へ移動	
17日（土）， 18日（日）		(free)	
19日（月）		「もんじゅ」サイト訪問， 東京へ移動	
20日（火）	午前	合同会議（日欧のＦＢＲ研究開発に関する現状紹介） （自転車会館９Ｆ，大会議室）	
	午後	Ｒ＆Ｄの現状紹介，協力計画のレビュー，及び新しい協力提案（安全性，運転経験） （動燃本社，第１会議室）	(free)
	夕方	合同レセプション （霞ヶ関ビル35Ｆ）	
21日（水）	午前	（同　上） （機器・構造，構造材料） （動燃本社，第１会議室）	日欧のステアリング委員会の紹介及び質疑応答 （自転車会館９Ｆ，大会議室）
	午後	（同　上） （燃料・炉心材料，炉物理） （動燃本社，第１会議室）	Questionnaireに沿っての質疑応答 （自転車会館９Ｆ，大会議室）
22日（木）	午前	（同上又はfree）	日独仏レビュー会議の概要報告と新協定（案）の説明及び質疑応答 （霞山会館９Ｆ，さくらの間）
	午後		(free)
23日（金）	午前	合同会議（会議のサマリー，会議記録確認） （霞ヶ関ビル33，会議室）	

AGENDA

Information Exchange Meeting

between

European and Japanese FBR R&D Steering Committees

(January 20 to 23, 1987 Tokyo)

Jan. 20 (Tue) (Joint Meeting, Jitensha Kaikan 9F)
(Chairman: Sawai and Itakura)

9:00- 9:30	Welcome address by Japanese side and introduction of members (Sawai and Itakura) Reply by European side and introduction of members (Lallement) Discussion on agenda
9:30-10:30	General review of Japanese FBR program (Hori)
10:30-10:45	Coffee break
10:45-11:45	General review of European FBR program (Lallement, Marth, Cicognani, Evans)
11:45-12:00	Discussion
12:00-13:30	Lunch at Tokai Club (Kasumigaseki Bldg. 33F, MIHONOMA)
(Afternoon)	
14:30-16:30	Specialist Meeting on Legal Matters (Welch, Le Niger, Yamaguchi, Matsuno, Saito, Ishimura, Iwata, Okada, Kano, Konomi)
18:00-20:00	Joint Reception of Review Meeting and Information Exchange Meeting (Kasumigaseki Bldg. 35F, Prunier)

Jan. 21 (Wed) (Information Exchange Meeting, Jitensha Kaikan 9F)
(Chairman: Itakura)

9:00- 9:10	Discussion of agenda
9:10-10:20	Introduction of Japanese FBR R&D Steering Committee and its activities (Nakagawa)

10:20-10:35 Coffee break

10:35-11:45 Introduction of European FBR R&D Steering Committee (Lallement)

11:45-12:00 Discussion

12:00-13:30 Lunch (Aoi Kaikan, 6F, ARIAKENOMA)

13:30-15:55 Japanese answer to questionnaire and discussion (Matsuno)

15:55-16:05 Coffee break

16:05-16:35 European answer to questionnaire and discussion (Lallement)

Jan. 22 (Thu) (Information Exchange Meeting, Kazan Kaikan 9F, Sakura)
(Chairman: Sawai)

9:00-10:00 Brief Review on the parallel Review Meeting (Hori, Marth and Rastoin)

10:00-10:20 Coffee break

10:20-11:40 Explanation and discussion on draft of agreements (Welch)

12:00-13:30 Lunch (Kazan Kaikan, TAKENOMA)

(Afternoon) (Free)

Jan. 23 (Fri) (Joint Meeting, Kasumigaseki Bldg. 33F)
(Chairman: Sawai and Itakura)

9:30-10:30 Summary and Confirmation of Information Exchange Meeting

10:30-12:00 Summary and Confirmation of Review Meeting

12:00-13:30 Lunch at Clair de Akasaka (Nissho Iwai Bldg. 19F)

2. 出席者

（欧州側出席者）

R．ラルマン	CEA	原子力技術開発産業化研究所， 原子力専任代表理事
W．マルト	KfK	高速炉計画部長
A．D．エバンス	UKAEA	高速増殖炉計画本部長
G．チコニアーニ	ENEA	高速炉開発本部長
G．A．ウェルシュ	UKAEA	商業化担当部長
Y．ル・ニジェール	CEA	産業政策交流局， 工業特許協定部長
P．フェルテン	CEA	在日フランス大使館 原子力アタッシェ

（日本側出席者）

板倉哲郎	原電	取締役高速炉開発部長
中川弘	原電	高速炉開発部，部長
宇田裕重	原電	高速炉開発部，副部長
澤井定	動燃	理事
明比道夫	動燃	動力炉開発推進調整部長
松野義明	動燃	動力炉開発推進調整部，次長
服部禎男	電中研	高速炉プロジェクトチーム 総括リーダ
朝岡卓見	原研	東海研究所，副所長
他計 約15名		

LIST OF PARTICIPANTS

CEA	R. Lallement	Directeur	Delegue Aupres de L'Institut de Recherche Technologique et de Development Industriel Pour La Mission Nucleaire
	Y.M. Le Niger	Chef	Department de la Propriete Industrielle et des Accords
	* M. Sauvage	Coordinnator	Fast Breeder Coodination (SACLAY)
	* J. Bouchard	Head	Fast Breeder Department (CADARACHE)
	J. Rastoin	Director	R&D for Reactors Member of the European Steering Committee (Saclay)
NOVATOME	* J.C. Lefevre	Manager	Head of Development Department Member of European R&D Steering Committee
Ambassade de France	P. Felten	Attache pour les Questions Nucleaires	
ENEA	G. Cicognani	Head	Fast Breeder Department
KfK	W. Marth	Director	Fast Breeder Project, Vice-Chairman European Steering Committee
	* G. Heusener	Deputy Head	Fast Breeder Project, Responsible for FBR Safety R&D
INTERATOM	E. Guthmann	Senior Advisor	Director of Research and Development Cooperation Office

Embassy of the Federal Republic of Germany	*H. Schunck	First Counsellor	Scientific
UKAEA	A.D. Evans	Director	Fast Reactor Programme
	*G.E.I. Smith	B.Sc., M.Inst.P.	U.K. Fast Reactor Liaison Agent
	G.A. Welch	Commercial Director	
JAPC	T. Itakura	Director	
	H. Nakagawa	General Manager	FBR development Dept.
	H. Uda	Deputy General Manager	FBR Development Dept.
	S. Saito	Assistant General Manager	Fast Breeder Reactor Development Dept.
	K. Yano	Manager	Fast Breeder Reactor Developmebt Dept.
PNC	S. Sawai	Executive Director	
	Y. Shoda	Executive Director	
	M. Akebi	Director	Reactor Development Coordination Div.
	M. Hori	Deputy Senior Director	Reactor Research and Development Project
	N. Nishimura	Senior Staff	Reactor Development Coordination div.
	Y. Matsuno	Deputy Director	Reactor Development Coordination Div.
	*Y. Nara	Director	Experimental Reactor Division, OEC
	T. Kano	Senior research Engineer	Reactor development Coordination Div.
	*J. Kubota	Assistant Senior Engineer	Reactor Research and Development Project
	T. Yamaguchi	General Manager	International Cooperation Office

	* A. Hiraguchi	Senior Staff	International Cooperation Office
	* A. Hashizume	Manager	International Cooperation Office
	S. Konomi	Manager	International Cooperation Office
CRIEPI	S. Hattori	Director	FBR Project Team
	H. Hatta	Assistant Director	FBR Project Team
JAERI	T. Asaoka	Deputy Director	Tokai Research Establishment
	* H. Yoshida	Head	Fast Reactor Physics Laboratory
	Y. Yoshida	General Manager	International Cooperation Office
	S. Denuma	Manager	Dept of Power Reactor Project
JAERI	* M. Sobajima	Senior Engineer	Reactivity Accident Lab.
FBEC	* M. Shimizu	Board Director	
TOSHIBA	* S. Abe	Manager	Advanced Reactor Engineering Dept.
HITACHI	* N. Nakao	Senior Engineer	Advanced Reactor Dept.
MHI	* G. Nakagawa	Deputy General Manager	Advanced Nuclear Systems Engineering Dept.
FUJI	* M. Kinoshita	Manager	FBR Project Nuclear Power Div.

* Joint Meeting Only

3. 配布資料

LIST OF DOCUMENTS FOR INFORMATION EXCHANGE MEETING

Japanese Documents

(January 20)

IJ-1 General Review of Japanese FBR Program (by Mr. Hori)

IJ-2 A Review of Fast Reactor Program in Japan (by PNC, for reference)

(January 21)

IJ-3 Introduction of Japanese FBR R&D Steering Committee and its activities (by Mr. Nakagawa)

IJ-4 Answer to Questionnaire (by Mr. Matsuno)

(January 22)

IJ-5 Postulated Structures of Steering Committee on FBR R&D and Revision of Umbrella Agreements (by Mr. Nakagawa)

European Documents

(January 20)

IE-1 Position of the governments (by Mr. Lallement)

IE-2 Germany (by Mr. Marth)

IE-3 ENEA budget (1985-1989) (by Mr. Cicognani)

IE-4 Two meetings (by Mr. Lallement)

(January 21)

IE-5 European Cooperation in the Research and Development of Fast Reactors (by Mr. Lallement)

IE-6 Founding and budget (by Mr. Lallement)

(January 22)

IE-7 AGT in Europe, WG in Japan (by Mr. Rastoin)

4. 会議の内容

4.1 日欧のＦＢＲ研究開発の現状紹介

① 日本の現状の紹介（ＰＮＣ　堀氏）

- 常陽，もんじゅ，およびＲ＆Ｄの現状
- 運営委員会を設立し，活動を開始したこと
- 日独協力協定にもとづく情報交換専門家会議，共同研究の現状，および今後の協力項目候補案

の３点を説明。

② 欧州の現状紹介

(イ) 欧州全般（仏：ラルマン氏）

○現在の主な課題

- ＳＰＸへのサポート
- ＳＮＲ－２の予備設計
- ＳＰＸ－２の　〃
- 長期のＲ＆Ｄ　（ＣＤＦＲを含む）

○ 欧州の次期炉は未定，電力間で話し合い中。

フランスとしては，ＳＰＸの１年間の運転状況を見守る必要があり，今年末に決定されるのではないかと考えている。

(ロ) 西独（マルト氏）

○ 現在の主な課題

- Ｒ＆Ｄ（約 150億円／年）
- ＳＮＲ－300 の完成（Non-Nuclear Testは完了）

- ＳＮＲ－２の設計（1500MWe,タンク型，５年以内に着工可能，国際協力による建設）

(ハ) 伊（チコニアニ氏）

○ 研究費の現状

1985～1989年の５ヶ年間の予算として5900× 10^3リラ（約 6,500億円）が政府から認められている。（但し年度毎に法律で決定する。）

このうち約 1/3がＦＢＲ用（約 2,000億円／５年間）

但し1987年度予算は厳しい。（1,170 → 700×10^3 リラ）

○ 当面の課題

- ＰＥＣの完成（1988年建設完，1990年臨界予定）
- 欧州との協力によるＲ＆Ｄ

○ その他

- エネルギー会議（1987年２月，官民のエネルギー関係者の意見をまとめ，ＥＮＥＡとしての活動指針をまとめ，政府に提案する）
- キリスト教民主同盟の大会が今月初旬に開催され，原子力賛成の決議をした。

(ニ) 英国（エバンス氏）

○ ＦＢＲ研究費（1986年）113 Ｍ£

今後も同じレベルを維持できそう。

なお，今後この研究費の約 1/3をＣＥＧＢが負担することが昨年12月に決定した。

○ ＰＦＲは昨年11月スーパーヒーターにリークが生じ，新しいものと交換した。（９Cr－１Mo材）

4.2　日欧の運営委員会の紹介

(1)　日本の運営委員会の紹介（原電，中川氏）

（主な質問）

イ)　原電には，研究施設もないが，どこがＲ＆Ｄを実施するのか。（主にメーカーへ委託，今後ＰＮＣなどへも）

ロ)　実証炉の基本仕様を決めるのはどの機関か。
（運営委員会で議論するが，基本的には電力。但しナショナルプロジェクトなので原子力委員会の合意も必要。現在は何も決めていない。64年度までにまとめる。）

ハ)　もんじゅ，実証炉の許認可申請者は？
（もんじゅ：ＰＮＣ，実証炉：原電）

ニ)　国際協力協定の締結者は運営委員会か。
（運営委員会または両議長の所属する機関）

ホ)　国際協力協定締結の際に関与する４機関以外の他の機関はあるか。（参与会，他）

ヘ)　日本のメーカーが海外メーカーと協力する際，運営委員会はどんな影響をもつのか。コントロールするのか。
（外貨申請）

ト)　４機関への出向者の守秘義務はあるか。

チ)　協力協定が締結された際，原電の情報が他の11電力会社により制限されることはないか。

リ)　ヨーロッパ情報が原電以外の他の機関（主としてメーカー）へ流れることはないか。

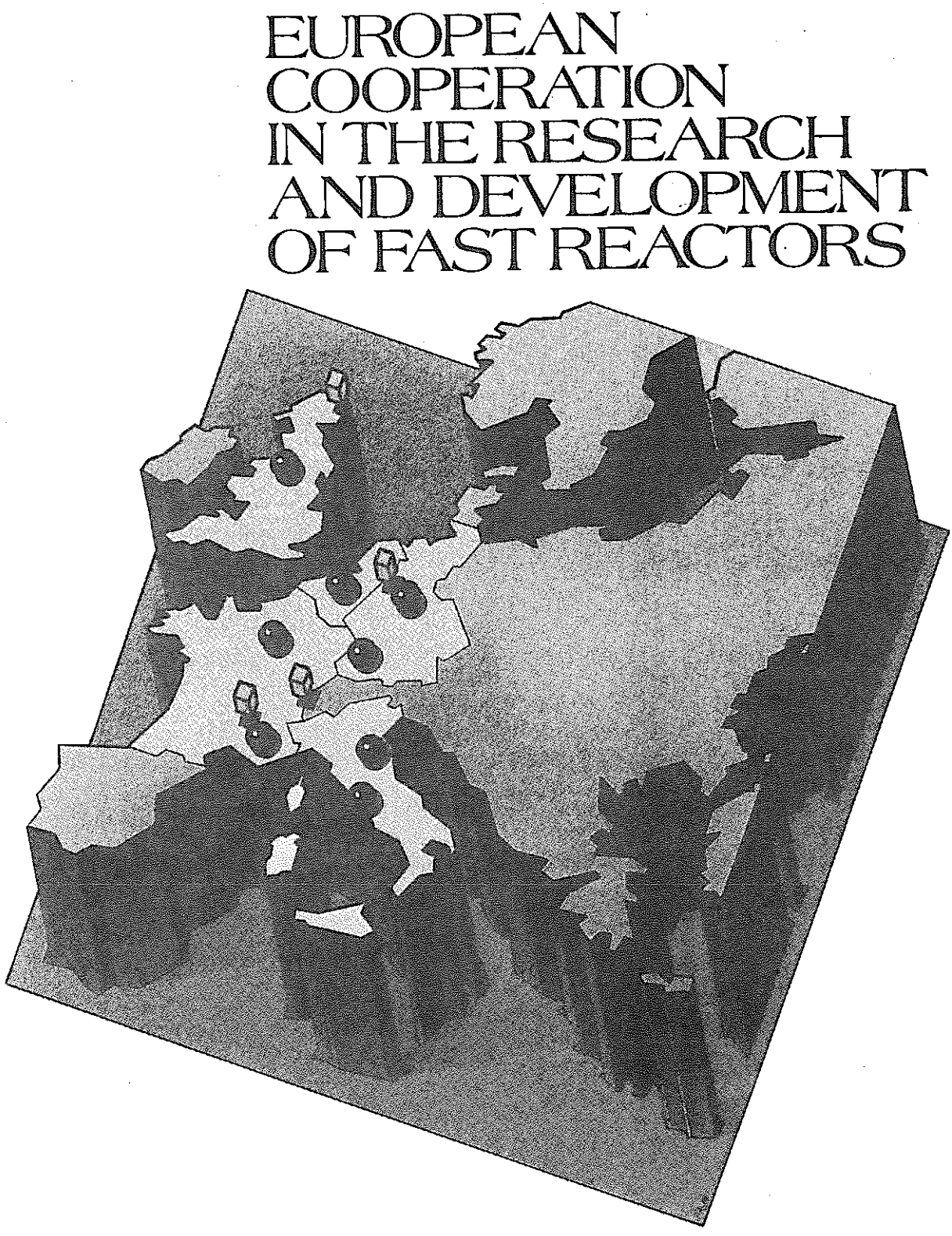
ヌ)　原電からの委託でメーカーが実施したＲ＆Ｄの成果が海外に流出しないようなシステムはあるか。

ル)　原電が現在実施中の「革新的技術の摘出」成果はヨーロッパの運営委員会への交換情報とすることが出来るか。

(2)　欧州の運営委員会の紹介

(イ)　概　要

（1984年設立，Ｒ＆Ｄ協定未，但し活動開始している。）



INTERGOVERNMENTAL MEMORANDUM OF UNDERSTANDING

Signed on January 10th, 1984, by:
UNITED KINGDOM, BELGIUM, FRANCE, the FEDERAL REPUBLIC of GERMANY and ITALY.
To support a collaborative programme of Research, Development Design and Construction of Fast Reactor Power Stations.

REACTOR MEMORANDUM OF UNDERSTANDING

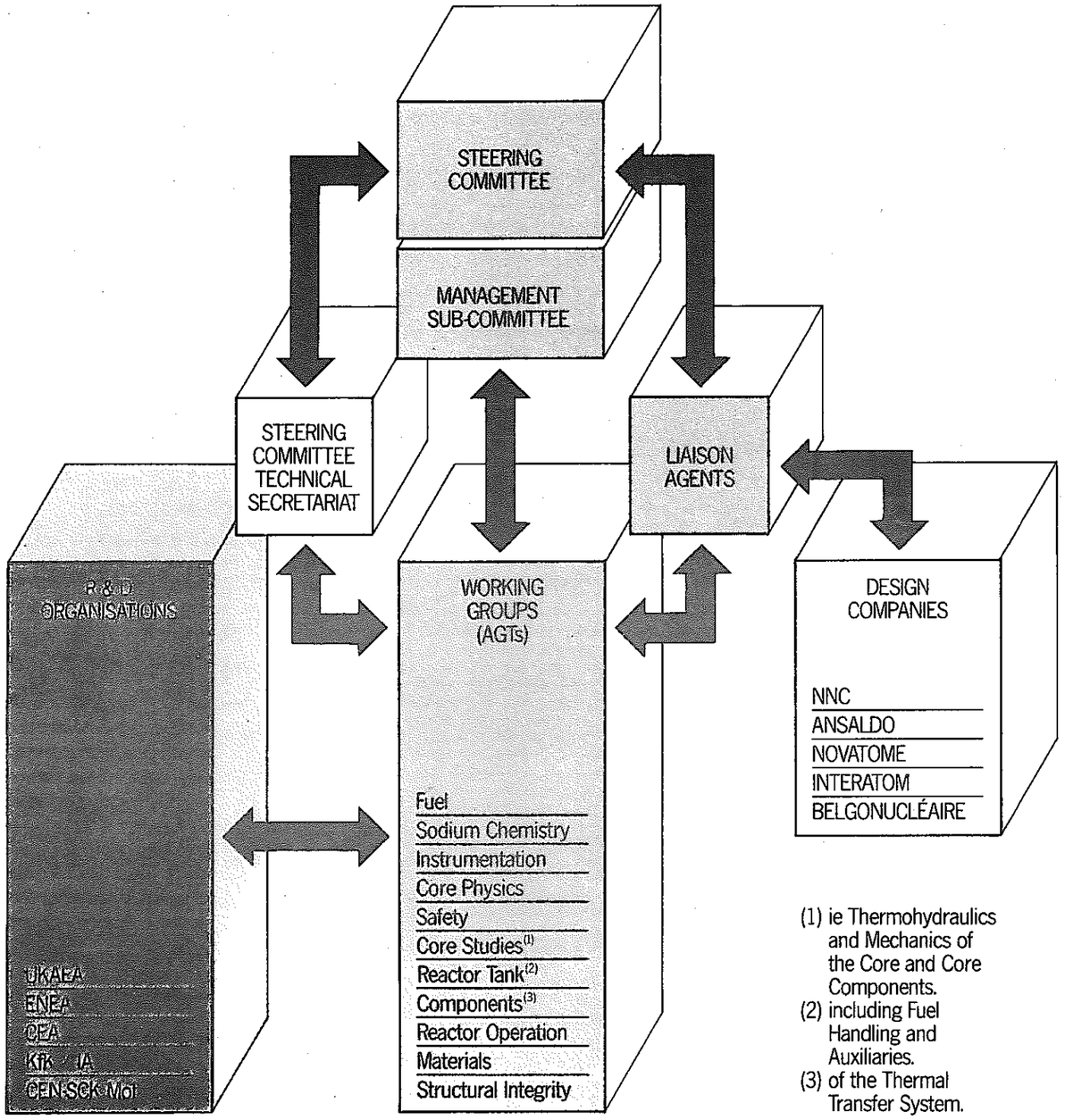
Signed on March 2nd 1984 by the following R & D and Design Organisations :
CEA, NOVATOME, KfK, INTERATOM, UKAEA, NNC, ENEA, NIRA*, CEN/SCK Mol and BELGONUCLÉAIRE.

The Signatories intend:
- to make every effort to promote the concept of a planned programme for reactor construction, each country building a reactor in turn;
- to arrange a complete exchange of information and know-how on fast reactors;
- to harmonize and co-ordinate their future R & D efforts on fast reactors;
- to exchange design information and collaborate on the design, construction and marketing of future fast reactors;
- to collaborate at industrial level and if it is deemed useful and possible, on the manufacture of fast reactor components;
- to unify the transfer of fast reactor information and know-how to and from parties who are not involved in the collaboration.

Through 3 separate Agreements:
- **The Research and Development Agreement;**
- **The Industrial Agreement;**
- **The Licensing (SERENA-FASTEC) Agreement.**

* now ANSALDO.

EUROPEAN STRUCTURE FOR THE FAST REACTOR R&D



(1) ie Thermohydraulics and Mechanics of the Core and Core Components.
(2) including Fuel Handling and Auxiliaries.
(3) of the Thermal Transfer System.

A Steering Committee comprising senior representatives of all the Signatories and of the Industrial Organisations is responsible for the management of the R & D collaboration. Each of the main Signatories ie: U.K., France, F.R.G. and Italy provides four members. One Belgian representative and an observer from Netherlands join them.

A series of technical Working Groups (designated AGTs from Arbeitsgruppen/Groupes de Travail) were established for particular technical areas of the R & D programme. They have to define and to organise the agreed common work with respect to the current design needs, taking account of the existing facilities or particular abilities of the partners. The goal is to set up a fully harmonized programme and to eliminate all the duplications which otherwise exist.

A Management Sub-Committee comprising only four members from the Steering Committee, one from each main country, meets more frequently and in more detail in order to follow and to orientate the work being done within the AGTs.

Two other groups were also created to help the Steering Committee:
- a permanent Secretariat, in the nature of a technical staff group, in charge of the liaison and administrative duties. It comprises four members and is located in France, at the Cadarache Center;
- a team of four Liaison Agents to assist the Steering Committee in maintaining regular contact with the Industrial Organisations.

DUTIES OF EACH WORKING GROUP

(extract from the R & D Agreement):

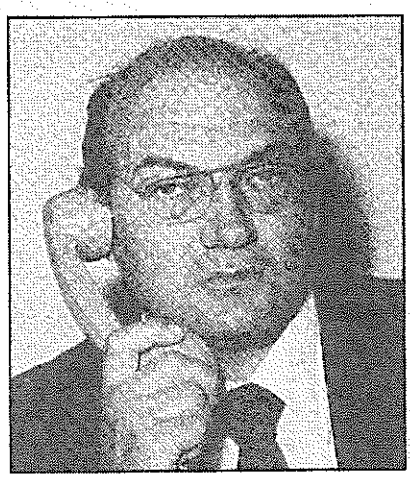
- to review the requirements of the Industrial Organisations as defined by the Steering Committee;
- to define the appropriate research and development objectives;
- to consider the research and development strategy necessary to attain these objectives;
- to advise the Steering Committee on the possible roles of individual Signatories in contributing to that strategy;
- to review regular reports provided by the Signatories on progress in its technical area;
- to propose modifications to the objectives and strategy in the light of design changes and/or research and development progress;
- to indicate to the Signatories the priorities for use of resources and facilities in the technical area;
- to identify the need and to present to the Steering Committee the justification for new facilities;
- to identify topics for specialist seminars, when appropriate, to bring together expertise from all the Signatories;
- to report regularly to the Steering Committee on progress and to bring to its attention any problems requiring action;
- to maintain close contact with the Liaison Agents.

MEETINGS OF THE STEERING COMMITTEE HELD SINCE 1984

Under the Chairmanship of:

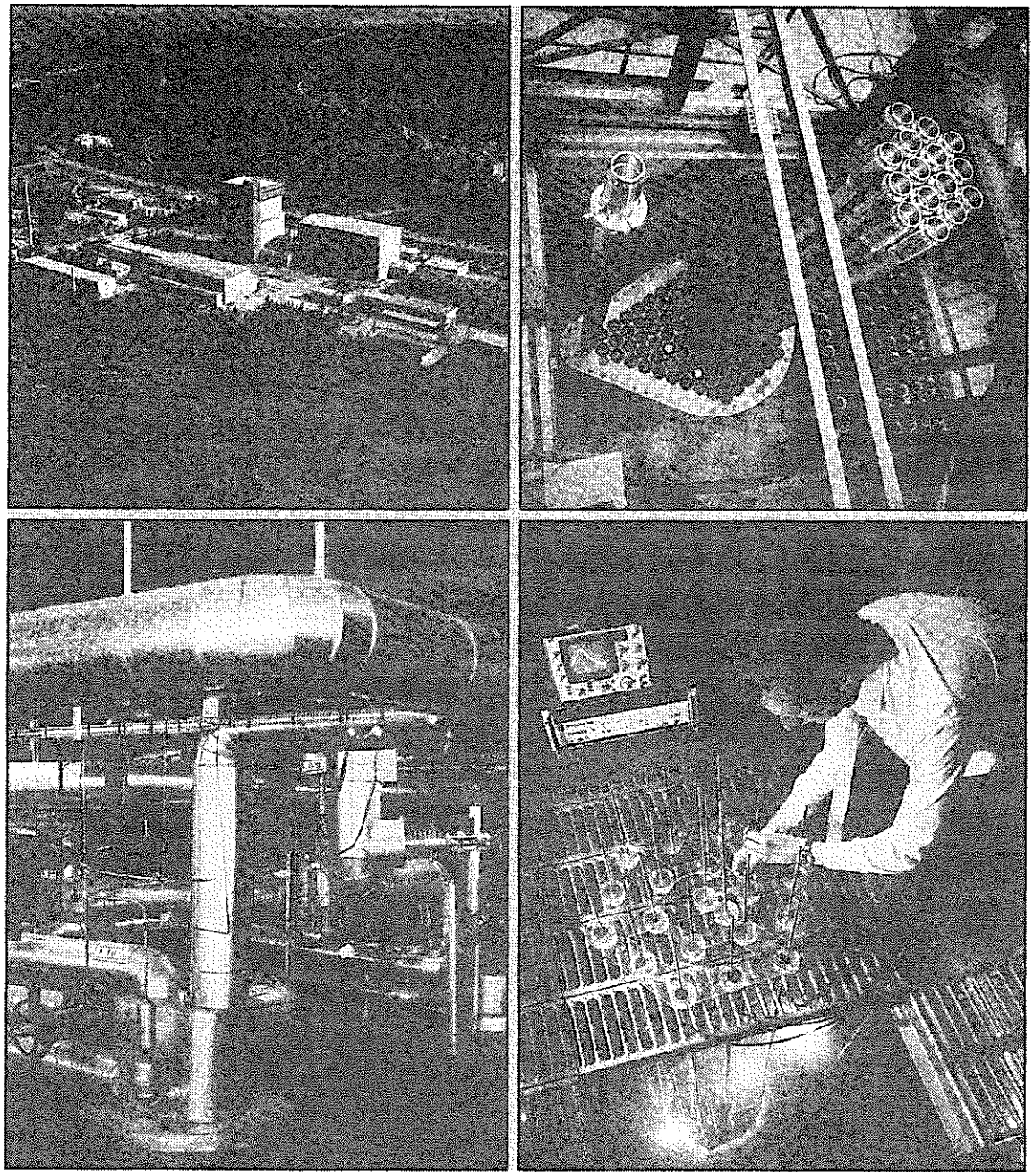
Dr. MAUSBECK - INTERATOM Director
1st Chairman - 1984 - Sept. 1985

1. LONDON (U.K.) July 10th, 1984.
2. ROMA (Italy) December 17th - 18th, 1984.
3. AVIGNON (France) June 20th - 21st, 1985.
4. CHIEMING-AM-CHIEMSEE (Germany) September 25th - 26th, 1985.



Mr. LALLEMENT - CEA Delegate Director
2nd Chairman - Oct. 1985

5. ANTWERP (Belgium) March 5th - 6th, 1986.
6. LONDON (U.K.) July 3rd - 4th, 1986.
7. BOLOGNA (Italy) November 27th - 28th, 1986.
8. _____



Steering Committee Technical Secretariat
STAIRD
Bâtiment 211 - CEN. Cadarache
BP No. 1 - 13108 Saint-Paul-lez-Durance Cedex - France
Tel.: 33/42.25.70.07 - Fax: 33/42.25.48.47

Steering Committee
Technical Secretariat
C.E.N. - Cadarache
13108 - Saint-Paul-lez-Durance
Cedex

January 1987,

WORK PACKAGES STATUS

Over the past two years the European Co-operation on Fast Reactor Research and Development has progressed well.

To date efforts have largely been concentrated on establishing and maintaining in progress a first collection of Work Packages. Each one includes, for a given technical theme related in principle to both projects SPX 2 and SNR 2, the contributions of the various partners (the tasks). Long term or basic Research and Development work may also be incorporated into the Work Packages.

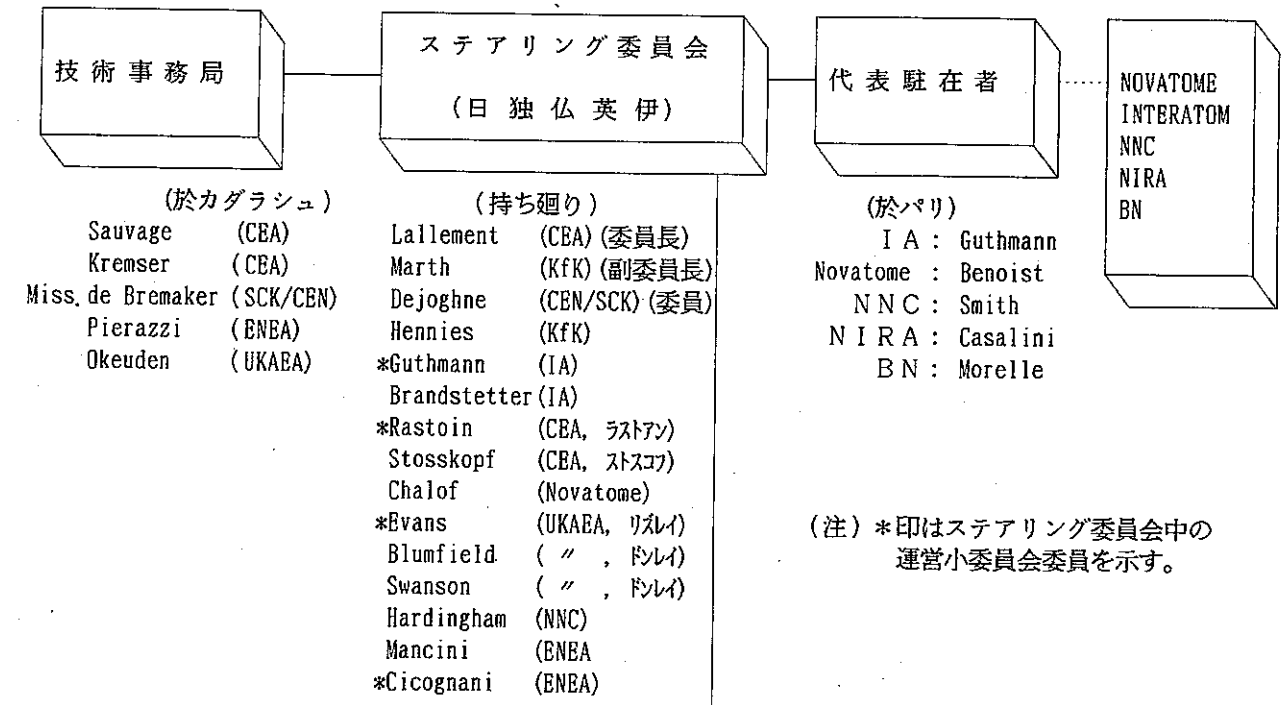
At the end of 1986, 71 Work Packages with a total amount of 888 elementary tasks have been approved by the Steering Committee. The distribution of tasks among the four main technical entities is as follows - UK : 26 % - France 34 % - DeBeNe 28 % Italy 12%.

1986 BUDGET

Total expenditure of the European Community for the Fast Reactor Programme for the year 1986 is as follows :

	UK	France	DeBeNe	Italy	Total
in millions of ECUS	117	169	115	68	469
in billions of YENS	20	30	20	12	82

欧州の高速炉Ｒ＆Ｄステアリング委員会



(ロ) 研究費

（1986年，人件費，施設維持等含む，但しＰＮＣ建設費除く）

		（今後予想）
DeBeNe	200 億円	増
仏	300 〃	減
伊	120 〃	現状維持
英　国	200 〃	〃
（計	820 億円）	

(ハ) 研究者数

DeBeNe	1,400	（技術者は 600人）
仏	2,000	（Phenix含む）
伊	700	
英　国	900	（ＰＦＲ(200人),再処理含む）
（計	5,000 人）	

(ニ) Ｒ＆Ｄテーマ

- defined by Eur. Sr. Comm.
- proposed by national organizations
- Proposed by AGTs

The themes are chosen with priority reference to the support to plant designs and engineering need.

A majority of themes are in continuity with the technical options of SPX.

〔欧州の高速炉Ｒ＆Ｄテーマ〕

WG1 燃料要素と炉心材料

1 Mixed oxide fuel : out of pile properties

2 Mixed oxide fuel : in pile thermal behaviour

3 Mixed oxide fuel : fuel-clad chemical interaction

4 Mixed oxide fuel : fuel-clad mechanical interaction

5 Advanced fuel

6 Out-of-pile properties of materials

7 Neutron behaviour of materials

8 Qualification to nertron of materials

9 Codes on wire wrapped bundles

10 Grid design irradiations

11 In service failure of fissile & fertile pins

12 Failure pin behaviour in low power storage conditions

13 Failed pin behaviour in off-normal condition

14 Failed pin behaviour : modelling

15 Pin and S/A in off-normal conditions : Molten fuel behaviour

16 Pin and S/A in off-normal conditions : Fuel element behaviour

17 Pin and S/A in off-normal conditions : Clad behaviour under temperature transients

18 Neutron absorber pin development : R&D and long term solutions

19 Neutron absorber pin development : Na bonded solutions

20 Neutron absorber pin development : He bonded solution

21 End cap welding

22 Welded cladding tuves

23 Fabrication technology for S/A ferritic wrappers

24 Specfications of materrials for Irradiations

WG2A ナトリウム化学

1 Chemistry of sodium

2 Activity transfer codes

3 Fission product and fuel in circuits

4 Hydrogen and trutium behavipur

5 Control of impurities by cold trapping

6 Hydrogen detection in steam generator

7 Chemical instrumantation for monitoring the sodium coolant in LMFBR's

8 Cleaning decontamination and requalification

9 Contamination trapping devices

10 Regeneration of cold traps

WG2B 計 測

1 Acoustic detection for SG

2 Acoustic surveillance of primary circuit

3 Undersodium viewing

4 Vibrational monitoring

5 Failed fuel detection

6 Neutron flux monitoring

7 Core temperature monitoring system

8 Sodium leak detection

9 Miscellaneous instrumentation

10 Ultra-Sonic (US) technology

11 Measurements

WG3　炉物理

1　Reduction of uncertainties in large core

2　Development of a unified core formulaire

3　Development of a unified shielding formulaire

4　Development of a unified heating formulaire

5　Development of a unified base for decay heat and its validation

6　Harmonization of codes and code systems

7　Core optinazation with respect to safety, economics and performance

WG4 安全性

1　Reactor dynamics in normal and design basis accident conditions

2　Decay heat removal by natural convection

3　Sub-assembly accident

4　Sodium fires

5　Radiological safety analysis

6　SNR2 design-concurrent risk analysis

7　Analysis of fuel elements during handling incidents

8　LIPOSO accident (pump to diagrid pipe fast failure)

9　Primary containment response etc.

WG5 炉心及び炉心機器の熱流動と機械力学

1　A common action for an experimental study of the static machanics of large arrays of sub-assemblies

2　Flow between the wrappers

3　Sodium tests on subassembly mockups

4 Core seismic analysis

5 Thermohydraulics of fuel bundles.

6 Dasign criteria standard rules

7 Core outlet thermocouples

8 PIE of REVE experiment

9 Hot spot calculations

WG6 炉容器及び付属機器

1 Sodium stratification in piping

2 Upper closures-head & mass transfer through the reactor cover gas

3 Emissivity of relevant materials

4 Diagrid sockets internal hardfacing

5 Use of elastomer seals as main sealing for rotating plugs

6 Investigations on the irradiation behaviour of elastomer seals

7 Thermal striping

8 Decay heat removal

9 Fuel handling

10 Control rod drive mechanism

11 Thermohydraulics of the thermal tank

WG7 蒸気発生器

1 Exchange of thermohydraulic calculations

2 Sodium pumps : program related to hypercritical shafts

3 Background and simulated leak noise measurements in KNKⅡ and Phenix steam generators

4 Sodium-water reaction : tube water leak studies

5 Steam-sodium surface interaction in the storage tank

6 SPX2 steam generator tubes/tubes clamps fretting

7 Comparison of mass transfer REACONV, NAPTA ARK, HYDRON codes

8 Na/H_2O reaction : behaviour & consequence of leak in SG tubes

9 Tharmal hydraulic computer codes for heat exchangers

10 IHX components

11 Dynamic instabiliteies in straight tube SG

12 Na/H_2O reaction leak propagation codes

13 Straight tube SG development

14 REGAIN secondary circuit configuration

15 In service inspection

WG8 原子炉運転

1 Tasts of high temperature fissons chamber

2 Estimate of balance of materials in operating SG

3 Radiation dose to operators of fast reactors

4 Radioactive gaseous, liquid and solid waste arisings from fast reactor operations

5 Experience wich DHR systems

6 Experience wich the removal of sodium from fuel S/A

7 Leak-before-break experience from operating fast reactors

8 Removel of Na from components (other than fuel) removed from primary and secondary sodium circuits

9 The deploynet of instrumented experimental rigs in fast reactors

WG9A プラント構造材料

1 Mechanical properties of "Type 316" steel

2 Mechanical properties of Alloy 800

3 Mechanical properties of weld metal and weldments for use with "Type 316" steel

4 Mechanical properties of ferritic steels for SG

5 Mechanical properties of other structural materials (Type 304, A 286)

6 Mechanical properties of structural steels in sodium

7 Effects of irradiation on near core permanent structural materials.

8 Effect of medium does irradiation on low temperature properties of stainless steels

9 Effect of helium produced by irradiation on high temperature behaviour of 316LN

10 Crack initiation and propagation in fatigue & creep

11 Fracture toughness behaviour

12 Sodium effect on SPX2 secondaty circuit materials

13 Waterside corrosioned SG materials

14 Fabrication technology

15 Volumetric non destructive testing

WG9B 構造健全性

1 Creep fatigue damage

2 Thermal striping

3 Ratcheting, strain limits and level D margins

4 Rules for specific components and pipings

5 Constitutive laws

6 Buckling

7 Computing tools

8 Seismic analysis

9 Impact analysis

10 Structural analysis on response to Na-water reactions

11 Pomp seismic analysis

12 Flow induced vibrations

13 Flaw assessment methodology

14 Flaw assessment codes

15 Numerical analysis for cracked components & structures

16 Experimental Validation

17 Component assessment

(ホ) 電力の役割

- プラントの基本仕様を決めること。各国電力のＲ＆Ｄに対する関心の度合いは異る。英（ＣＥＧＢ）は強，西独（ＲＷＥ）は弱，仏（ＥｄＦ）は両者の中間。
- 建設資金の拠出

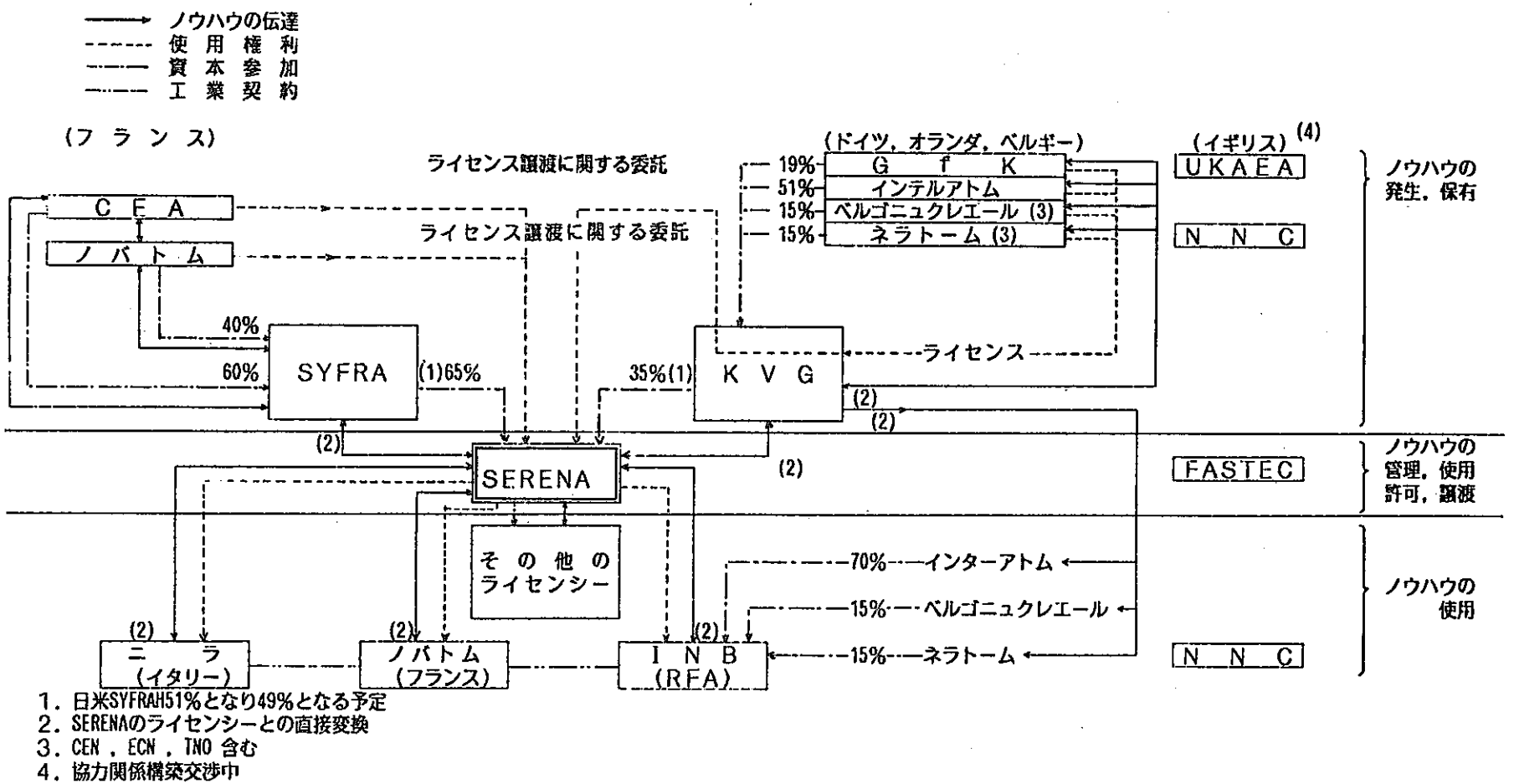
(ヘ) 情報の管理

- SERENA, FASTEC
  別紙７に示す。
- メーカーとの協定により管理（仏，伊）
  (NOVATOME, Ansaldo以外の製造メーカー)

(ト) 建設費等

別紙８，９にキロワット当りの建設費と原子炉構造の全重量変化を示す。

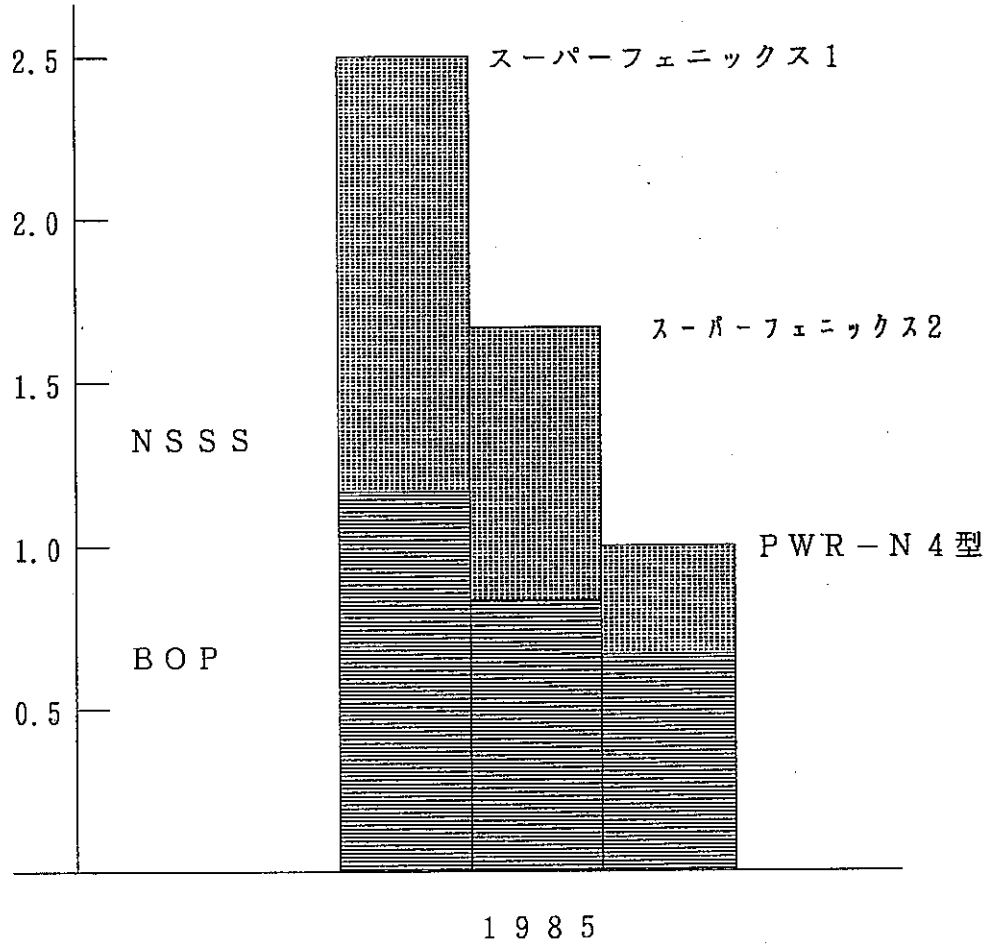
ノウハウの工業的及び商業的開発
（研究，設計，エンジニアリング及び建設）



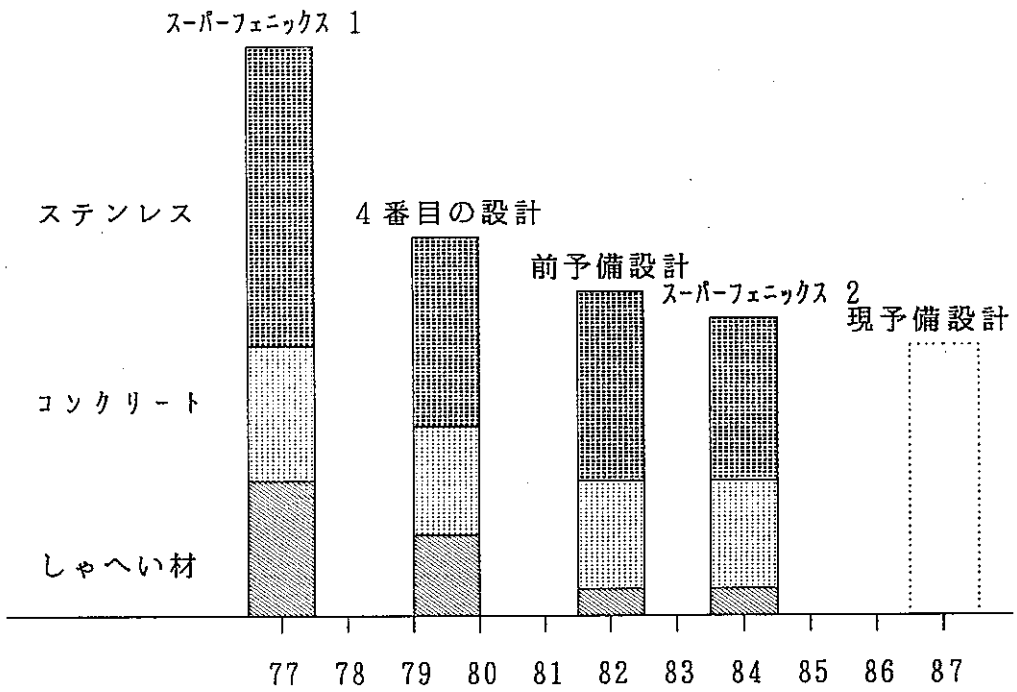
1．日米SYFRAH51%となり49%となる予定
2．SERENAのライセンシーとの直接変換
3．CEN，ECN，TNO 含む
4．協力関係構築交渉中

〔参考〕

別紙８　　KWe当たりの建設費の比較



別紙９　　原子炉構造の全重量の変化



4.3　日独仏協定にもとづく今後の協力事項報告

日独仏レビュー会議における協議結果について下記の報告があった。

○　下記４項目について協議中。

(イ)　情報交換

(i)　レポート交換　CONTAIN,軸非的質炉心，AI応用，他

(ii)　専門家会議　CDA,耐震，材料，DHR（自然循環),他

(ロ)　共同研究

SIMMER, COMMIX, 信頼性データベース，交換照射，他

(ハ)　プロジェクト参加

CABRI-Ⅱ，JOYO-INTA, SAPFIRE, SWAT, Rapsodie廃炉，大型ベローズ，他

(ニ)　委託研究

TTS, ISI　（欧州→日本）

○　今後アメリカも含めた共同研究の可能性

JUPITER-Ⅲ，信頼性データベース　9Cr-IMO，他

○　情報交換会議における両者W/G が取扱う分野の調整。

（今後の検討事項）

4.4　欧州提案の新協定の説明

イ)　日本と欧州との協力協定にしたい。
（現在の日英協定，日独仏協定を一本化して）

ロ)　両者の状況の変化にともない（日欧の運営委員会の設立）新協定は２つに分けたいとして原案を送付した。

1)　運営委員会同志の協定（Agreement，MOU，又はJoint Statement，などとする）

- 法的拘束力なし
- Ｒ＆Ｄ実施機関間協定のガイドライン的なもの
- 協力内容，協力方法などを記述したもの

2)　Ｒ＆Ｄ実施機関間の協定

- 法的に権利・義務を規定
- 関連機関（Affiliated Organization，ヨーロッパではＥｄＦ，ＣＥＧＢ，など）への情報の提供などは有。
- 日本側として原電が署名者として参加するかどうかは今後の検討事項。

ハ)　欧州としても，日本の状況がわかったので，協定の内容を再検討し，Draft を作り日本に送る。同時に欧州内のコンセンサスを得る。日本側として方針が未確定の点について困ってきて，こうしてほしいというコメントがあれば知らせてほしい。

ニ)　欧州内のＲ＆Ｄ協定の締結はまだだが今年中に締結される見通しだ。これをうけて日欧の協定も出来れば今年中に締結したい。（日英協定が62年12月末で期限となるため）

欧州および日本のＦＢＲ　Ｒ＆Ｄ運営委員会の間における
ＦＢＲ　Ｒ＆Ｄ分野の情報交換協力協定（要約）

（序　文）　日本側　欧州側の協力の背景と日欧双方のＦＢＲ運営委員会等について言及。新しく本協定（監督協定）とＲ＆Ｄ機関による情報交換協力協定を結ぶ。

（第１条）　定　　義　　欧側　日本側のＲ＆Ｄ機関他

（第２条）　目　　的　　Ｒ＆Ｄ機関の情報交換の枠組を設定

（第３条）　協力範囲　　ＦＢＲ　Ｒ＆Ｄ分野に関し，a)～i)　９項目

（第４条）　情報交換　　Ｒ＆Ｄ機関を当事者として妥当な形でバランスのとれた情報交換を行う。

（第５条）　ﾚﾋﾞｭｰ会議　　およそ１８ヶ月毎にレビュー会議を開く。ａ）運営，ｂ）テーマの確定，ｃ）情報交換の制限についてとりきめ，ｄ）バランス，ｅ）活動のタイムスケジュール決定

（第６条）　専門家会議　レビュー会議において専門家会議の計画決定

（第７条）　契　　約　　情報の使用，知的所有権等についてはＲ＆Ｄ機関による情報交換協力協定の適用を受ける。

（第８条）　全体の協定　日英ＦＢＲ協定，日独仏ＦＢＲ協定はＲ＆Ｄ機関による協定に置き換えられ，新協定が優先される。

ＦＢＲ燃料サイクル分野におけるＲ＆Ｄに関するものは除外

（第９条）　有効期間　　両当事者の合意により延長されない限り署名後５年間

欧州および日本のＲ＆Ｄ機関のＦＢＲ　Ｒ＆Ｄに関する情報交換協力協定（要約）

（序　文）　当事者を欧側　UKAEA, CEA, KfK, INTERATOM, ENEA, CEN/SCK, ECN

日本側　PNC, JAERI, CRIEPI

欧州及び日本の運営委員会及び両運営委員会間の協定（案）に言及，この協定が両運営委員会間の協定の枠の中にある事を明示。

（第１条）　定　　義　　Ｒ＆Ｄ機関　他

（第２条）　目　　的　　ＦＢＲ　Ｒ＆Ｄ分野での情報交換，協力の条件を設定

（第３条）　協力範囲　　ＦＢＲ　Ｒ＆Ｄに関し，a)～i)　９項目

（第４条）　情報交換　　交換される情報を定義

（第５条）　関係機関　　関係機関として欧州側はＥＤＦ，ＣＥＧＢ

日本側はＪＡＰＣ

（第６条）　情報の使用　　Ｒ＆Ｄ目的の使用

関係機関への伝達　他

（第７条）　情報の信頼性　提供機関の免責を規定

（第８条）　損害賠償

（第９条）　知的所有権　　交換された情報をもとにした発明発見等の取扱

（第10条）　既存の協定　　既存協定が優先

（第11条）　有効期間　　両運営委員会による協定の発効により発効し，その有効期間がある限有効

4.5　法的問題に関する予備打合せメモ

(1) 日　　時　　昭和62年1月20日（火）　　14：30～16：30

(2) 場　　所　　動燃役員小会議室

(3) 出 席 者　　Welch（ＵＫＡＥＡ），Le Niger（ＣＥＡ）
齋藤　蔚（ＪＡＰＣ）
山口，許斐，石村，岩田，岡田，松野，加納（ＰＮＣ）

(4) 配布資料　　なし

(5) 討論概要

Ｅ１　（欧州での協力体制について説明後），今後の日欧協力におけるＪＡＰＣの役割はどうなると考えればよいのか？

Ｊ１　欧州から送付された新協定のドラフトについてはまだ社内で充分話していない。

ＪＡＰＣは施設を持っていないのでＲ＆Ｄはやらないが，メーカーに委託研究をしており，その成果は電力のものとなっているので，電力もpropertiesを持っている。

したがってＲ＆Ｄ協定のドラフトに署名者としてＪＡＰＣが入っていないのはおかしいと思っている。

今回はなぜこのような提案を欧州側がしたのかその理由を良く聞いて，その上でＪＡＰＣ又は運営委員会として対応したい。

Ｅ２　メーカーからその成果の使用について条件がつくことはないか？

Ｊ２　ない。

Ｊ３　欧州側が区別しているシステムノウハウと製造ノウハウの違いはどこにあるのか？

Ｅ３　欧州各国で微妙に内容が違う。考え方としては，一方は仕様書を作るためのノウハウであり，他方は仕様書に沿って製造するためのノウハウである。

一般設計，詳細設計，及び重要な製造ノウハウの一部を含むものをシステムノウハウと呼んでいる。

機器関係の（component oriented）Ｒ＆Ｄの場合でも，製造ノウハウはメーカーに残っている。しかしシステムノウハウは別である。例えばＣＥＡは製造メーカー３社とＩＨＸについてライセンス協定を持っている。だから製造会社にサブコントラストをする。

Ｅ４　欧州内ではシステムノウハウを交換することにしているのだが，ＪＡＰＣは日本の協力関係の中でどのような industrial propertiesを持っているのか？

Ｊ４　細目を言わずにメーカーに設計建設させると思う。

Ｅ５　電力のお金でＲ＆Ｄをしても製造者は自分独自のノウハウを蓄積出来るのですね。

Ｊ５　Yes

Ｅ６　ＥＰＲＩと情報交換協定を結ぶと，どんな情報が米国へ流れるのか？　欧州情報も出るのか？

ＥＰＲＩは米国の全ての電力会社に情報を出す義務を持っているが日本のＪＡＰＣも同様の義務があるのか？

欧州情報も電力に流れるのか？

Ｊ６　まだ詳細は日本の電力会社とも話していないが，ＪＡＰＣは電力11社のお金で仕事をする以上ＪＡＰＣが得たものは電力に返すのが基本的姿勢と思う。ただし，電力会社はそれを得て商売をするわけではない。どの辺が心配か？（解答なし）

Ｅ７　ＪＡＰＣがサブコントラクトするとき，欧州情報が有益なら使うか？　またそのときメーカーは海外パートナーにその情報を流すことはないか？

またサブコントラクトするとき，資金の 100％を電力が出さない場合には日本のメーカーにノウハウが残ってしまうのではないか？

Ｊ７　Yes

Ｊ８　しかし同じ問題は欧州側にもあると思う。

Ｅ８　日本ではＲ＆Ｄ機関が約束しても，その先が心配だが，欧州側はもし日本の情報を使用しても，Ｒ＆Ｄ機関及びＦＢＲプラントの売り手（venders)という一定の枠の中でクローズされている。

その中では出せるようになっているが，その他の産業界及び電力には流れないことが保障されている。

Ｊ９　電力はシステムのノウハウを知らずに発注するのか？

Ｅ９　電力はノウハウを買えばよい。炉型を選ぶために必要な情報だけでよい。同じレベルのノウハウはいらないはずだ。

Ｊ10　日本ではかなり詳しく知る必要がある。安全審査も工事認可も電力が受けるので，そのために詳しいことを知っていたい。

Ｅ10　一般的情報と，仕様を決めるためのものだけがあれば充分ではないか。そうでないと１社のノウハウが他者に流れてしまう。必要性という点では日本も欧州も同じ

ではないか。同様にサブコントラクトに際して全部の情報をとる権限があるとしても製造ノウハウはとらないことにしている。

J11　しかし，ＣＥＧＢもＥｄＦも実際にはいろいろ知っているはずだが，どのような流れでそれを知っているのか？

E11　電力として必要な情報は得ることが出来る。先の説明は誇張して示した。実際にはいろいろ知ることは出来るが，これを第三者に与えたり売ったりすることは出来ない。国によって違うが，ＥｄＦやＣＥＧＢはシステムノウハウにも近い所におり，ＲＷＥはもっと離れている。

E12　日本ではなぜ電力はＲ＆Ｄ国際協力の表に出たがるのか。

J12　日本の電力は軽水炉を導入したけれども，その後電力共同研究として 100億／年位の研究開発費を使って稼動率の向上に努めてきた。

またＦＢＲについても電力として，お金をだしてやるということになっている。

今まではＰＮＣが中心でやってきたが，今後は国も民間も協力してやろうということになってきた。

表に出たいとういう訳ではないが，ＦＢＲのＲ＆Ｄの計画にも参加して，その成果を設計に一本化したいと考えている。

E13　ＪＡＰＣの資金による仕事は多くのものが他の機関がしているものとオーバーラップしているのではないか？

詳細設計をするのか？　コンポネントの開発もするのか？　政府のやっていることと同様のこともするのか？

J13　今後の話し合いによって決めてゆくが，要は設計のとりまとめを中心として，それに必要なＲ＆Ｄをすることになると思う。

E14　ＰＮＣとＲ＆Ｄ協定を結んでいると，日本のどんな情報でも欧州に入るのか？新しい協定では日本の出せるものは広がるのか，それとも少なくなるのか？　サブコントラクトによって得られた情報は日欧の交換対象に入らないのか？

Ｊ14　安い電力を作ることを目指すのが日本の電力の姿勢なので，そのためにメーカーに力をつけさせるという考え方はある。また日本全体が今，民活の流れの中にある。

E15　ＪＡＰＣは情報を提供するための法的な能力（legal capacity to provide the information)をもっているのか？　ＪＡＰＣがメーカー等（industries）に委託したとき，その発注したパテントは誰が持って，どのように自分（ＪＡＰＣ）が使い，どのように他人に使用させるのか？

Ｊ15　電力10社とＪＡＰＣが持つ。

E16　ＪＡＰＣ以外の電力のどこか１社でも反対すると，それが欧州側で入手できないようでは対等（symmetrical)な協定は出来ない。

かってある国と協定を結んでいたが，１％位のお金を出してうるさいことを言うので困ったことがある。

特にその協定参加者に法的な拒否権（legal veto）があるときに困る。一度この中に入ると，あらゆる情報を提供でき，また選択出来るという体制になっていないのでは協力はできない。

Ｊ16　今の話はＳＥＲＥＮＡを含めたもののように聞こえる。

Ｊ17　今までの日欧情報交換内容はＳＥＲＥＮＡに入っているものではないのではないか？

E17　ＳＥＲＥＮＡは２人だけの会社であり，大きな組織ではない。しかし誰がビジネ

スをするかという点が重要である。

E18　パテントは誰が所有するのか？　電力１１社はどうなるのか，１１社も同じ権利を持つとは考えられないが？

11社の同意がないとライセンスも出せないというのでは困る。

決定権は協定のパートナーが持っていないと困る。

J18　これからの話と思う。

E19　もう一つ重要な点はＪＡＰＣはＦＢＲ開発にどこまでコミットするのかを明確にしていない。今後ともどこまでやるのか，それを示していない。どこまでゆくのか聞いていない。その段階でパートナーになるというのはどうか……という考えでこの協定のドラフトではリザーブ（reserve)している。

まだＦＥＰＣがＪＡＰＣの将来の立場について明確に決めていないとしたら，このパートナーとなることを保留することもあると思う。

J19　欧州でもＲ＆Ｄ協定は署名されていないと思う。

J20　したがって日本でも大急ぎでこの協定締結を進めることはないとして，ゆっくり検討して進めている面がある。

E20　その通りである。しかし署名し，日欧協力をするとしたら……という話で準備を進めてゆくことは出来ると思う。

5. 会議のまとめ

(1) 日欧の両運営委員会の紹介

(2) 事前に送付された質問状に沿っての質疑応答

(3) 別途実施中の日独仏レビュー会議の概要報告

(4) 欧州側から提案された新しい日欧協力協定（案）の説明と討論

が行なわれた。

その結果，下記の事項が確認された。

(1) 欧州側のＲ＆Ｄ協力協定は未署名であるが，欧州内の共同研究活動は活発に進展している。

(2) 欧州側から事前に動燃に送付された新協定（案）についてその背景となる考え方等について説明があり，質疑応答が行なわれた。

(3) 日本側は国内関係機関の役割の明確化と，上記協定（案）の検討になお時間を要するので，その結果が出た後欧州側にコメントを伝える。

(4) 日欧の両運営委員会は，新協定署名のために必要なすべての条件が，今後満たされることを希望する。

また今回の会議を通じて，下記の事項が話題となった。

(1) 原電の役割，位置づけ（Ｒ＆Ｄの実施機関かどうか）

(2) 欧州情報の日本における伝達経路（原電以外の10電力へ，メーカーへ，海外（米国）へ）及び日本側関係者の守秘義務とその体制

(3) 欧州側へ提供される日本側情報の内容と質

（４機関の情報が，４機関以外から（原電の場合，他の10電力から）制限されることがないか）

日欧ＦＢＲＲ＆Ｄ運営委員会間の情報交換会議議事録

日欧ＦＢＲＲ＆Ｄ運営委員会の代表者による会議かつ1987年１月20～23日にかけて東京において開催された。

１．欧州ＦＢＲ運営委員会は，Ｒ＆Ｄに関する新しい組織についての日本側の説明に非常に興味をもった。また，日本のＦＢＲ運営委員会は，未署名の新協定のもとで実施されている共同研究活動についての欧州側の説明に非常に興味をもった。

２．事前にＰＮＣへ送付されていた新協定案の背景，特に２つの協定案が作成された理由について説明された。欧州側より２つの草案についての基本精神についての説明があり，その後興味深い討論が行われた。

３．日本側は，本件協力に関係する各機関の役割について国内での検討に今しばらく時間を要することが了解された。日本のＦＢＲ運営委員会は，関係機関間での検討を終え，結論が出た後，協定案に対するコメントを提出する。

４．日欧両運営委員会は，協定署名の為に必要な両当事者の全ての条件が速やかに満たされるよう希望する。

５．会議のアジェンダ（付属書１），参加者リスト（付属書２）及び交換書類（付属書３）を本議事録の１部として添付する。

ラルマン	板　倉
欧州高速炉運営委員会議長	日本高速炉運営委員会企画部会長

Record of Meeting for Information Exchange Meeting
between European and Japanese FBR R&D Steering Committees

A series of meetings between representatives of the Japanese and European fast reactor R&D Steering Committees took place in Tokyo during the period 20-23 January, 1987.

1. The European Steering Committee was very interested in the Japanese explanation of their new organizational structure for R&D work. The Japanese Steering Committee was also interested in the European description of their collaborative activities which were being carried out under their new agreement which was yet to be signed.

2. The reasons behind the drafts of New Agreements which had been sent to PNC were explained, in particular the reason for there being two agreements. The main principles of these drafts were explained by the European side and an interesting discussion followed.

3. It is understood that the Japanese side need more time to discuss among themselves what role each organization will play in the collaboration. The Japanese Steering Committee will present their comments on the draft agreements after they have discussed and come to a conclusion among the organizations involved.

4. Both Japanese and European Steering Committees sincerely wish that all of the requirements of both parties will be satisfied as soon as reasonably possible to enable an agreement to be signed.

5. The Agenda (Attachment 1) for the meetings and the list of participants (Attachment 2) and of documents exchanged (Attachment 3) are attached herewith as a part of this record.

R. Lallement
Chairman of the ESC
Co-chairman of the meeting

Hiroshi Nakagawa
for
TV Itakura
Chairman of Planning
Sub-committee of JSC
Co-chairman of the meeting

〔Ⅱ〕　日本側配布資料

I. ANSWER TO QUESTIONNAIRE

PREPARED FOR INFORMATION EXCHANGE MEETING
BETWEEN
EUROPEAN AND JAPANESE FBR R&D
STEERING COMMITTEE

20～23 JANUARY 1987, TOKYO

QUESTONARY TO PNC

1. PRESENT ACTIVITIES AND FUTURE PLAN ON FBR DEVELOPMENT AT PNC

   a) FOUNDING AND BUDGET
   b) ORGANIZATION AND MANPOWER
   c) R AND D THEME
   d) PROCESS TO DIFINE THE PROGRAM

2. BUDGET PROSPECTS IN NEAR TERM AND LONG TERM

3. STATUS OF PARTICIPATION TO JAPANESE DOMESTIC COLLABORATION ON FBR DEVELOPMENT AND THE ROLE OF PNC

4. ACTIVITIES OF THE JAPANESE COORDINATING COMMITTEE BETWEEN CRIEPI, JAERI, JAPCO, PNC

   a) FOUNDING AND BUDGET
   b) ORGANIZATION AND MANPOWER
   c) R AND D THEME
   d) PROCESS TO DIFINE THE PROGRAM

5. POLE OF THE JAPANESE GOVERNMENT IN THE FBR DEVELOPMENT

6. ROLE OF THE JAPANESE UTILITIES IN THE FBR DEVELOPMENT

7. STATUS OF ACCEPTANCE OF ENGINEERS AND SCIENTISTS FROM OTHER JAPANESE ENTITIES RELATING TO FBR DEVELOPMANT

8. COOPERATIVE ACTIVITIES OF PNC WITH OTHER FOREIGN COUNTRIES RELATING TO FBR DEVELOPMENT IN PARTICULAR WITH USA. FUTURE PROSPECTS IN LONG TERM, COMMITTMENTS OF PNC TOWARDS US ENTITIES

9. POSSIBLE SUPPORT OF PNC TO AN EUROPEAN ADVANCED DEMO PLANT HOW PNC ENVISAGE A POSSIBLE JAPANESE PARTICIPATIPN TO SUCH A PLANT ?

10. POSSIBLE INCREASE OF COOPERATIVE ACTIVITIES OF PNC WITH EUROPEAN ASSOCIATED COUNTRIES

    a) IN THE NEAR TERM
    b) FUTURE PROSPECTS IN LONG TERM
    c) JAPANESE RULES ASSICIATED TO THE USE OF TRANSMITTED PROPRIETARY INFORMATION BY INDUSTRIAL ENTITES (DESIGNERS, MAKERS, UTILITIES,...) : RULES IN VIEW OF INTERNAL USE, RULES IF EXTERNAL USE IS ENVISAGED

11. TECHNICAL STATUS OF FBR DEVELOPMENT IN JAPAN

    a) REACTOR OPERATION AND CONSTRUCTION (IN PARTICULAR STATUS OF MONJU, SCHEDULE FOR THE JAPANESE DEMO PLANT)
    d) PROGRESS ON SYSTEM DESIGN
    c) SAFETY, RELIABILITY, ECONOMY
    d) COMPARISON OF LOOP TYPE AND POOL TYPE REACTORS
    e) SEISMIC CONSIDERATIONS
    f) FUEL CYCLE FACILITIES

CONTENT

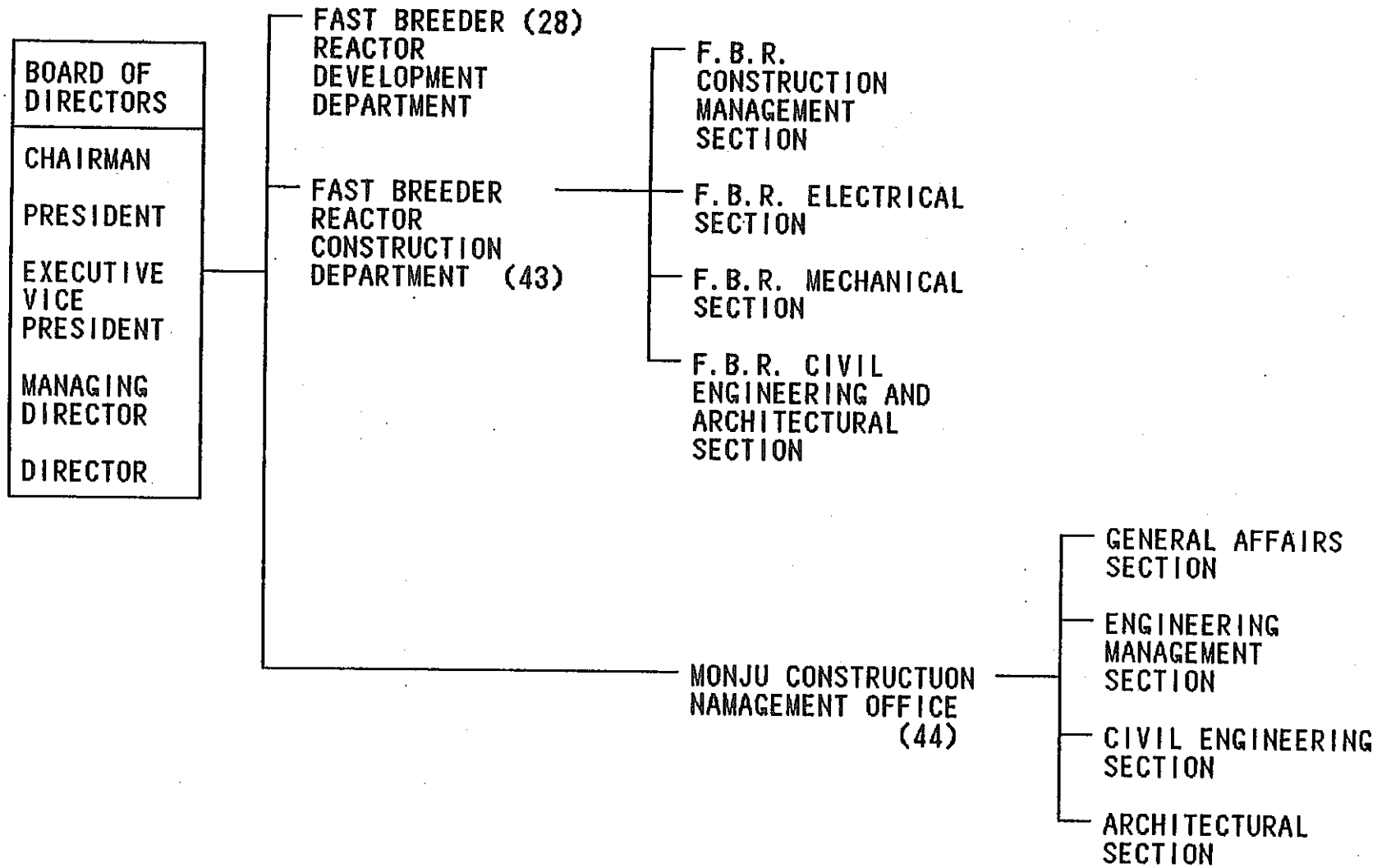
FOUNDING

PLANT	FOUNDING
EXPERIMENTAL FBR JOYO	JAERI : R&D, PRELIMINARY DESIGN PNC : DESIGN, CONSTRUCTION AND OPERATION
PROTO-TYPE FBR MONJU	PNC : R&D, DESIGN, CONSTRUCTION AND OPERATION JAPC : CONSTRUCTION MANAGEMANT
DEMO PLANT NO.1	ST. COM. : COORDINATION OF R&D ORGANIZATIONS JAPC : CONSTRUCTION, OPERATION AND R&D PNC : R&D JAERI : R&D CRIEPI : R&D

ORGANIZATION AND MANPOWER

( ) MANPOWER

J A P C



J A E R I

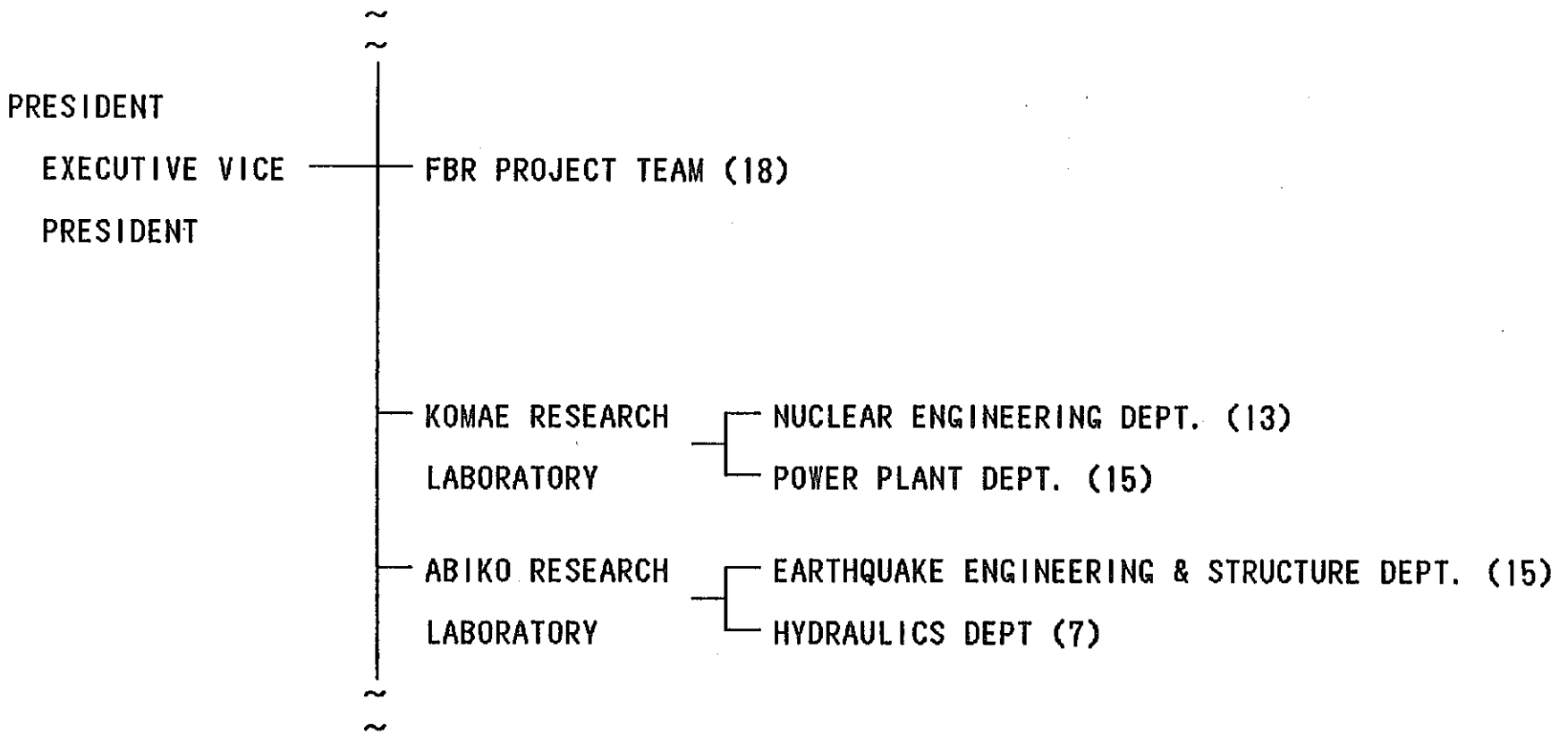
( ) MANPOWER

TOKAI RESEARCH ESTABLISHMENT JAERI

- DEPARTMENT OF PHYSICS (5)
  - NUCLEAR DATA CENTER
- DEPARTMENT OF REACTOR ENGINEERING (10)
  - REACTOR SYSTEM LAB.
  - FAST REACTOR PHYSICS LAB.
  - SHIELDING LAB.
  - REACTOR CONTROL LAB.
- DEPARTMENT OF REACTOR FUELS RESEARCH (5)
  - PLUTONIUM FUEL LAB.
- DEPARTMENT OF REACTOR SAFETY RESERACH
  (TO BE STARTED IN 1988)
  - REACTOR SAFETY EVALUATION LAB.
  - RISK ANALYSIS LAB.
- DEPARTMENT OF FUEL SAFETY RESEARCH
  - REACTIVETY ACCIDENT LAB.
  (TO BE STARTED IN 1988)

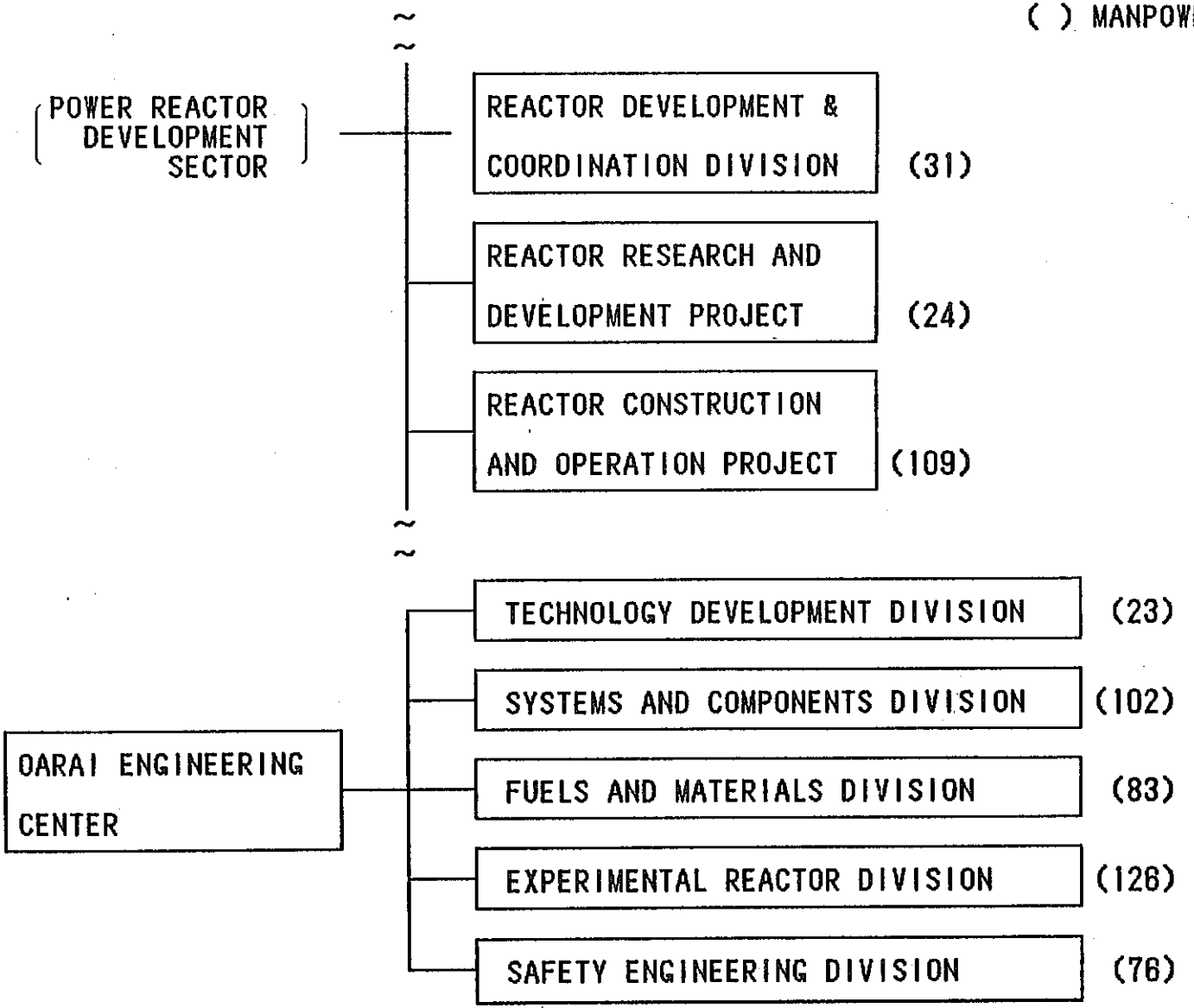
C R I E P I

( ) MANPOWER



P N C

( ) MANPOWER



2. BUDGET PROSPECTS IN NEAR-TERM AND LONG-TERM

×10⁸YEN

	1986	1987	1988 ~
JAPC	33	60	SIMILER AMOUNT TO ACCOUNTING FY 1987 EXPECTED
PNC	162*	154*	
JAERI	3	3	
CRIEPI	17	11	

EXCL. PERSONNEL WAGES

* INCLUDING FACILITIES OPERATING CHARGE
APPROX 20×10⁸YEN/YEAR EXPECTED FEOM MITI

ACTIVITIES OF STEERING COMMITEE ON FBR R&D IN JAPAN

1. OBJECTIVES

a) DISCUSSION AND COORDINATION OF EFFECTIVE ALLOCATION OF WORKSCOPE, UTILIZATION OF R&D RESOURCES IN DOMESTIC ORGANIZATIONS

b) DISCUSSION AND COORDINATION OF MATTERS OF INTERNATIONAL COOPERATIONS

c) BASIS MUST BE IN ACCORDANCE WITH NATIONAL POLICY OF FBR DEVELOPMENT WHICH WILL BE REVISED BY AEC

2. SCOPE OF DISCUSSION AND COORDINATION

a) R&D OF THE FIRST DEMO FBR AND FOLLOWING PLANTS

b) POLICY OF INTERNATIONAL COOPERATION

c) RELATED IMPORTANT ITEMS OF R&D

4. CURRENT ACTIVITIES OF STEERING COMMITTEES

a) PREPARATION AND DISCUSSION OF OVERALL INTERMEDIATE- AND LONG-TERM R&D PROGRAMS FOR DEVELOPMENT OF JAPANESE FIRST DEMO PLANT AND COMMERCIALIZATION

b) COORDINATION OF ALLOCATION OF R&D WORKS TO THE FOUR ORGANIZATIONS IN FY 1987

c) DISCUSSION AND COORDINATION OF THE POLICY OF USA-JAPANESE AND EUROPE-JAPANESE COLLABORATIONS

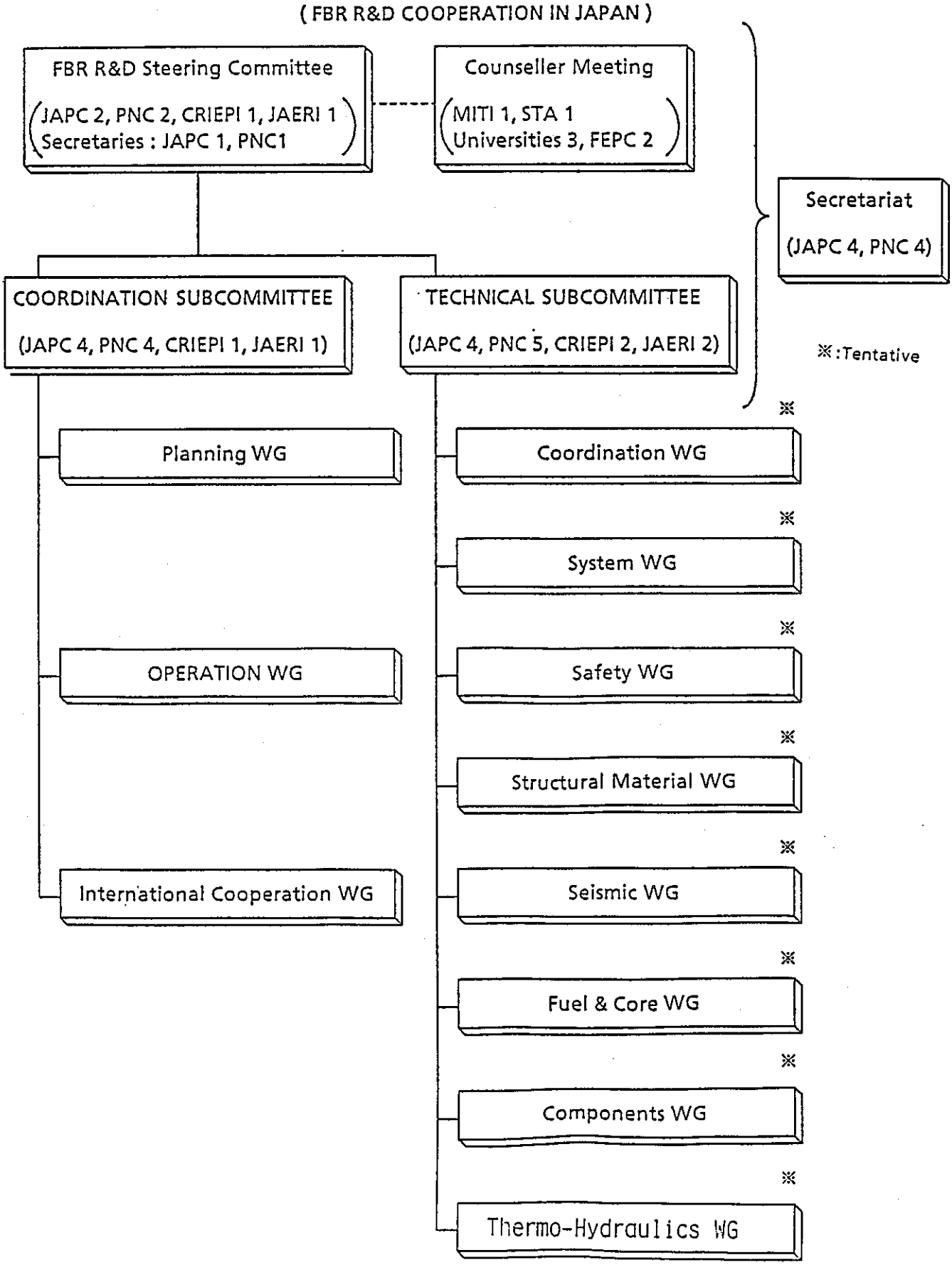
FBR BUDGETS IN JAPAN (FY 1987)

(10^8YEN)

	BUDGETS APPROVED	REMARKS
CONSTRUCTION OF MONJU	650	GOVERNMENT : 405 PRIVATE SECTORS : 245 [CAPITAL COST OF MONJU IS ASSUMED TO BE 5900 INCLUDING CONTRIBUTION OF 1380 BY PRIVATE SECTORS]
R&D	252	(PNC 155) OPERATION OF FACILITIES (INCLUDING 44 FOR JOYO) 100 R&D FOR LARGE REACTORS 50 R&D FOR MONJU 5 (JAERI 3) OPERATION OF TEST FACILITIES 0.1 R&D FOR LARGE REACTORS 2.9 (JAPC 58) R&D FOR LARGE REACTOR 58 (CRIEPI 16) CONSTRUCTION OF TEST FACILITIES 2.8 R&D FOR LARGE REACTORS (INCLUDING CONTRIBUTION OF 4.2 BY FABRICATORS) 13.2 (MITI 20) R&D FOR LARGE REACTORS (TO BE MANAGED BY CRIEPI) 17 FEASIBILITY STUDY 3

ORGANIZATION AND MAN POWER

(FBR R&D COOPERATION IN JAPAN)



5. PROCEDURES TO DEFINE PROGRAMS

a) THE FBR R&D STEERING COMMITTEE PREPARE THE OVERALL FBR R&D PROGRAMME IN ACCORDANCE WITH THE NATIONAL "LONG TERM PROGRAM FOR DEVELOPMENT AND UTILIZATION OF NUCLEAR ENERGY" WHICH WILL BE REVISED THIS YEAR BY AEC

b) THE STEERING COMMITEE WILL REVIEW CONTINUOUSLY THE STATUS OF R&D AND FUTURE PROGRAMS IN ACCORDANCE WITH CHANGE AND PROGRESS OF R&D SITUATIONS

c) EACH OF FOUR ORGANIZATIONS HAS FINAL RESPONSIBILITY TO EXECUTE PROGRAMMES ALLOCATED AND TO EVALUATE

6. GENERAL IMFORMATION

a) STEERING COMMITEE WAS HELD THREE TIMES SINCE JULY 29 1986 WHEN IT WAS ORGANIZED

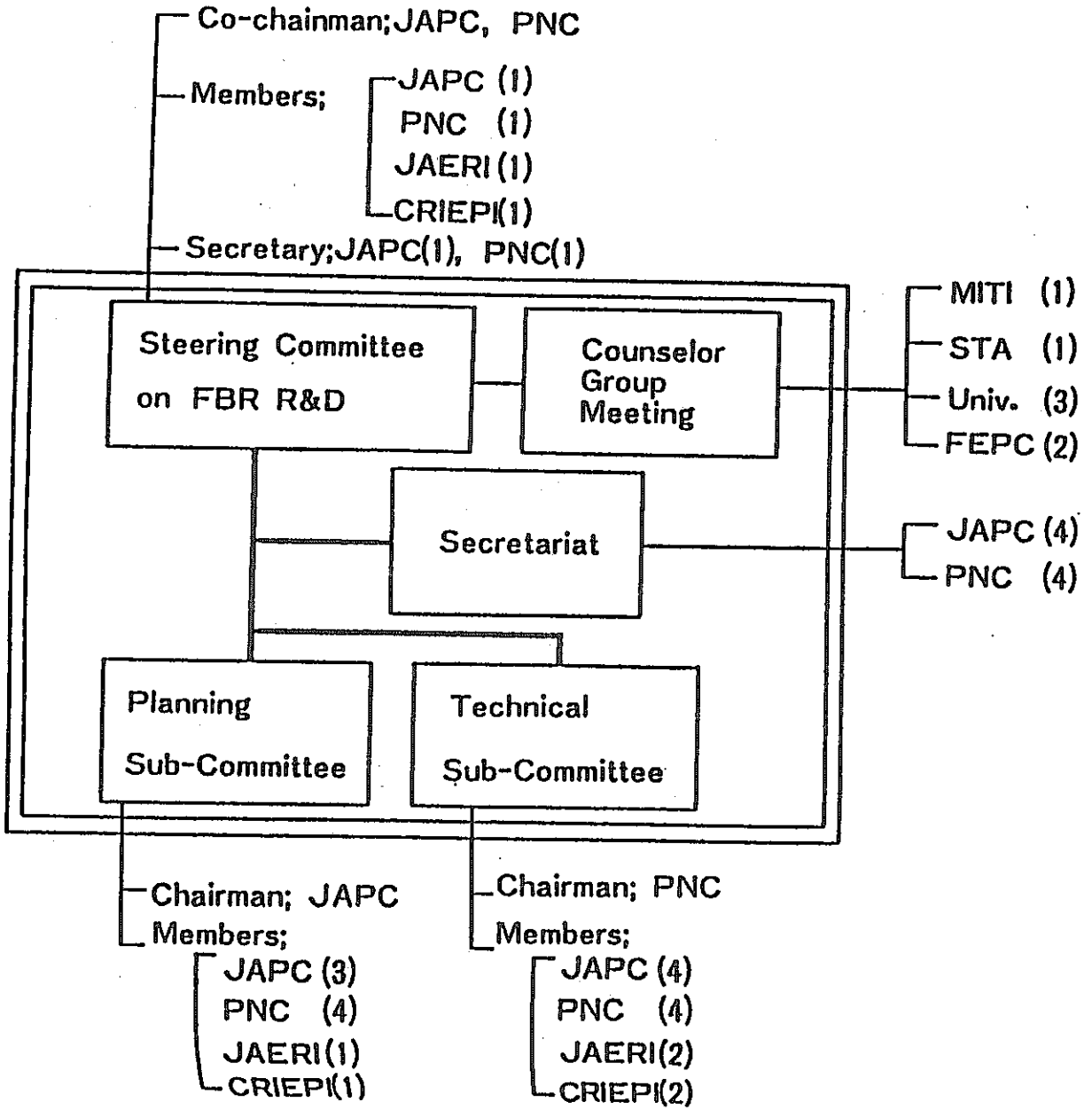
b) PLANNING AND TECHNICAL SUBCOMMITEES WERE HELD SIX TIMES EACH

c) COUNSELLOR MEETING WAS HELD ONCE

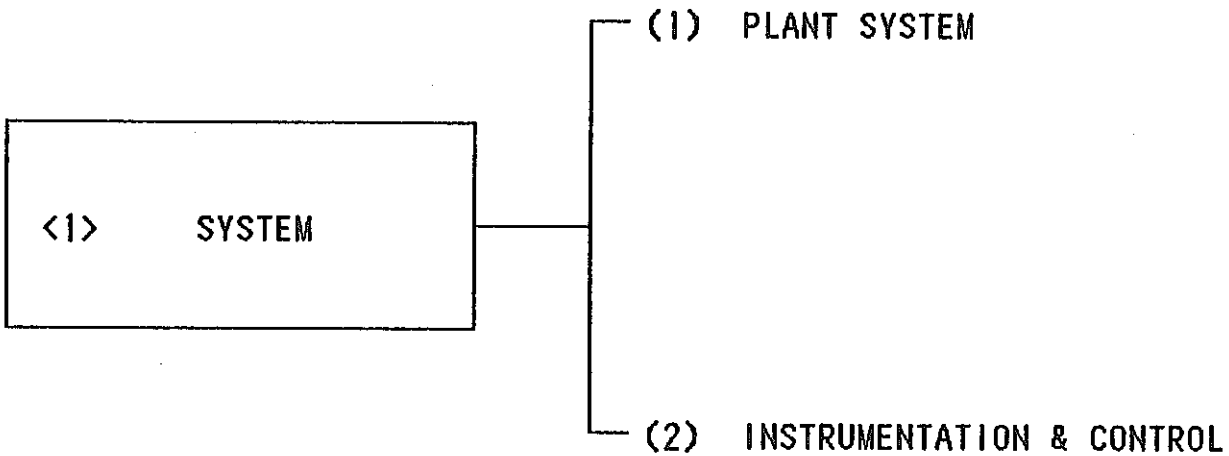
d) WORKING GROUP MEETINGS WERE HELD THREE TO SEVEN TIMES RESPECTIVELY

e) THE DIRECT EXPENSE FOR OPERATION OF STEERING COMMITEE IS CHARGED TO JAPC, PNC, CRIEPI AND JAERI AT THE RATE OF 4:4:1:1

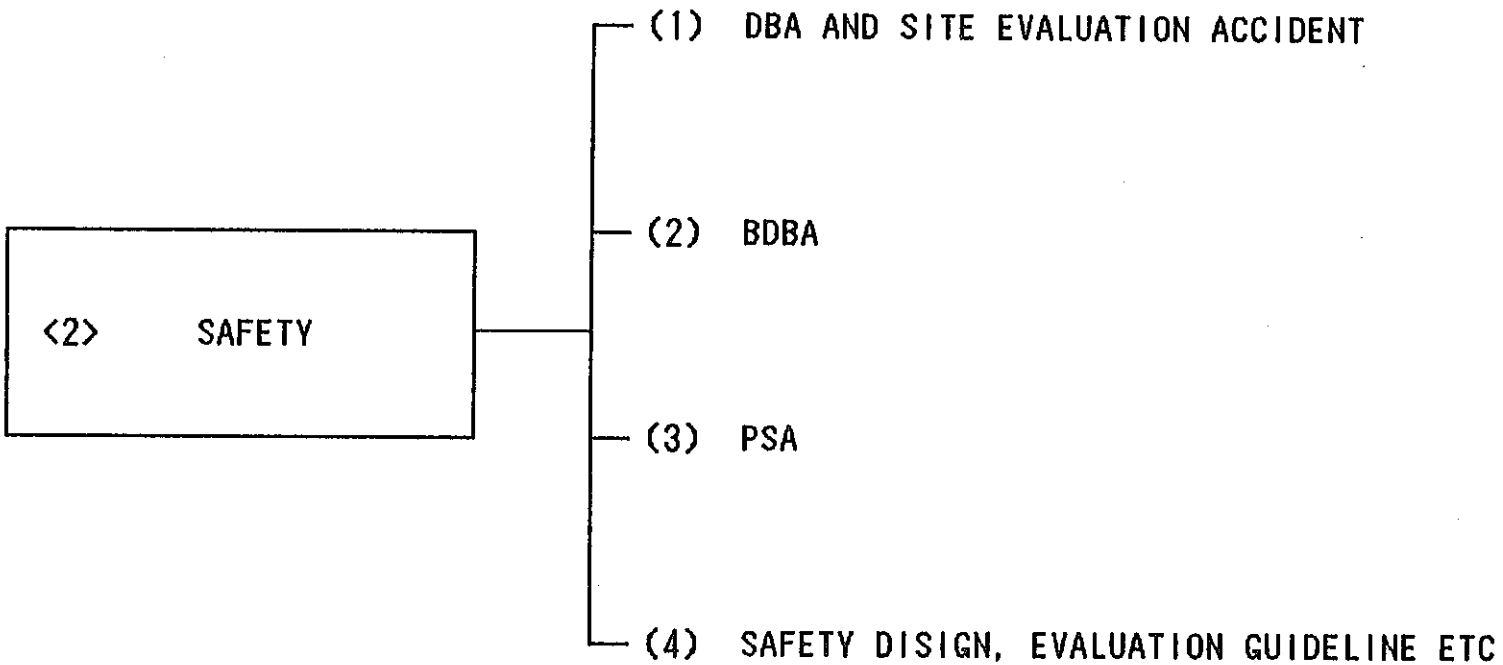
Organization of Steering Committee on FBR R&D



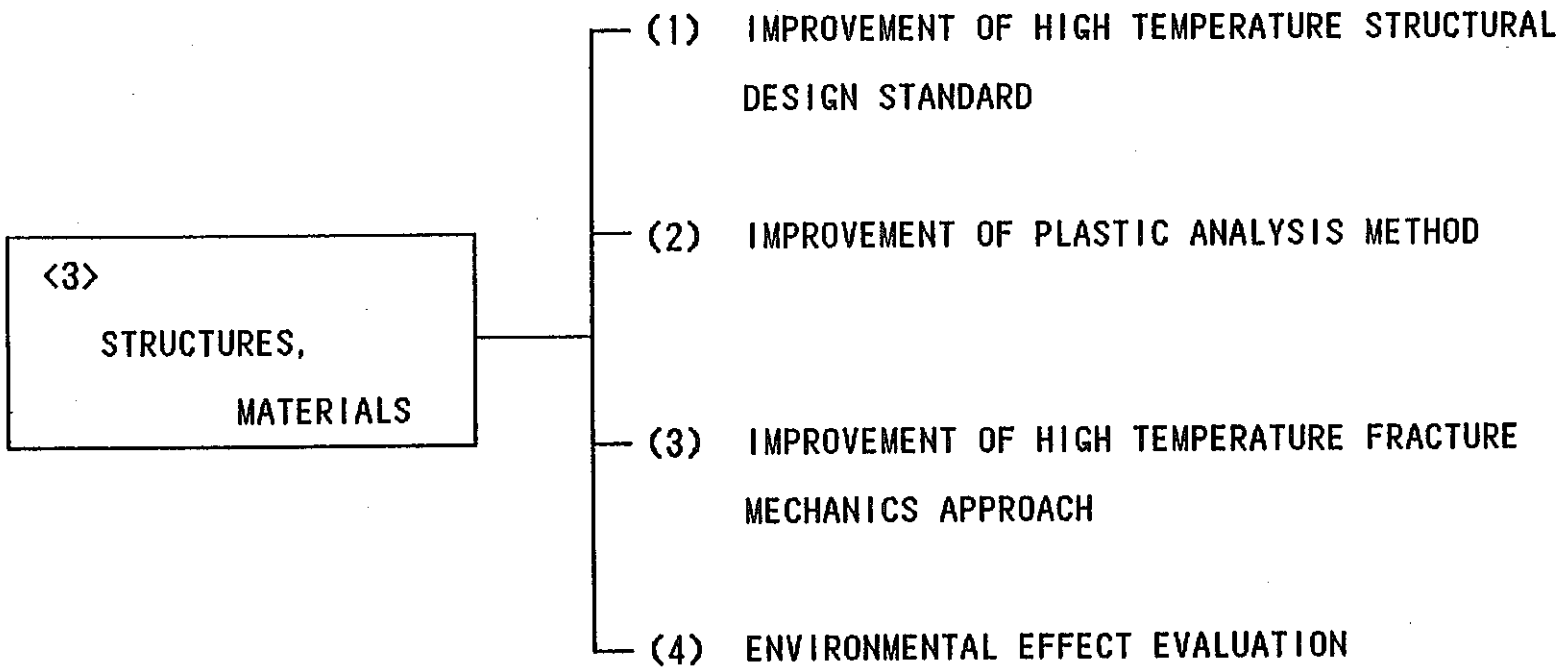
R&D THEME (1)



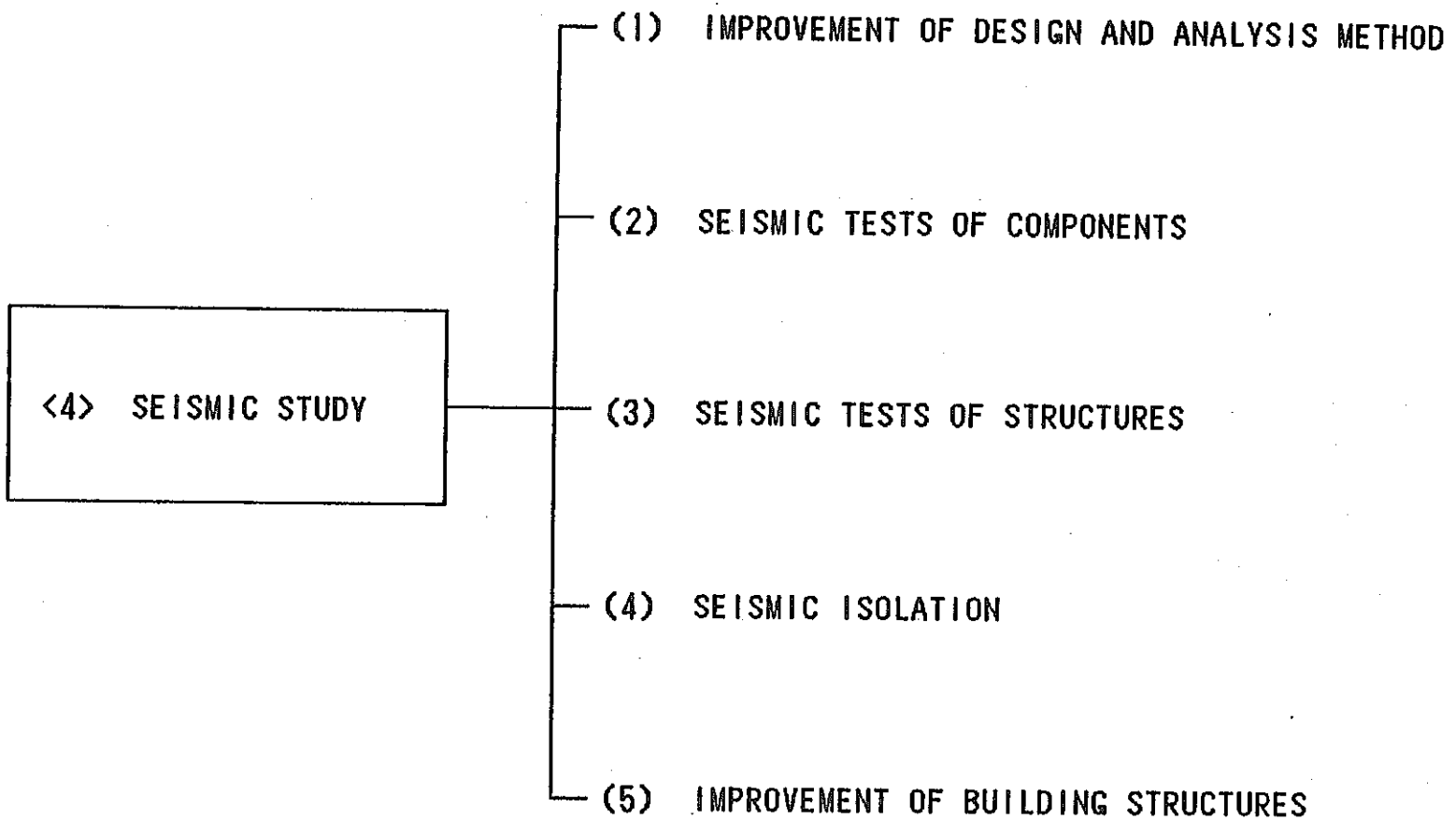
R&D THEME (2)


<2> SAFETY
(1) DBA AND SITE EVALUATION ACCIDENT
(2) BDBA
(3) PSA
(4) SAFETY DISIGN, EVALUATION GUIDELINE ETC

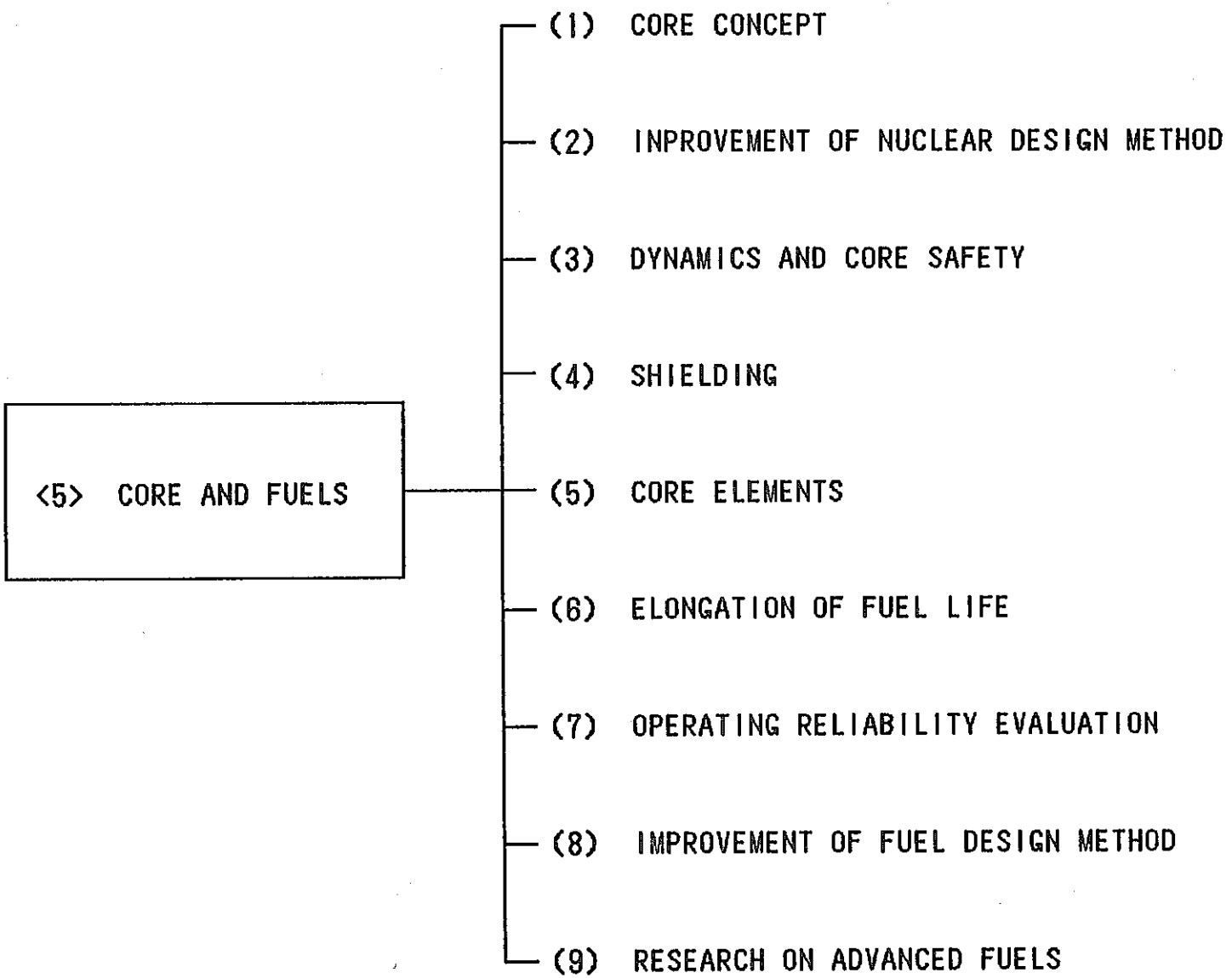
R&D THEME (3)


<3>
STRUCTURES,
MATERIALS
(1) IMPROVEMENT OF HIGH TEMPERATURE STRUCTURAL DESIGN STANDARD
(2) IMPROVEMENT OF PLASTIC ANALYSIS METHOD
(3) IMPROVEMENT OF HIGH TEMPERATURE FRACTURE MECHANICS APPROACH
(4) ENVIRONMENTAL EFFECT EVALUATION

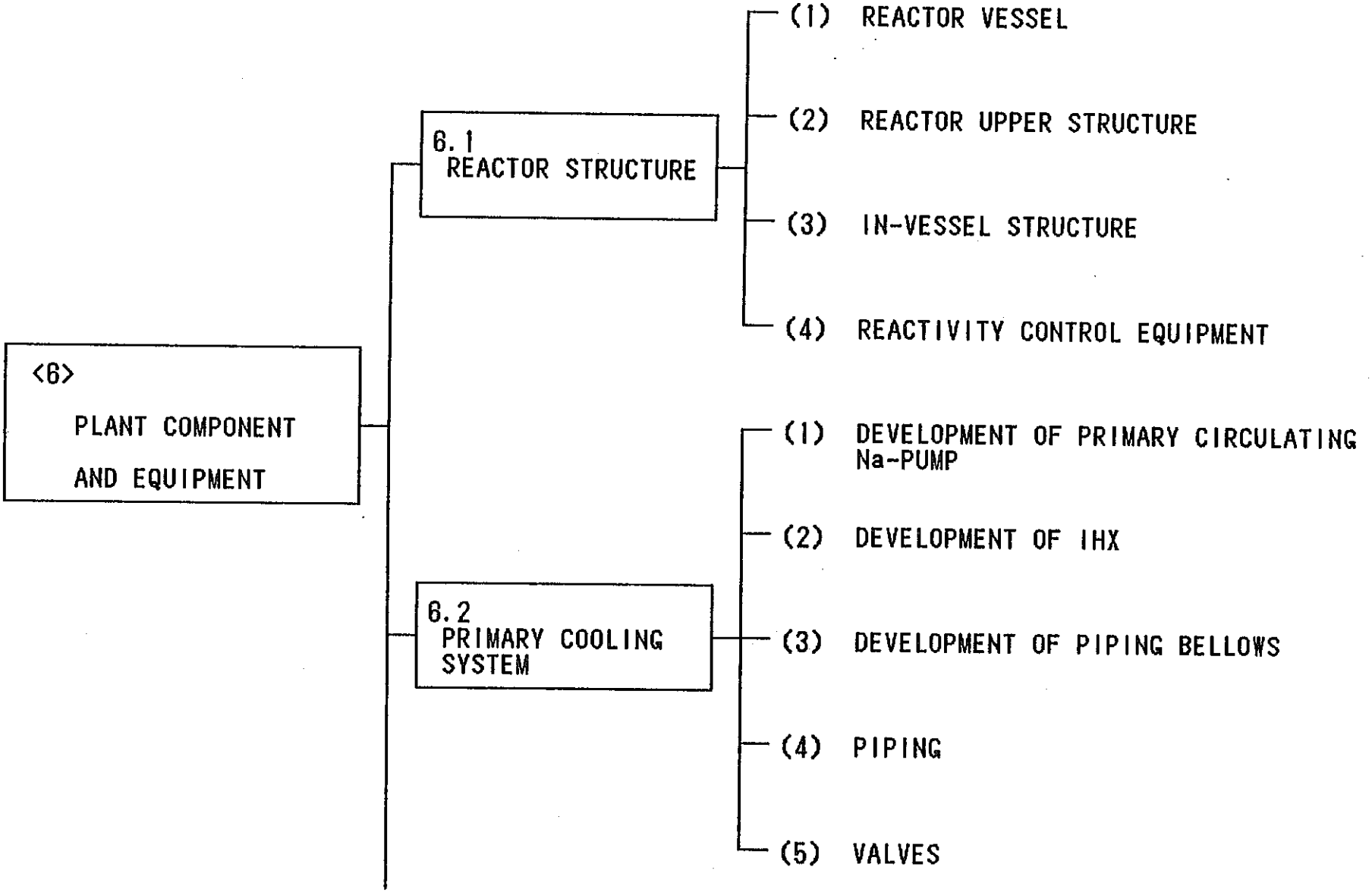
R&D THEME (4)


<4> SEISMIC STUDY
(1) IMPROVEMENT OF DESIGN AND ANALYSIS METHOD
(2) SEISMIC TESTS OF COMPONENTS
(3) SEISMIC TESTS OF STRUCTURES
(4) SEISMIC ISOLATION
(5) IMPROVEMENT OF BUILDING STRUCTURES

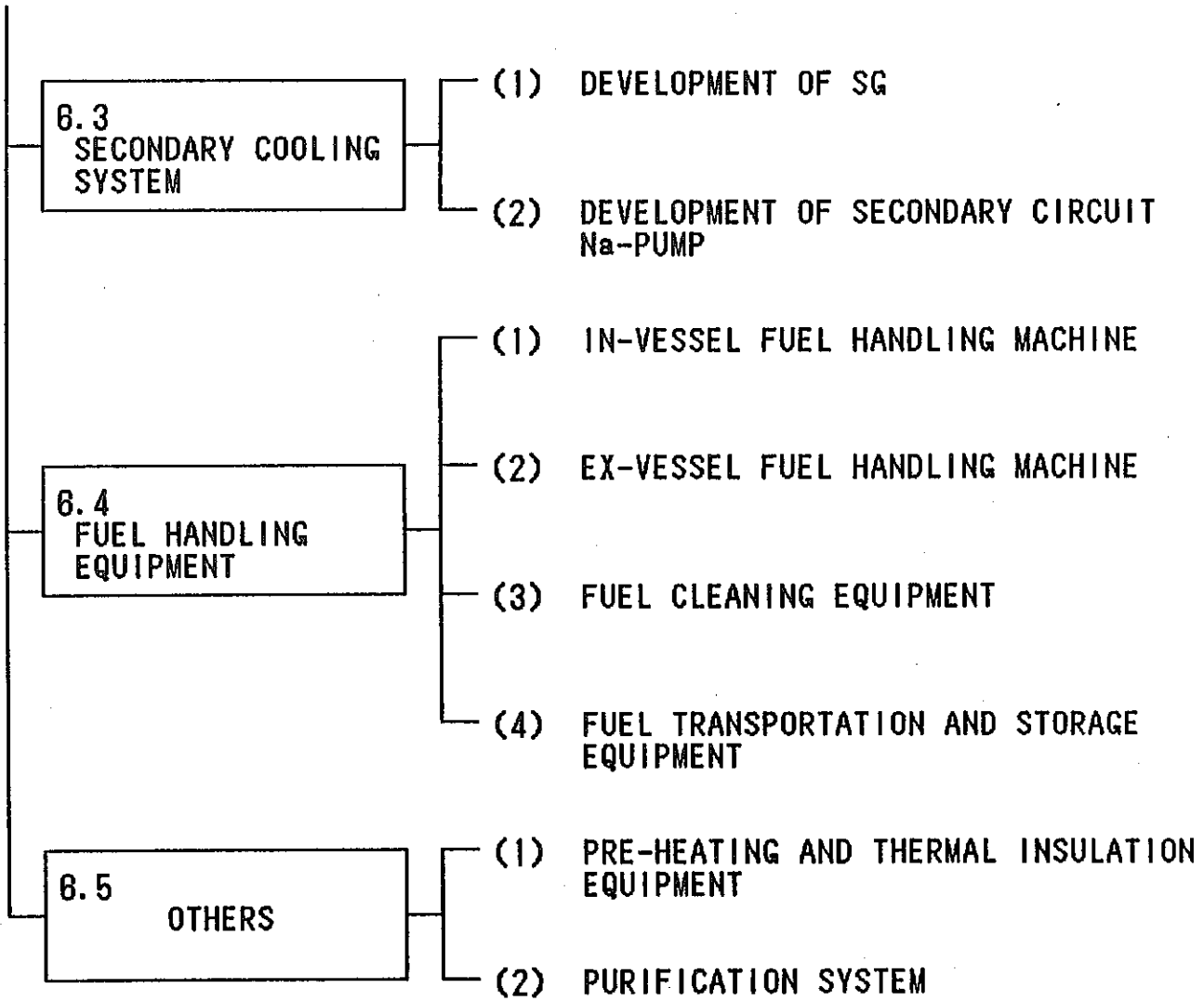
R&D THEME (5)


<5> CORE AND FUELS
(1) CORE CONCEPT
(2) INPROVEMENT OF NUCLEAR DESIGN METHOD
(3) DYNAMICS AND CORE SAFETY
(4) SHIELDING
(5) CORE ELEMENTS
(6) ELONGATION OF FUEL LIFE
(7) OPERATING RELIABILITY EVALUATION
(8) IMPROVEMENT OF FUEL DESIGN METHOD
(9) RESEARCH ON ADVANCED FUELS

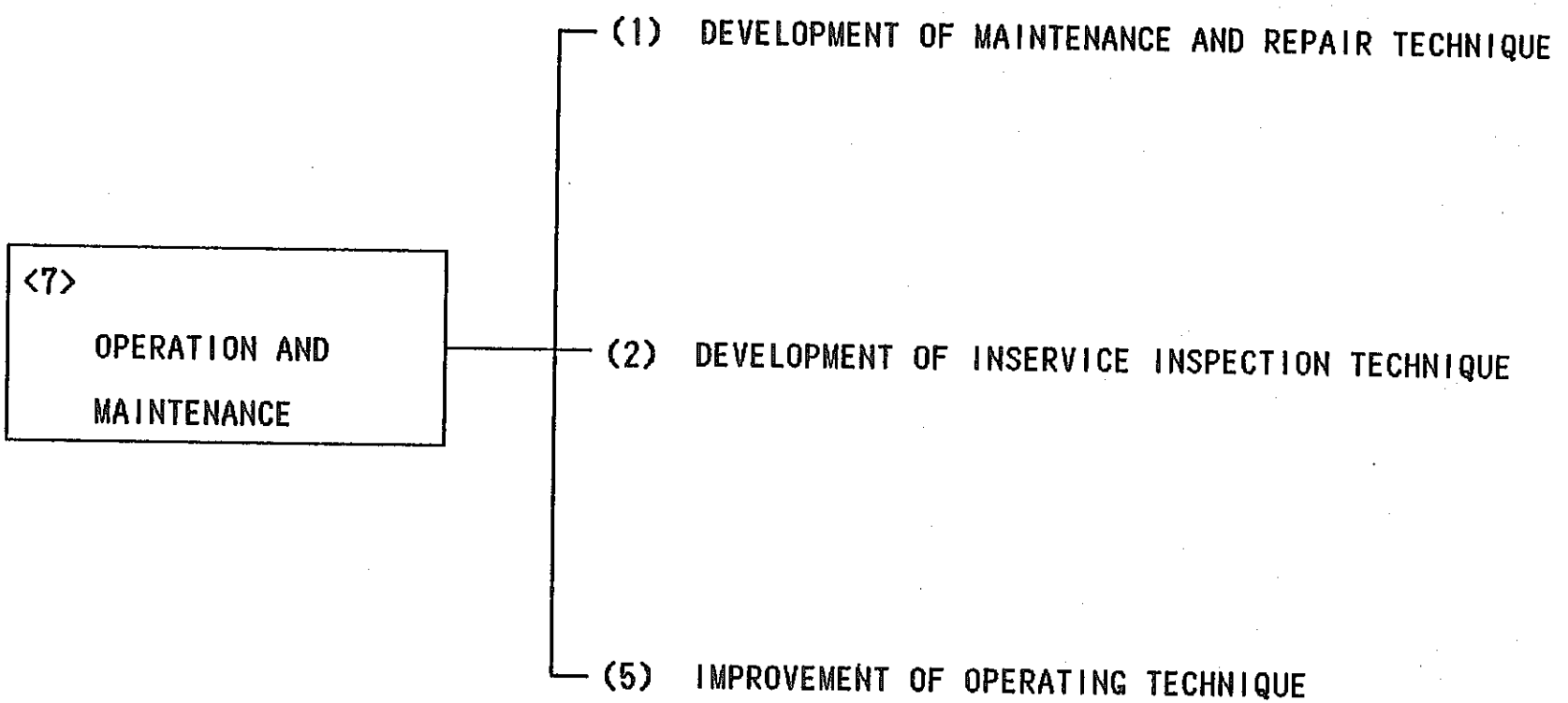
R&D THEME (6)-1


<6>
PLANT COMPONENT
AND EQUIPMENT
6.1
REACTOR STRUCTURE
(1) REACTOR VESSEL
(2) REACTOR UPPER STRUCTURE
(3) IN-VESSEL STRUCTURE
(4) REACTIVITY CONTROL EQUIPMENT
6.2
PRIMARY COOLING
SYSTEM
(1) DEVELOPMENT OF PRIMARY CIRCULATING Na-PUMP
(2) DEVELOPMENT OF IHX
(3) DEVELOPMENT OF PIPING BELLOWS
(4) PIPING
(5) VALVES

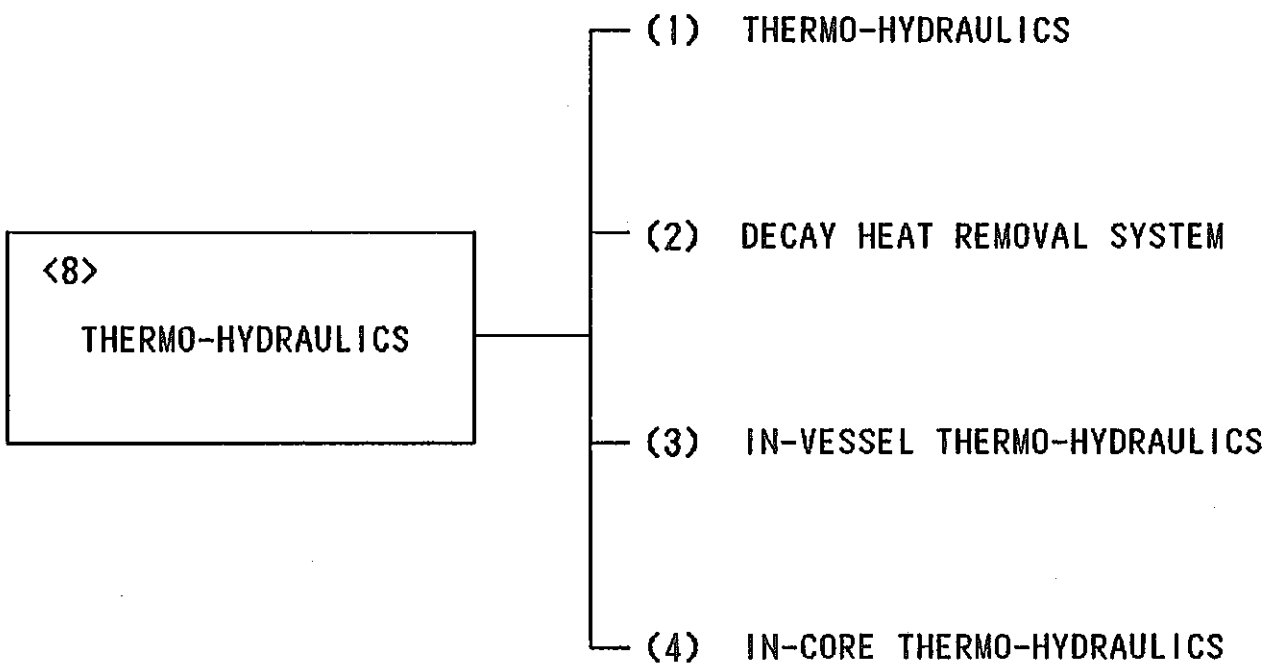
R&D THEME (6)-2


6.3
SECONDARY COOLING SYSTEM
(1) DEVELOPMENT OF SG
(2) DEVELOPMENT OF SECONDARY CIRCUIT Na-PUMP
6.4
FUEL HANDLING EQUIPMENT
(1) IN-VESSEL FUEL HANDLING MACHINE
(2) EX-VESSEL FUEL HANDLING MACHINE
(3) FUEL CLEANING EQUIPMENT
(4) FUEL TRANSPORTATION AND STORAGE EQUIPMENT
6.5
OTHERS
(1) PRE-HEATING AND THERMAL INSULATION EQUIPMENT
(2) PURIFICATION SYSTEM

R&D THEME (7)


<7>
OPERATION AND
MAINTENANCE
(1) DEVELOPMENT OF MAINTENANCE AND REPAIR TECHNIQUE
(2) DEVELOPMENT OF INSERVICE INSPECTION TECHNIQUE
(5) IMPROVEMENT OF OPERATING TECHNIQUE

R&D THEME (8)


<8>
THERMO-HYDRAULICS
(1) THERMO-HYDRAULICS
(2) DECAY HEAT REMOVAL SYSTEM
(3) IN-VESSEL THERMO-HYDRAULICS
(4) IN-CORE THERMO-HYDRAULICS

R&D PLAN OF EACH ORGANIZATION FOR FY 1987

SYSTEMS

J A P C	P N C	J A E R I	C R I E P I
○ EXAMINE SYSTEMIZATION OF INNOVATIVE TECHNOLOGIES. ○ STUDY PLANT CONCEPT WITHOUT INTERMEDIATE CIRCUITS. ○ STUDY PLANT CONCEPT "INHERENTLY SAFE"	○ STUDY BASIC DESIGN PARAMETERS FOR DEMO.		○ EXAMINE INNOVATIVE STRUCTUAL CONFIGURATION IN REACTOR VESSEL.

R&D PLAN OF EACH ORGANIZATION FOR FY 1987

SYSTEMS (CONTINUED)

J A P C	P N C	J A E R I	C R I E P I
○ ASSESS TOP-ENTRY PIPING. ○ PERFORM PRELIMINARY DESIGN OF LARGE THERMO-HYDRAULICS RIG. ○ CONDUCT IN-VESSEL THERMO-HYDRAULICS TEST FOR DHRS IN WATER. ○ CONDUCT IN-VESSEL THERMO-HYDRAULICS ANALYSIS (WITH SPX-1). ○ CONDUCT HEAT TRANSPORT SYSTEM ANALYSIS (WITH PFR).	○ INITIATE CODE DEVELOPMENT FOR IHX-LESS PLANT. ○ CONTINUE SYSTEMATIZATION OF SAFETY-RELATED THERMO-HYDRAULICS CODES. ○ DEVELOP NAT. CONV. DHRS (DRACS, FLOW DIODES) ○ CONDUCT TESTS FOR THERMAL FLUCTUATIONS AND DEVELOP CODE. ○ CONDUCT TEST FOR INTER-SUBASSEMBLY HEAT TRANSFER. ○ IMPROVE & VALIDATE THERMO-HYDRAULICS WITHIN SUBASSEMBLY.		○ ASSESS NAT. CONV. DHR CAPABILITY WITHIN TANK. ○ PERFORM FEASIBILITY STUDY OF NAT. DRAFT DHRS. ○ CONDUCT TESTS FOR IN-VESSEL・THERMO-HYDRAULICS. ○ STUDY FLUID-STRUCTURE INTERACTION. ○ CLARIFY PROBLEMS IN THERMAL STRIPING.

R&D PLAN OF EACH ORGANIZATION FOR FY 1987

SAFETY

J A P C	P N C	J A E R I	C R I E P I
○ EXAMINE & CODIFY SAFETY DESIGN CRITERIA. ○ STUDY PRELIMINARY CHANNEL BLOCKAGE PHENOMENA IN SUBASSEMBLY.	○ EXAMINE SAFETY ASSESSMENT CRITERIA. ○ RBCB PROGRAM AT EBR-II. ○ CLARIFY PHENOMENOLOGIES IN SUBASSEMBLY ACCIDENT (SCARABEE). ○ ASSESS PHENOMENOLOGIES IN ATWS SEQUENCE (CABRI, TRAN/STAR). ○ ASSESS PHENOMENOLOGIES IN LOHRS SEQUENCE. ○ ASSESS PHENOMENOLOGIES IN PAHR. ○ EVALUATE DEBRIS-CONCRETE REACTION. ○ ENHANCE PSA TECHNIQUES FOR MONJU. ○ CONTINUE TO AMASS RELIABILITY DATA IN CREDO. ○ STUDY CONSEQUENCES OF IHX-LESS SYSTEM.		○ ASSESS BIOLOGICAL EFFECTS OF Na AEROSOLS.

R&D PLAN OF EACH ORGANIZATION FOR FY 1987

STRUCTURES AND MATERIALS

J A P C	P N C	J A E R I	C R I E P I
○ EXAMINE & MODIFY STRUCTURAL DESIGN CRITERIA.	○ DEVELOP STRUCTURAL INTEGRITY ASSESSMENT CRITERIA. ○ IMPLEMENT INELASTIC DESIGN METHODS. ○ IMPROVE STRUCTURAL ANALYSIS METHODS (BUCKLING, LARGE DEFORMATION ETC). ○ CONDUCT THERMAL TRANSIENT INDUCED STRENGTH TEST, ○ CONDUCT CRACK GROWTH TESTS. ○ ENLARGE MATERIAL PROPERTIES DATABASE.		○ APPLY INELASTIC ANALYSIS. ○ STUDY APPLICABILITY OF NON-LINEAR FRACTURE MECHANICS.

R&D PLAN OF EACH ORGANIZATION FOR FY 1987

SEISMICS

J A P C	P N C	J A E R I	C R I E P I
	○ DEVELOP METHODS TO LOWER FLOOR RESPONSE (ASEISMIC BUILDINGS). ○ DEVELOP ANALYTICAL METHOD FOR FLUID-STRUCTURE VIBRATION. ○ DEVELOP ASEISMIC DESIGN FOR COMPONENTS. ○ STUDY SEISMIC RESPONSE OF BELLOWS. ○ DEVELOP SUPPORTS WITH HIGH SEISMIC ATTENUATION.		○ DEVELOP DESIGN METHODS FOR LOW FLOOR RESPONSE. ○ DEVELOP METHOD FOR ASSESSING BUCKLING OF HIGH WALLED VESSELS. ○ EXAMINE COUNTERMEASURES AGAINST SLOSHING. ○ DEVELOP ASEISMIC SYSTEMS. ○ TEST ULTIMATE LIMITS OF THIN WALLS AND PIPING. ○ DEVELOP NEW PIPING SUPPORTS.

R&D PLAN OF EACH ORGANIZATION FOR FY 1987

CORE AND FUELS

J A P C	P N C	J A E R I	C R I E P I
○ EXAMINE CORE CONCEPTS. ○ IMPLEMENT CORE ANALYSIS TOOLS. ○ ASSESS JUPITER RESULTS (ZPPR) ○ ASSESS JASPER RESULTS (TSF) ○ EVALUATE LARGE CORE EXPERIENCE (WITH FRANCE)	○ DEVELOP CORE ANALYSIS TOOLS. ○ OPTIMIZE LARGE CORE. ○ CONDUCT JUPITER. ○ CONDUCT JASPER.	○ MAINTAIN & UPGRADE REACTOR PHYSICS DATA. ○ CONDUCT FCA EXPERIMENTS. ○ UPGRADE REACTOR PHYSICS & SHIELDING CODES.	○ EVALUATE FEASIBILITY OF METAL FUEL.
○ EVALUATE SAFETY CONSEQUENCE OF ROD WITHDRAWAL PLOBLEM. ○ DEVELOP NOVEL, LONG-LIFE FUELS. ○ CONDUCT PRELIMINARY STUDY OF NEW CORE CONFIQURATION.	○ IMPROVE FUEL DESIGN AND ANALYSIS CODES. ○ CONDUCT FUEL RELIABILITY & INTEGRITY TESTS.	○ CONDUCT BASIC RESEARCH ON CARBIDE, NITRIDE & MATAL FUEL.	○ DEVELOP ULTRA-LONG LIFE CORE CONCEPT.

R&D PLAN OF EACH ORGANIZATION FOR FY 1987

CONPONENTS

J A P C	P N C	J A E R I	C R I E P I
○ STUDY INSULATION OF REDAN IN TANK. ○ DEVELOP NEW CRD CONCEPTS. ○ DEVELOP SHORT CRDM. ○ CONDUCT PARTIAL MOCKUP TEST OF MAIN 1ry PUMPS. ○ STUDY SHROUD-INDUCER PUMPS. ○ STUDY INTEGRAL ONCE-THRU SG TUBES WITH MOD. 9 Cr-1 Mo. ○ CONDUCT PARTIAL TESTS FOR IHX-LESS SG.	○ EXAMINE THERMAL INSULATION OF PIPES THRU SHIELD PLUG. ○ COOPERATE WITH JAPC REGARDING NEW CRD. ○ DEVELOP CONCEPT FOR SMALLER MAIN 1ry PUMPS. ○ DEVELOP JOINTS FOR BELLOWS. ○ COOPERATE WITH JAPC REGARDING INTEGRAL SG. ○ BUILD UP WASTAGE DATA-BASE FOR HIGH Cr TUBES. ○ COOPERATE WITH JAPC FOR IHX-LESS SG.		○ EXAMINE FEASIBILITY OF UNCOOLED ROOF SLAB. ○ COOPERATE WITH JAPC FOR CAVITATION DAMAGE IN SHROUND-INDUCER PUMP. ○ CONDUCT THERMO-HYDRAULICS TESTS IN WATER FOR NON-CYLINDRICAL IHX. ○ CONDUCT WATER CHEMISTRY TESTS. (9 Cr vs SCC) ○ TEST HEAT TRANSFER TUBES OF BOOSTER SG. ○ EXAMINE FEASIBILITY OF FLOW-COUPLED, PANEL-TYPE SG.

R&D PLAN OF EACH ORGANIZATION FOR FY 1987

CONPONENTS (CONTINUED)			
J A P C	P N C	J A E R I	C R I E P I
○ STUDY FUEL HANDLING MACHINES. ○ STUDY FUEL TRANSFER MACHINES. ○ TEST DRY-CLEANING OF SUBASSEMBLIES. ○ EXAMINE CONCEPT OF HIGH-TEMPERATURE CONCRETE LINER SYSTEM.	○ DEVELOP BARE STORAGE OF SPENT FUEL IN WATER. ○ DEVELOP SYSTEMS FOR FFD AND ANOMALY DETECTION. ○ DEVELOP DETECTION SYSTEM FOR WATER LEAK IN SODIUM.		

R&D PLAN OF EACH ORGANIZATION FOR FY 1987

OPERATION & MAINTENANCE

J A P C	P N C	J A E R I	C R I E P I
	○ DEVELOP OPERATION & MAINTENANCE COMPUTERIZED SYSTEM. ○ EXAMINE METHODS FOR REDUCING PERSONNEL EXPOSURE (CCP, FP SUPPRESSION & DECONTAMINATION)		

5.6 RELATION BETWEEN GOVERNMENT AND PRIVATE SECTORS w.r.t. DFBR

1. CONSTRUCTION AND OPERATION

   PRIVATE UTILITIES ARE EXPECTED TO PLAY LEADING ROLE, BEING SUPPORTED BY THE GOVERNMENT

2. R&D

   PNC LEADS R&D ACTIVITIES, INCREASING ROLES OF PRIVATE SECTORS

PNC

BASIC PHILOSOPHY OF ALLOCATION

- SUPPORT FOR REACTOR TYPE DETERMINATION, DESIGN AND LICENSING ETC, UTILIZING ACCUMULATED EXPERIENCE AND TECHNICAL KNOWLEDGE THROUGH JOYO OPERATION AND MONJU DESIGN, CONSTRUCTION AND OPERATION

- BASIC RESEARCH AIMING AT FBR COMMERCIALIZATION FROM LONG RANGE VIEW

MAIN R&D ITEMS ALLOCATED

① BASIC TECHNOLOGY
② SAFETY RELATED TECHNOLOGY
③ DESIGN EVALUATION STUDY
④ TECHNOLOGY DEVELOPMENT RELATED TO FUEL AND REPROCESSING
⑤ OPERATING AND MAINTENANCE TECHNOLOGY UTILIZING JOYO AND MONJU EXPERIENCE
⑥ R&D WORK, UTILIZING OEC FACILITIES.

C R I E P I

BASIC PHILOSOPHY OF ALLOCATION

- BASIC STUDY SUPPORTING DFBR DESIGN WITH EXISTING POTENTIALS.

- FUTURE TECHNOLOGY DEVELOPMENT

MAIN R&D ITEMS ALLOCATED

① ASSEISMIC DESIGN
② SEISMIC ISOLATION
③ STRUCTURES AND MATERIALS
④ HEAT TRANSFER AND HYDRAULICS
⑤ COMPONENT DESIGN OPTIMIZATION

① FEASIBILITY OF METALLIC FUEL
② FEASIBILITY OF PYRO-REPROCESSING
③ INNOVATIVE REACTOR DESIGN CONCEPT
(EX. DOUBLE-POOL REACTOR, PANEL TYPE SG, FLOW COUPLER TYPE REACTOR AND ULTRA LONG-LIFE CORE)

JAERI

BASIC PHILOSOPHY OF ALLOCATION

○ BASIC AND LEADING RESEARCH USING EXISTING RESOURCES AND POTENTIALS

MAIN R&D ITEMS ALLOCATED

① BASIC SAFETY RESEARCH

② BASIC AND LEADING RESEARCH OF ADVANCED Pu FUELS (CARBIDE, NITRIDE, METALLIC)

JAPC

BASIC PHILOSOPHY OF ALLOCATION

- TO FULFILL DUTY AS INVESTOR OF DEMO PLANT, IMPLEMENT AND CONSOLIDATE R&D WITH AIDS OF DOMESTIC ORGANIZATIONS
- R&D SCOPES OF JAPC ARE FOCUSED ON THE ITEMS FOR SELECTING BASIC SPECIFICATIONS, IMPROVEMENTS OF SAFETY AND ECONOMY, FOR ASSISTING DESIGN, LICENSING, CONSTRUCTION, OPERATION AND MAINTENANCE WORK
- IMPROVEMENTS OF ECONOMY AND SAFETY OF COMMERCIAL FBR

MAIN R&D ITEMS ALLOCATED

① DESIGN STUDIES OF PLANT AND COMPONENTS
② TECHNOLOGY OF CONSTRUCTION, OPERATION AND MAINTENANCE
③ SAFETY RESEARCH AS INVESTOR OF DEMO PLANT
④ IMPROVEMENTS OF EQUIPMENTS AND SYSTEMS TO ATTAIN ECONOMY AND RELIABILITY
⑤ ENGINEERING DEVELOPMENT OF CORE AND FUELS TO ATTAIN PRACTICAL USE
⑥ TRIAL FABRICATION, IMPROVEMANT OF EQUIPMENTS AND MATERIALS
⑦ SUPPORT OF FABRICATION TECHNOLOGY
⑧ DEMONSTRATION TEST OF EQUIPMENTS AND SYSTEMS (GOVERNMENT SUPPORT EXPECTED)

6. ROLES OF JAPANESE UTILITIES IN FBR DEVELOPMENT

(UTILITIES' PHILOSOPHY)

(1) FBR UPON COMMERCIALIZATION, MUST BE COMPETITIVE WITH LWR. THUS EXTRAPOLATION OF CONVENTIONAL DESIGN CONCEPT IS NOT ENOUGH.

(2) DEPLOYMENT STRATEGY WILL BE ETABLISHED BY 1990. 2-3 DEMO PLANTS WILL BE BUILT TO DEMONSTRATE TECHNOLOGY AND ECONOMY IN STEPS, TILL FULL COMMERCIALIZATION ENVISAGED AROUND 2000.

(3) DEMOS MUST BE EXTRAPOLATABLE TO COMMERCIAL PLANTS. FIRST DEMO DISIGN WILL BE DETERMINED AROUND 1990, CONSTRUCTION IN LATE 90's AND OPERATION EARLY 2000s.

(4) FUTURE R&D MUST EMPHASIZE COOPERATION BETWEEN PRIVATE AND GOVERNMETAL SECTORS. UTILITIES MUST PLAY CENTRAL ROLE IN CONSTRUCTION OF DEMOS AND IN OVERALL COORDINATION.

(5) JAPC IS PRIMARILY RESPONSIBLE FOR CONSTRUCTION & OPERATION OF DEMO-1, AND ALSO FOR COORDINATION OF R&D DONE UNDER UTILITY FUNDS.

(6) DOMESTIC COOPERATION IS A NECESSITY FOR PROMOTING R&D FOR DEMOS. IN PARTICILAR, EFFECTIVE LINK BETWEEN JAPC AND PNC TO BETTER UTILIZE MANPOWER RESOURCES AND TO INTENSIFY R&D COMMUNICATION.

(7) ACTIVELY PURSUE INTERNATIONAL COLLABORATION WITH EFFECTIVE ROLES OF INDIVIDUAL ORGANIZATIONS UNDER UNIFIED PLANNING FOR R&D.

STATUS OF ACCEPTANCE OF ENGINEERS AND SCIENTISTS FROM
OTHER JAPANESE ENTITIES RELATING TO FBR DEVELOPMENT

ORGANIZATION	MANPOWER (JAN. 1987)			
	MONJU SITE		R&D, DEMOPLANT	
	FR. OTHER ENTITIES	TOTAL	FR. OTHER ENTITIES	TOTAL
JAPC *1	0	87	2	28
PNC	39	99	110	400
JAERI *2	0	0	0	20
CRIEPI	0	0	7	68

*1 : EXCLUDING ENGINEERS FROM OTHER UTILITIES

*2 : SOME ENGINEERS FROM MANUFACTURERS IN THE PAST

(1) P N C

D O E : ○ FUEL INTERGRITY TEST AT EBR-Ⅱ

○ CREEP TEST OF FUEL PIN AND TEST OF LONG-LIFE FUEL AT FFTF

○ JASPER PROGRAM AND JUPITER-Ⅲ PROGRAM

○ CREDO PROGRAM

N R C : ○ SIMMER AND CONTAIN CODES FOR SAFETY ANALYSIS

(2) J A P C

D O E : ○R&D PLAN FOR DOUBLE WALLED TUBE SG UNDER DISCUSSION

○INDIRECT COOPERATION TO JUPITER, JASPER PROGRAMS WITH PNC/DOE

EPRI／COMO : ○MOU FOR INFORMATION EXCHANGE

○FINANCIAL SUPPORT TO COOPERATIVE ACTIVITIES OF JAPANESE INDUSTRIES WITH AMERICAN INDUSTRIES

(3) J A E R I NONE

(4) C R I E P I

E P R I : ○ JOINT RESEARCH (11 THEMES AS OF FY 1986)

○ INFORMATION EXCHANGE AND EXCHANGE OF RESEARCHERS

STATUS OF COOPERATION

(1) P N C

- ○ COOPERATION AGREEMENTS BY JAPAN/GERMANY/FRANCE AND JAPAN/U.K.
- ○ IMFORMATION EXCHANGE AND JOINT RESEARCH
- ○ PROMOTION OF JOINT RESEARCH

(2) J A P C

- ○ CONTRACT R&D WORKS WITH EUROPEAN INDUSTRIES AND LABORATORIES

(3) J A E R I

- ○ COOPERATION AGREEEMENT BY JAPAN/U.K.

(4) C R I E P I

- ○ CONTRACT R&D WORKS WITH EUROPEAN INDUSTRIES AND LABORATORIES

LONG-TERM

(1) P N C

- ESTABLISHMENT OF R&D BETWEEN JAPAN AND EUROPEAN COUNTRIES, DEPENDING ON THE FUTURE DIRECTION
- PROMOTION OF COOPERATION AND ASSIGNMENT OF R&D BY JAPANESE STEERING COMMITTEE
- INTERNATIONAL WORK-SHARING AT PLANNING STAGE OF R&D

(2) J A P C

- CONTRACT RESEARCH AND CONDUCT JOINT RESEARCH FOR DEMO PLANT DEVELOPMENT

(3) J A E R I

- DEPENS ON ASSIGNMENT COORDNATION OF FUTURE FBR R&D PLAN BY JAPANESE ST. COM. FOR FBR R&D AND AGREEABLE INTERNATIONAL ARRANGEMENT.

(4) C R I E P I

- DEPENS ON ASSIGNMENT COORDNATION OF FUTURE R&D PLAN ON FBR BY JAPANESE ST. COM. FOR FBR R&D AND AGREEABLE INTERNATIONAL ARRANGEMENT.

USE OF PROPRIETARY INFORMATION

- DEPENDS ON AGREEMENTS

- DISSEMINATION OF INFORMATION IS RESTRICTED AS FOLLOWS :
  (UNLESS OTHERWISE MUTUALLY AGREED TO)

  IN JAPAN

  TO RECEIVING PARTY, AFFILIATED ORGANIZATIONS,
  GOVERNMENTAL ORGANIZATION, AND
  PRIME OR SUB-CONTRACTORS

  FOR FURTHERANCE OF FBR PROGRAMS

Operational Experience of JOYO

(1986. 12)

• Accumulated Reactor Operation Time	28,442 h
• Accumulated Heat Generation	2,031,359MW h
• Fuel Irradiation	
Maximum Fuel Burn Up Achieved	50,000MW d/ t
Number of Fuel Assemblies Discharged from Reactor Vessel	418 (Core Fuel)
• Number of Start Ups	396 (Including Critical Test)
• Number of Core Subassemblies Handled	1,428
• Number of Annual Inspections	6

IRRADIATION TEST PLAN OF INTA - 1

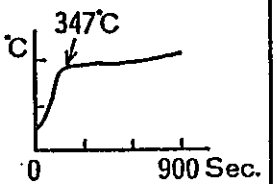
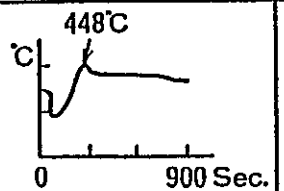
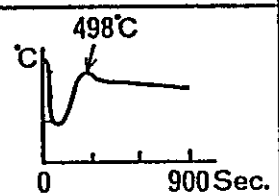
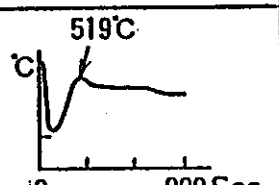
OBJECTIVES

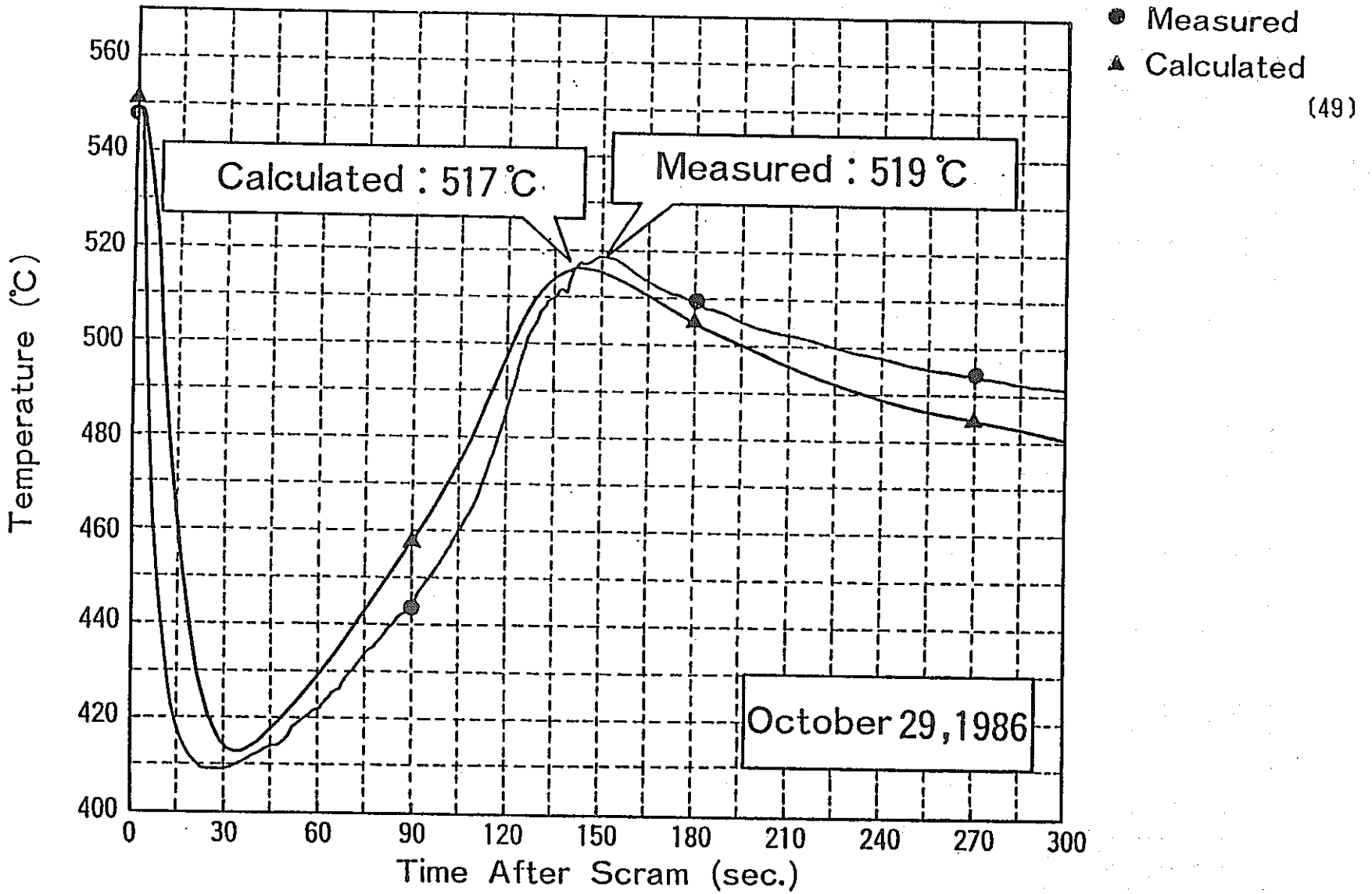
- EXAMINE INTA PERFORMANCE IN THE REACTOR
- MEASURE IRRADIATION BEHAVIOR OF "MONJU" SPECIFICATION FUEL.

IRRADIATION CONDITION

- POSITION IN THE CORE — 5F2
- PERIOD — 1985.12～1986.10 (225 EFPD)
- MAX. LINEAR HEAT RATE — 360 W / cm
- MAX. CLADDING TEMPERATURE — 675 ℃ (MID. WALL)
- MAX. FUEL TEMPERATURE
  - HOLLOWED FUEL WITH THERMO COUPLE — 2000℃
  - SOLID FUEL — 2200℃
- MAX. FLUENCE ($E \geqq 0.1$ MeV) — 3.1×10^{22} nvt
- MAX. BURN-UP (PIN AVERAGE) — 37000 MWD / T

JOYO Natural Circulation Test (MK-Ⅱ core)

Test		Test Conditions			Test Results		
		Power	Main Pumps		Central Subass. Outlet Temp.	Loop Flows	
			Pri.	Sec.		Pri.	Sec.
Steady State Test	TEST-ⅡA (84.10.22)	1 MW	15% Flow ↓ Stop	40% Flow ↓ Stop		~1 %	1~3%
Transient Test	TEST-ⅡB (85.4.27)	30MW ↓ Scram	100% Flow ↓ Stop	100% Flow ↓ Stop		~1.5%	~ 3 %
Steady State Test	TEST-ⅡC	2 MW	15% Flow ↓ Stop	40% Flow ↓ Stop	—	—	—
Transient Test	TEST-ⅡD (86.3.31)	75MW ↓ Scram	100% Flow ↓ Stop	100% Flow ↓ Stop		~2.3%	~4.3%
	TEST-ⅡE (86.10.29)	100MW ↓ Scram				~2.6%	~ 6 %



Coolant Outlet Temperature of Center Fuel Assembly
Natural Circulation Test Ⅱ-E (100MW Transient Test)

PROTOTYPE FAST BREEDER REACTOR "MONJU"

- SITE LOCATION : SHIRAKI DISTRICT, TSURUGA CITY, FUKUI PREF. ~400KM WEST OF TOKYO

- UTILIZING EXPERIMENTAL, TEST AND OPERATING DATA FROM EXPERIMENTAL JOYO REACTOR AND OTHER OEC TEST FACILITIES

- HISTORIC MILESTONES

  1968 : DESIGN START OF MONJU

  1970 : SHIRAKI AREA CHOSEN AS A PROSPECTIVE SITE

  1982 : COMPLETION OF ENVIRONMENTAL ASSESSMENT BY FUKUI RREF. & GOVERNMENT

  1983 : SAFETY APPROVAL OF MONJU CONSTRUCTION

  1984 : CONTRACT TO FOUR MAIN COMPONENT MANUFACTURERS

  1984 : INITIAL APPLICATIONS FOR APPROVAL OF DESIGN AND CONSTRUCTION PROCEDURES (STA & MITI)

PRESENT STATUS OF MONJU (DECEMBER, 1986)

- STA COMPLETED 4TH STEP LICENSING APPLICATION
- MITI IS EXPECTED TO ISSUE APPROVAL OF 5TH STEP SHORTLY
- OVERALL PLANT CONSTRUCTION PROGRESS IS 24.1% COMPLETE
  - — R/B AND A/B MAT CONCRETE COMPLETED
  - — C/V COMPLETED TO LEVEL OF POLAR CRANE AND THE POLAR CRANE INSTALLED

MONJU CONSTRUCTION MILESTONES

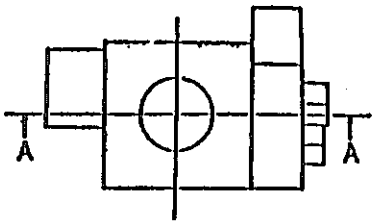
1. COMPLETED MILESTONES

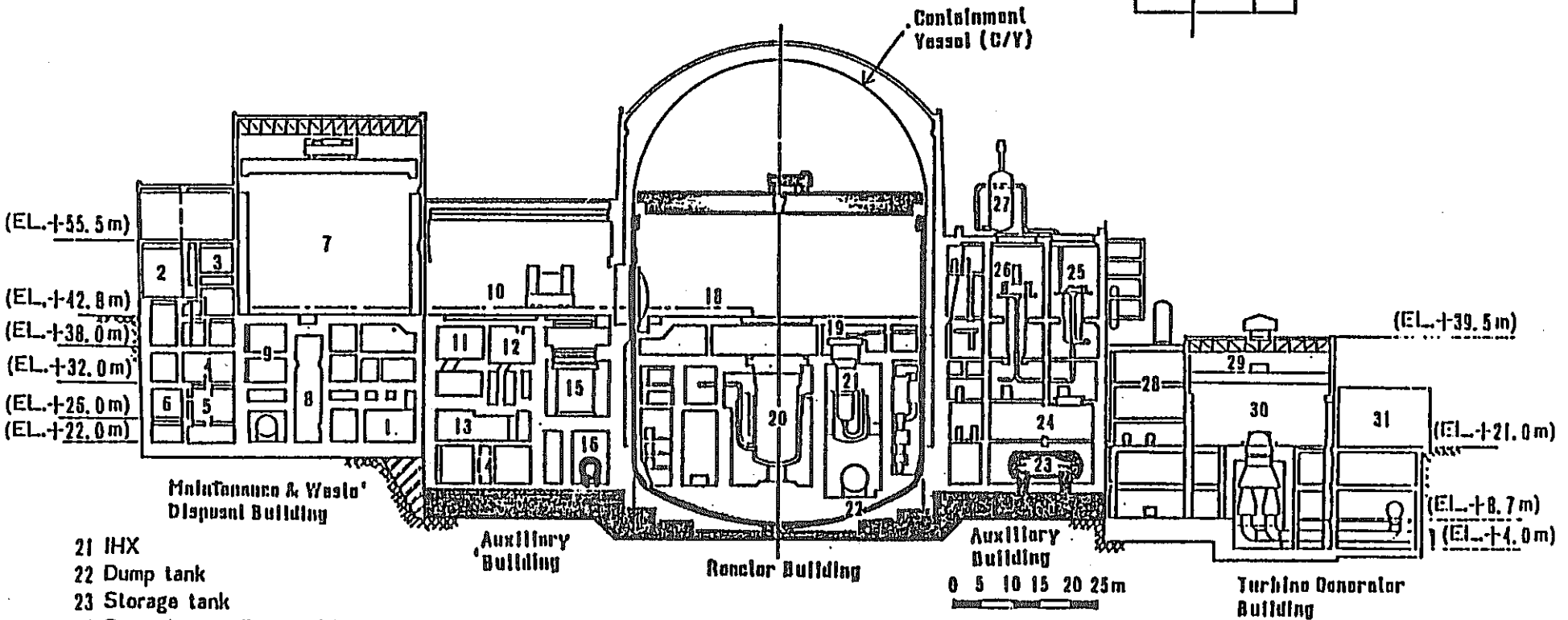
'83. 1	START CONSTRUCTION OF SEASIDE ACCESS ROAD
'85.10	START REACTOR BUILDING EXCAVATION
'86. 1	INSPECTION OF BEDROCK FOR REACTOR BUILDING
'86. 4	START TRANSPORTATION OF C/V PARTS TO SITE
'86. 7	START C/V ERECTION

2. FUTURE MILESTONES

'87. 4	COMPLETE C/V ERECTION
'88.10	SET REACTOR VESSEL
'91. 4	COMPLETE COMPONENT INSTALLATION
'91. 5	START PRE-OPERATIONAL TESTING
'92.10	CRITICALITY

1 Ventilator and conditioner room
2 Maintenance room
3 Switchgear room
4 Monitor tank room
5 Miscellaneous waste collector tank room
6 Concentrated miscellaneous waste tank room
7 Maintenance area
8 FHM cleaning room
9 Cleaning ventilation system room
10 Ex-vessel transfer machine room
11 Fuel canning room
12 Fuel cleaning room
13 Fuel inspection equipment room
14 Gaseous radwaste processing system room
15 EVST
16 Sodium overflow tank
17 Polar crane
18 Operation floor
19 IHX head area
20 Reactor vessel



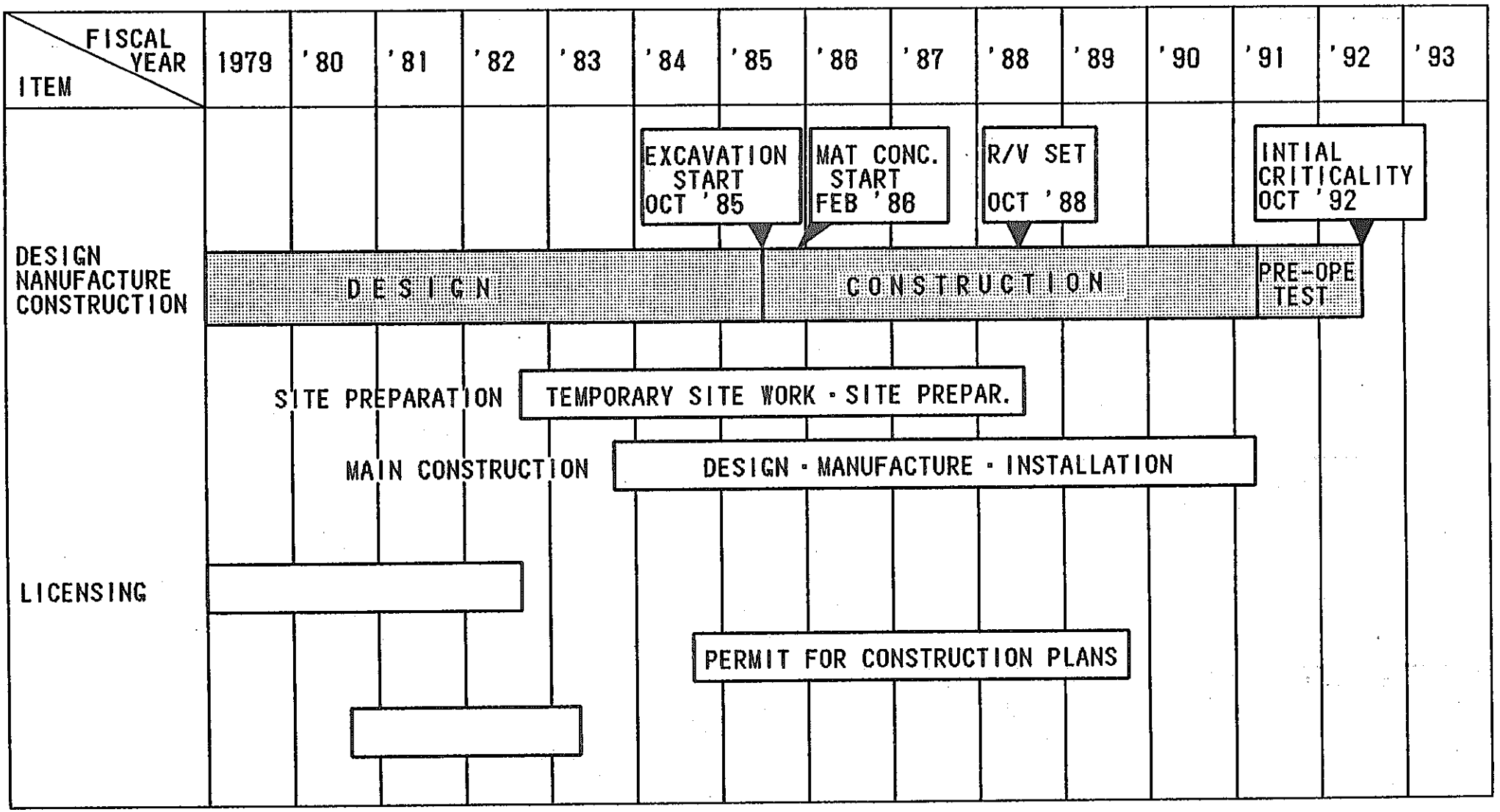


21 IHX
22 Dump tank
23 Storage tank
24 Secondary sodium purification system room
25 Super heater
26 Evaporator
27 Reaction product storage tank
28 Switchgear room
29 Crane
30 Turbine generator
31 Transformer area

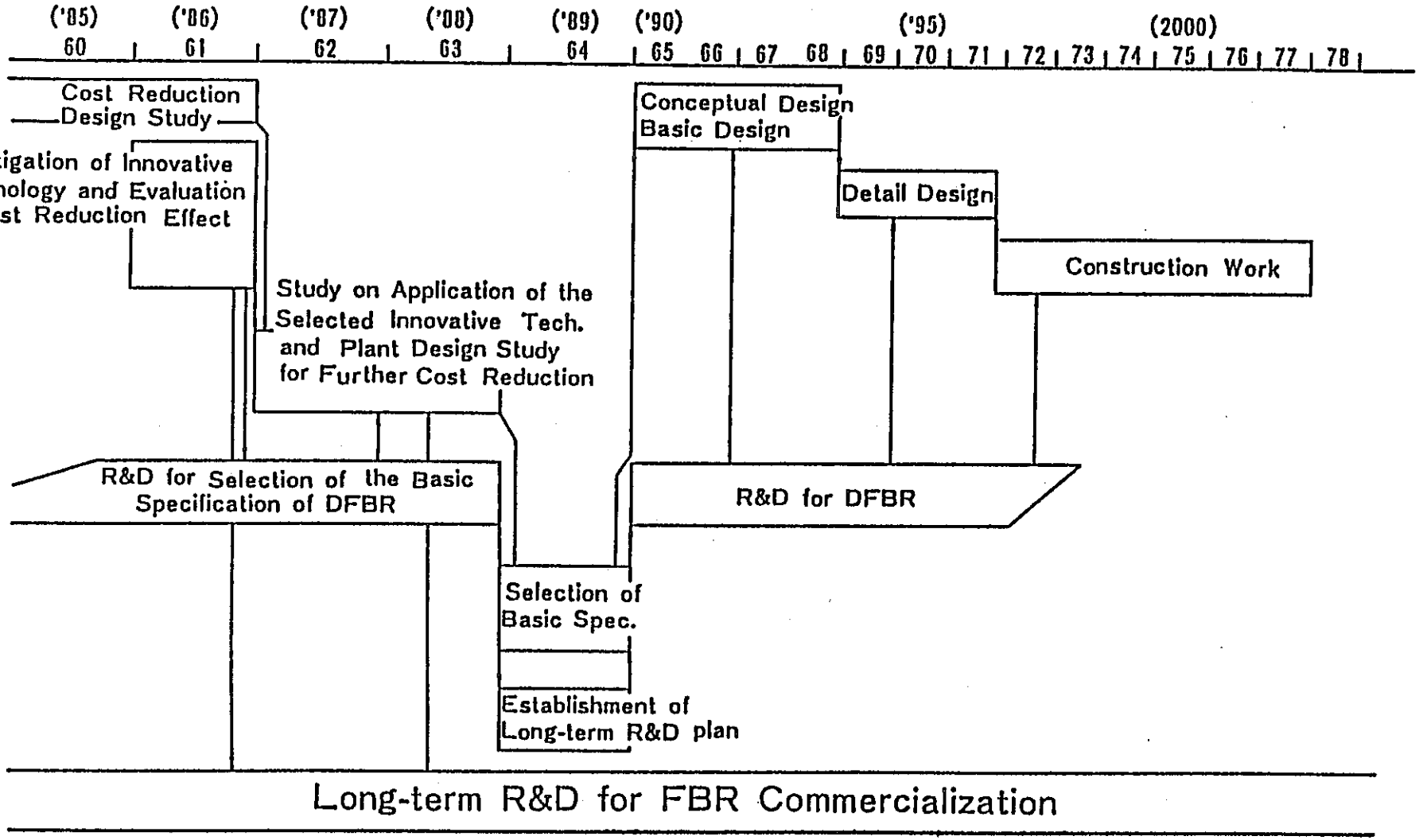
Note: Completed construction is indicated by the shaded areas.

MONJU CONSTRUCTION STATUS — DECEMBER, 1986

CONSTRUCTION SCHEDULE OF "MONJU"



SCENARIO OF DFBR DEVELOPMENT



PROGRESS IN SYSTEM DESIGN

CONTEMPLATED IDEAS FOR DIMINISHING MATERIALS QUANTITY

(AT THE START OF COST REDUCTION DESIGN)

TARGET DECREASE DISTANCE BETWEEN REACTOR AND SG,
REACTOR AND SG WITHIN 35M DIAMETER AREA

LOOP TYPE

LEVEL I : MODERATE IMPROVEMENTS IN DESIGN CONCEPTS TO DIMINISH PIPE LENGTH, CONTAINMENTS SIZE

- A. IMPROVED PIPING LAYOUT
- B. FLOATING SUPPORT OF PIPING
- C. TOP ENTRY SYSTEM
- D. EXPANSION BELLOWS IN PIPES

LEVEL II : CONCEPTS OF INTEGRATED PRINCIPAL COMPONENTS IN HEAT TANSPORT SYSTEMS

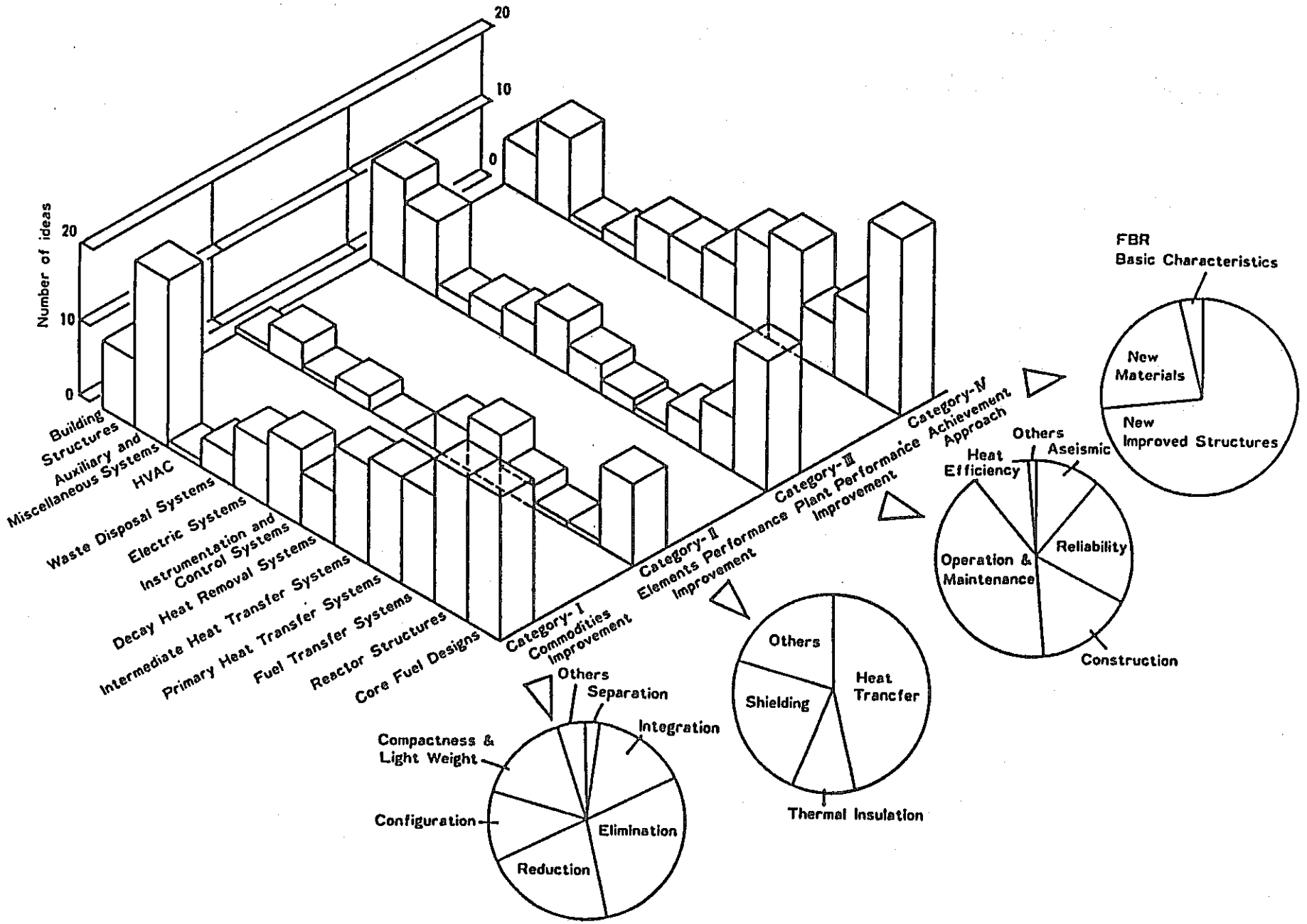
- A. UNITE IHX AND SG
- B. UNITE IHX, SG AND PUMP
- C. UNITE SG AND PUMP

LEVEL III : SECONDARY HEAT TRANSPORT SYSTEM ELIMINATATION

- A. INSTALL SG SEPARATELY IN EACH PIT
- B. INSTALL DOUBLE WALL SG

POOL TYPE CONCENTRATE ON DECREASING REACTOR VESSEL SIZE BY REDUCTION OF REACTOR INTERNALS (1～2 METERS), AND OF SECONDARY PIPING LENGTH

DISTRIBUTION OF DEVELOPED INNOVATIVE IDEAS



COST REDUCTION DESIGN STUDIES

① OVERALL GOAL : A CONST. COST WHICH LEADS TO 1.1 TIMES OF LWR UPON COMMERCIALIZATION

② LOOP TYPE — TOP ENTRY

③ POOL TYPE — (CORE SUSPENSION FROM TOP)
SUPPLEMENT — SEISMIC ISOLATION OPTION

④ COST ESTIMATION BY COMMAND-COST CODE
DEVELOPED BY JAPC-KHI-RI-BECHTEL

⑤ REF. DESIGN-1983 LOOP 1000MWe >3.0×LWR

INNOVATIVE DESIGN FEATURES OF ELEMENTS AND THEIR COST EFFECTIVENESS

IMPLEMENTED BY TOSHIBA, HITACHI AND MHI ; EACH GROUP EXPLOITED 130～170 FEATURES, AND ELECTED 30～40 FEATURES FOR STUDY

	TOS.	HI.	MHI.	TOTAL
① CORE AND FUEL	7	4	3	14
② REACTOR STRUCTURE	10	7	6	23
③ HEAT TRANSPORT SYSTEMS	12	12	9	33
④ FUEL HANDLING	2	3	5	10
⑤ INST. AND CONTROL	6	-	-	6
⑥ BUILDING	3	4	7	14
	40	30	30	100

TASK SUPPORT FOR SELECTING BASIC SPEC.

SUBJECTS WHICH HELP PRECLUDE HCDA FROM DESIGN BASE, SUCH AS

① INNOVATIVE REACTOR SHUTDOUN SYSTEM

② COMMON CAUSE FAILURE

③ LOCAL FAULT EVENTS IN FUEL S/A

TASK SUPPORT FOR STRUCTURAL INTEGRITY

KEY TECHNOLOGY AREAS TO ACCOMPLISH COST REDUCTION DESIGNS OF TOP ENTRY LOOP AND POOL TYPES

① LOOP — ENGINEERING OF KEY TECHNOLOGIES OF TOP ENTRY SYSTEM

② POOL — CORE SUSPENSION CYLINDER, AXIALLY HETERO. CORE, RAD. SHIELD IN REACTOR VESSEL

TASK SUPPORT FOR COMMERICIALIZATION IN LONG RANGE

① MATERIALS OF SG, 9Cr-1Mo(M)

② DOUBLE WALL STEAM GENERATOR, ORIGINAL BOILER TUBE DEVELOPMENT

③ SHROUDED INDUCER PUMP

④ HIGH BURNUP CORE & FUEL ~200,000MWD/T

⑤ ALTERNATIVE FUEL CYCLE, POTENTIAL OF METAL FUEL CYCLE

⑥ ADVANCED FUEL HANDLING SYSTEM

SAFETY, RELIABILITY, ECONOMY

TRAGET FOR FBR COMMERCIALIZATION

1. CONSTRUCTION COST REDUCTION FOR ECONOMICAL COMPETITION WITH LWR

2. TARGETS FOR COMMERCIAL FBR
   (1) ELECTRICITY COST : LESS THAN LWR
   (2) CONSTRUCTION COST : LESS THAN 1.1 TIMES OF LWR
   (3) BURNUP : MORE THAN 150,000MWD/T

3. TARGETS FOR DFBR
   (1) CONSTRUCTION COST : A COST WHICH LEADS TO 1.1 TIMES OF LWR UPON COMMERCIALIZATION
   (2) SAFETY : SAME LEVEL AS LWR
   (3) OPERABILITY & MAINTENABILITY : SAME LEVEL AS LWR

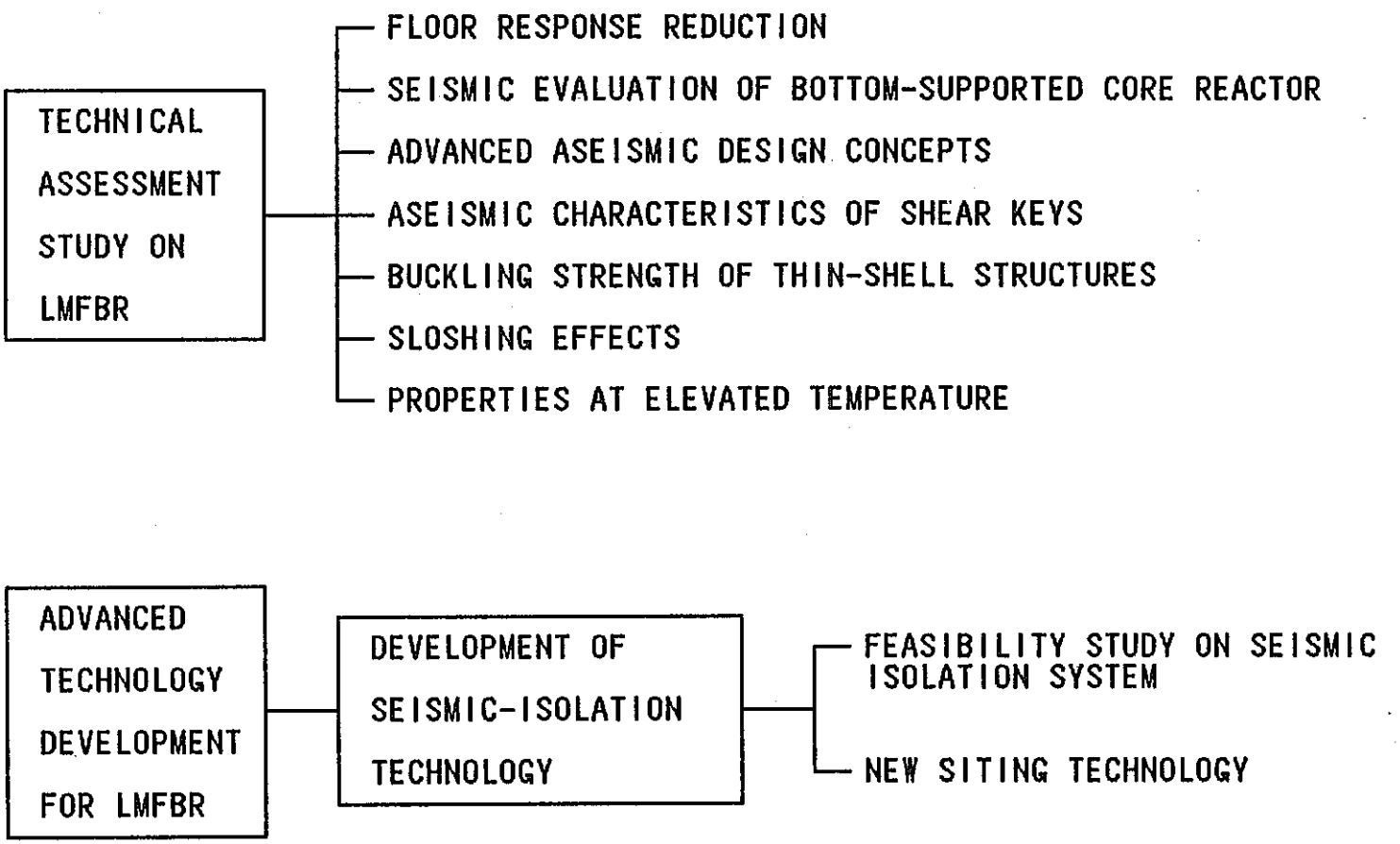
COMPARISION OF LOOP- AND POOL-TYPE REACTORS

1. ARGUMENTS ON SELECTION OF REACTOR CONCEPTS, LOOP- OR POOL-TYPE, ARE SUSPENDED IN JAPAN

2. LESS EXPENSIVE PLANT CONCEPTS ARE BEING EXPLORED FREE FROM THOSE EXISTING CONCEPTS

3. EXPLOITED CONCEPTS OF DEMO PLANT SHOULD ENVISAGE REQUIRED ECONOMY OF FUTURE COMMERCIAL PLANT

SEISMIC CONSIDERATIONS



STATUS OF ACCEPTANCE OF ENGINEERS AND SCIENTISTS FROM OTHER JAPANESE ENTITIES RELATING TO FBR R&D

ORGANIZATION	MANPOWER (JAN, 1987)									
	MONJU					R&D, DEMOPLANT				
	FR. OTHER ENTITIES				TOTAL	FR. OTHER ENTITIES				TOTAL
	GOV.	MANU.	OTHERS	*1		GOV.	MANU.	OTHERS	*1	
J A P C	0	0	0	0	87	0	0	2	2	28
P N C	2	2	16	20	99	1	86	19	110	400
J A E R I *2	0	0	0	0	0	0	0	0	0	20
C R I E P I	0	0	0	0	0	0	7	0	7	68

*1 : EXCLUDING ENGINEERS FROM OTHER UTILITIES

*2 : SOME ENGINEERS FROM MANUFACTURERS IN THE PAST

Postulated structures of Steering Committee on FBR R&D and Revision of Umbrella Agreements

(Under Preparation)