INTERNATIONAL WORKING GROUP ON PAST REACTORS

THIRTEENTH ANNUAL MEETING

Vienna, Austria
9-11 April 1980

SUMMARY REPORT
PART I
THIRTEENTH ANNUAL MEETING

Vienna, Austria
9-11 April 1980

SUMMARY REPORT
PART I
FOREWORD

The Thirteenth Annual Meeting of the IAEA International Working Group on Fast Reactors was held at the IAEA Headquarters, Vienna, Austria from 9 to 11 April 1980.

The Summary Report (Part I) contains the Minutes of the Meeting.

The Summary Report (Part II) contains the papers which review the national programme in the field of LMFBRs and other presentations at the Meeting.

The Summary Report (Part III) contains the discussions on the review of the national programmes.
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1. **Introduction**

The Thirteenth Annual Meeting of the IWGFR was held in accordance with the recommendation of the previous AGM, at the VIC, Vienna from 9 to 11 April 1980. The meeting was attended by the Member States of the group: France, the Federal Republic of Germany, Italy, Japan, the United Kingdom, the Union of Soviet Socialist Republics, and the United States of America, as well as by representatives from CEC, IAEA and OECD and an observer from India. The meeting was opened by Prof. I. Zheludev, Deputy Director General of the IAEA Department of Technical Operations and by Mr. H.-J. Laue, Director of the IAEA Division of Nuclear Power and Reactors. They informed the members about current IAEA programme planning considerations and requested that these be discussed and suitable recommendations made by the working group concerning the nature of the future activities of the IWGFR.

Mr. Laue announced the new members and alternates to the IWGFR that had been nominated by the Director General including Mr. M. Kempken and Mr. W. Marth for the Federal Republic of Germany and Mr. S. Rosen from the USA.

The List of Participants is attached to the Summary Report (Appendix 1). The meeting was presided over by Mr. K. Tomabechi, Japan. The Agenda was revised to include discussions of the future method of operation of the working group. The Agenda and Time Schedule of the meeting are given in Appendix 2. The items of the Agenda were discussed in turn and recommendations were made to the IAEA where appropriate.

2. **Approval of the Minutes of the Twelfth IWGFR Meeting (Item 1a)**

The Chairman suggested the approval of the Minutes of the Twelfth Annual IWGFR Meeting. It was so agreed.

3. **Report by Scientific Secretary Regarding Activities of the Group (Item 1b)**

The Review of the IWGFR activities for the period since the Twelfth Annual Meeting of the IWGFR was distributed in advance amongst the members of the Group and the Scientific Secretary mentioned only the changes which took place during the time after the distribution of the Review. The final version of the Review is given in Appendix 3.


The US member reported that the meeting will be well attended. A member of the organizing committee from the US reports that preparations for the conference are going well.

5. **International Conference on Breeder Reactors as a World Energy Resource and the Breeder Fuel Cycle, United Kingdom, 1981 (Item 2b)**

The UK member reported that the BNES is now proposing November 9, 1981, instead of Spring 1981 as a provisional date for the conference. The meeting location will be somewhere in the UK but outside of London.
It is planned that IWGFR members will be asked to provide overseas corresponding members of the organizing committee, which is now being set up. The proposed Agenda has been revised (see Appendix IV) in accordance with the discussions at the last annual meeting and will be sent to the organizing committee. The meeting is planned to emphasize broad aspects rather than detailed technology.

Mr. Laue informed the members that the IAEA is planning a major conference on nuclear power and its fuel cycle including fast breeder reactors. The conference has been recommended by the scientific advisory committee to be held early in 1983 and therefore the time schedule for the BNES conference is fully compatible.

6. IAEA Symposium on Design, Construction and Operating Experience of LMFBR Power Plants, 1984 (Item 2c)

The IWGFR members agreed that new data will be accumulated by mid-1984 on design, construction and operating experience of prototype and first-generation commercial LMFBRs including FFTF, JOYO, BN-600 and Super-Phenix so that 1984 will be an opportune time for convening a symposium on this topic.

The members expressed strong support for this conference and expressed a strong interest in participating in the organization of this symposium. It was agreed by the members that the question of location of the conference should be deferred until the next meeting of the Working Group.

7. Coordination of the Schedule for the Major Fast Reactor Meetings and other International Meetings having a Predominant Fast Reactor Interest (Item 2d)

Several meetings concerning conferences of fast breeder reactors were discussed by the members.

(a) An international conference on the safety of fast breeder reactors to be jointly sponsored by the ANS and the BNES is planned to be held in Lyons, France in the summer of 1982. This conference will follow the national ANS topical meeting on the same subject in Seattle, USA, August 1979. The members endorsed the conference and recommended to avoid having too many parallel sessions. Mr. Vautrey hopes to circulate to members some detailed information on the conference in the very near future and that the IWGFR would be asked to strongly support and assist the organizing committee. The members agreed that it would be very useful and that the IWGFR strongly supported the meeting.

(b) A national ANS topical meeting on "Probabilistic Reactor Safety and Related Physical Phenomena" will be held in the USA in September 1981. The meeting will include LMFBRs within its range of topics.

(c) A national topical meeting on "Chemistry of Liquid Metals in Fast Reactors" will be held by the University of Nottingham somewhere in the UK in 1982. It was noted that notice of national topical meetings is briefly presented as a matter of interest to the members but not discussed at length since they are not normally endorsed by the working group.

8. Consideration of the Future Matters of Operation of the IWGFR (Item 3)

The members were informed by the Secretariat of the impact of an increasingly stringent Agency budget on the planned future activities of IWGFR. The members were asked to consider reducing costs by reducing the frequency of the
group's meetings which until now have been held annually and to consider possible changes in the character of the meeting which might result in more useful products available to a broader set of users. The most significant budget factors were noted to be the cost of simultaneous translation of the annual meetings, and the publication cost of the reports of the specialists' meetings which have a very limited distribution. It was noted, however, that the major problem is that of defining priorities for the programmes competing for funds.

The topic was discussed by the members by first reviewing past and current activities and subsequently considering new activities or changes. The main conclusions and recommendations from the review of past and current activities were as follows:

(a) Review of National Programmes at Annual Meetings

The members recommended that review of the national programmes should be continued and members are obliged to prepare as complete a picture of their national programmes as possible, as has been done previously, but to restrict the presentations to important points of significance to the other members. It is also recommended that these reviews continue to be published as an internal IWGFR report.

(b) Specialists' Meetings

The members stressed the usefulness of the specialists' meetings and endorsed their continuation. It was recommended that three specialists' meetings per year should be planned.

The question of the cost of publication of the reports of specialists' meetings was raised by the IAEA. After discussion it was agreed that there could be some saving by minimising the number of and length of papers presented. It was in fact the original intention that it should not be necessary to produce special papers for specialists' meetings.

In future each delegation will produce a short summary paper outlining their national position. These papers, together with a summary of the meeting will be published by the IAEA in the same format as before.

Any additional information considered to be necessary by national delegates shall be published by the individual countries concerned and will be referenced in the IAEA summary publication, but will not be republished by the IAEA.

(c) Frequency of the IWGFR Meetings

In response to a request by the Agency to consider meeting less frequently rather than annually, the members strongly recommended to continue to hold the meetings of the IWGFR annually as in the past.

(d) Review Articles for Atomic Energy Reviews

The members were informed that it is anticipated that the publication of Atomic Energy Reviews will be discontinued, and therefore new review articles for publication are no longer being solicited. However, articles currently under preparation in accordance with previous agreements are expected to be published.
Review of Planned International Meetings

The members agreed that this activity at the annual meetings was a useful coordinating function and since no additional costs are involved that this activity should be continued.

The working group discussed possibilities for new activities or changes in its future activities. A number of aspects were discussed at length including the results of the INFCE as a source of important topics for future activities and the possibility of considering broad topics of wider public concern. The members noted that they had already placed considerable emphasis on dissemination of information to a large audience through Atomic Energy Reviews and they would no longer be able to use that mechanism. Mr. Laue informed the members that a suitable publication form could be an annual IAEA Technical Report containing a number of suitable individual reports of a general, scientific, or meeting summary nature.

The members found the question of improvements in future activities placed before them by the Agency to be difficult to respond to without having had sufficient time for adequate preparation.

Accordingly, the members agreed to ask the Agency to prepare a letter to Member States containing a clear set of options and asking for comments that can be discussed at the next meeting of the working group.

A number of specific suggestions were made. Dr. Smith informed the members that in the U.K. they are getting ready for a public inquiry into fast reactors and preparing written material for distribution to the public which might be used as a basis for preparing informative material for the IAEA by the working group.

9. Specialists' Meeting on In-Service Inspection and Monitoring of LMFBRs, Bensberg, Federal Republic of Germany, May 20-23, 1980 (Item 4a)

The member from the Federal Republic of Germany reported that preparations for the meeting are well underway and that there are no problems.

10. Specialists' Meeting on Demonstration of Structural Integrity under Normal and Faulted Conditions, Chester, United Kingdom, June 3-5, 1980 (Item 4b)

The member from the United Kingdom said preparations for the meeting were progressing well. He distributed details of the meeting and said that he had already received the names of some of the participants. He asked the remaining participants to make known their requests for accommodation to the UK organisers as soon as possible.

11. Specialists' Meeting on Design for Improved Safety Characteristics, Rome, Italy (Item 4c)

The Italian member proposed to change the date of this meeting from 1980 to Spring 1981 and a draft agenda was distributed as a basis for discussion. It was agreed to change the title of the meeting to "Core Design Features Affecting Dynamic Behaviour of Fast Reactor Cores" in order to concentrate attention on heterogeneous core design and closely related topics relevant to safe operation of fast reactors. The provisional agenda will be redrafted along these lines.
12. **IAEA Meeting on Gas-Cooled Fast Breeder Reactors, Minsk, USSR, 1981 (Item 4d)**

The USSR member informed the members that responsibility for consideration of the proposed meeting on gas-cooled fast breeder reactors had been transferred to the member of the International Working Group on Gas-Cooled Reactors (IWGGR, formerly called the IWG on High Temperature Reactors) because of the closer affinity of that working group to the gas-cooled breeder reactor. It is expected to be discussed at the next IWGGR meeting (now scheduled for January 1981). Consequently this meeting should not appear on the list of specialists' meetings of the IWCFR but should have a different classification.

13. **Meeting on Advanced Fuel for LMFBRs (Item 4e)**

At the 12th Annual Meeting of the IWGFR the members discussed the plans of the Nuclear Materials and Fuel Cycle Section of the IAEA to organize a consultants' meeting on advanced fuel for LMFBRs. Mr. Rybalchenko, Head of the Nuclear Materials and Fuel Cycle Section reported that the meeting took place 19-21 November 1979 in Vienna and summarized the resulting conclusions and recommendations which were sent to the Members (Appendix A). The UK member reported that little work was being done in the UK on carbide fuels and that their use was likely to be so far in the future that there was little urgency in having a meeting of this sort. Regarding the question of advanced structural materials, this question was partially covered by the Agency meeting in June 1979 so that it is not currently high on our priority. The French delegate reported no major activity in carbides and suggested that in the absence of any urgency, another consultants' meeting could possibly be held later. The member from the Federal Republic of Germany reported that the carbide program in his country has almost entirely stopped because of the considerations of closing the fuel cycle for oxides before the year 2000. In view of the small effort on advanced fuels and claddings they would be unable to contribute to a meeting on the subject.

It was generally agreed that there is no need at the present time to recommend a meeting in the field of advanced fuel for LMFBRs.

14. **Suggestions of the IWGFR on other Specialists' Meetings and their Justifications (Item 4f)**

A list of proposed topics for Specialists' Meetings is given in Appendix 4K and Justifications for them can be found in Appendix 4X.

As a result of the discussion on the list of topics for Specialists' Meetings, it was recommended that the IAEA should sponsor the following meetings in addition to the meetings which were endorsed above:

(i) **Fuel Failure Detection and Location**

It was recommended that this meeting be held at Karlsruhe, in the Federal Republic of Germany in April 1981.

(ii) **Boiling Noise Detection**

It was recommended that this meeting be held at Risley in the United Kingdom in June 1981.
(iii) Compatibility Problems between Sodium and Concrete

This meeting was recommended by the members but no date or place was selected at present. It was agreed that if someone wishes to host the meeting they should inform the Secretariat. The member from France suggested that his country might be considered as an alternative choice of location.

It was agreed by members that the list of topics to be considered for specialists' meetings should be reviewed and a new list be produced for consideration next year. Members agreed to send to the Secretary of IWGFR titles of three such specialists' meetings, together with their justifications by the end of July. The Secretary will then compile a new list which he will circulate to members in September, allowing time for consultations within the countries before the choice for the next few specialists' meetings is made at the next meeting of the working group.

15. Atomic Energy Review's Publication Programme (Item 5)

The Secretariat reported that the Agency plans to discontinue publication of Atomic Energy Review. The review papers that have been accepted and are under preparation will be published as planned provided that the remaining outlines that have not yet been submitted to the editor should be sent right away and the final manuscripts must be received before the end of the year at the very latest. The current status of the review papers is as follows:

The following review articles recommended by the IWGFR were published in the "Atomic Energy Review" in 1979:


Four review articles recommended by the IWGFR have been accepted and will be published in "Atomic Energy Review" this year:

1. Problems of Fast Reactor Physics Related to Breeding by V.V. Orlov, et. al.

Manuscripts for five review articles which topics were recommended by the IWGFR are being prepared for publication in the near future:

1. Fuel-Cladding Chemical Interactions by M.G. Adamson, USA.
4. **Equation of State of Materials of Relevance to the Analysis of Hypothetical Fast Breeder Reactor Accidents** by P.E. Potter, UK.

5. **Core Design and Analysis of Large LMFBR Heterogeneous Reactors** by B. Sicard, France.

16. **Inter-Comparison of Design for Safety of LMFBR Nuclear Power Plants (Item 6)**

Following discussion of this topic at the 12th Annual Meeting of the IWGFR a letter from Dr. Balz, CEC representative to the IWGFR, was sent by the Scientific Secretary to the members on 24 August 1979 transmitting a copy of a document on "CEC activities to harmonize safety criteria and safety guidelines", and outlining a proposed IAEA plan of work for comments by the members.

Dr. Balz, the CEC representative to the IWGFR, informed the members that good progress was being made on the work performed by the Safety Working Group of the CEC. Accident-oriented criteria and guidelines (system oriented criteria and guidelines will be considered later) will probably be concluded by mid-1981, and it was on the basis of this data that the Agency had proposed to hold a specialists' meeting on "Inter-comparison of Design Safety Criteria of LMFBRs" in October 1981. However, the CEC activities are not scheduled for completion much before the proposed meeting date, and the members agreed that the meeting would be premature. It was recommended to keep the meeting on the list but not to set a date at present and to reconsider the matter at the next IWGFR meeting.

Mr. Laue reported that the matter had been discussed by the Senior Advisory Group (SAG) of the IAEA NUSS Programme in March 1980. As regards fast reactor safety SAG recently endorsed publication of information by the IAEA in a form such as a technical report (on safety-related designation). It was decided that some years might elapse before the subject reaches the maturity necessary for SAG to advise in favour of expanding the NUSS programme to include fast reactors. It now feels that in the light of current development of this system that this question should be reviewed again in 1985.

It was agreed by the members that after the completion of the work in progress by the CEC that based on the results the IAEA should do some preliminary work which would then be reviewed by the working group and further work plans considered.

17. **Presentations and Discussions on National Programmes on Fast Breeder Reactors (Item 7)**

The national programmes of all the members were presented and discussed including India. These will be issued as Parts II and III of the Summary Report.

18. **Recommendation of the IWGFR regarding a Request of India concerning Participation in the IWGFR (Item 8)**

A request was received from India for membership in the IWGFR and an observer was invited to participate in the meeting and accordingly Mr. Paranjpe reported on his national programme for the development of fast breeder reactors.

The members recommended to the Director General that India should be a member of the IWGFR.
19. **The Date and Place of the Fourteenth Annual Meeting of the IWGFR (Item 9)**

It was recommended that the next IWGFR meeting should be held in Vienna, 31 March - 3 April 1981.
# List of Participants at the 13th Annual Meeting of the IWGFR

## FRANCE

<table>
<thead>
<tr>
<th>Name</th>
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Appendix II

Agenda and Time Schedule of the 13th Annual Meeting of the IWGFR

1. Review of IWGFR Activities:
   a. Approval of the Minutes of the Twelfth IWGFR meeting.
   b. Report by the Scientific Secretary regarding Activities of the Group.

2. Consideration of Conferences on Fast Reactors:
   d. Coordination of the schedule for the major fast reactor meetings and other major international meetings having a predominant fast reactor interest.

3. Consideration of future method of operation of the IWGFR

4. Consideration of a schedule for specialists' meetings in 1980-81:
   a. SM on In-Service Inspection and Monitoring of LMFBRs, Bensberg, Federal Republic of Germany, May 1980.
   b. SM on Demonstration of Structural Integrity under Normal and Faulted Conditions, Chester, United Kingdom, June 1980.
   c. SM on Design for Improved Safety Characteristics, Rome, Italy.
   e. Meeting on Advanced Fuel for LMFBRs.
   f. Suggestions of the IWGFR on other specialists' meetings and their justifications.

5. Atomic Energy Review's publication programme.

6. Consideration of the other IWGFR activities:
   Inter-Comparison of Design for Safety of LMFBR Nuclear Power Plants.

7. Presentations and Discussions on National Programmes on Fast Breeder Reactors.

8. Recommendation of the IWGFR regarding a request of India concerning participation in the IWGFR.

9. The date and place of the Fourteenth Annual Meeting of the IWGFR.
### Time Schedule
of the
13th Annual Meeting of the IWGFR

**9 April 1980**

<table>
<thead>
<tr>
<th>Time</th>
<th>Activity</th>
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<tbody>
<tr>
<td>9.30 a.m.</td>
<td>Opening of the meeting</td>
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<td>Discussion and approval of the time schedule of the meeting</td>
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<td>Approval of the Agenda and discussion of the Agenda items</td>
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<tr>
<td>11.00 a.m. - 11.20 a.m.</td>
<td>Break</td>
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<td>11.20 a.m. - 12.30 p.m.</td>
<td>Session</td>
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<td>12.30 p.m. - 2.00 p.m.</td>
<td>Lunch</td>
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<td>2.00 p.m. - 4.00 p.m.</td>
<td>Session</td>
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<td>4.00 p.m. - 4.20 p.m.</td>
<td>Break</td>
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<tr>
<td>4.20 p.m. - 5.30 p.m.</td>
<td>Session</td>
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<tr>
<td>7.00 p.m.</td>
<td>Dinner</td>
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**10-11 April 1980**

- Morning Sessions beginning at 9 a.m.
- Afternoon Sessions end at 5.30 p.m.
- Breaks at 11.00 a.m. and 4.00 p.m.
- Lunch at 12.00 - 2.00 p.m.
Review of the IWGFR Activities for the Period since the Twelfth Annual Meeting of the Group

Various activities of the International Atomic Energy Agency within the framework of the International Working Group on Fast Reactors have been carried out based on IWGFR recommendations made at the Twelfth or previous annual meetings (AGM) of the working group.

I. Specialists' Meetings

Since the last (Twelfth) Annual Group Meeting three Specialists' Meetings were held and five Specialists' Meetings are under preparation.

a) The Specialists' Meeting on Theoretical Modelling of LMFBR Fuel Pin Behaviour was held in Fontenay-aux-Roses, France from 28 May to 1 June, 1979. I would like to mention here some of the conclusions and recommendations of the meeting:

(1) It is worthwhile that contact continues to arrange verification of models against reference test data and hypothetical problems, which will increase confidence in the verification and establish agreement on the state-of-the-art and work to be done.

(2) The required accuracy in the modelling of the relevant details of the in-pile performance of advanced fuels is much higher than for oxide fuels.

Until recently modelling of advanced fuel was exclusively concerned with pellet fuels. However, first attempts are now being made to model the thermal conductivity of sphere-pack carbide fuel and oxide fuel. This certainly will lead to the development of more complete models and codes to describe the in-pile performance of this type of fuel especially during its first period in the reactor, when strong restructuring occurs.

(3) A code must provide the opportunity to be simplified to rough calculations according to very specific requirements. It must also be able to couple different processes when this is made necessary by experimental or theoretical results.

(4) Applicability to a wide range of fuel pin designs should be aimed at in order to analyse fissile as well as fertile pins.

(5) Independent development of different models (best estimate and conservative) on the same phenomenon provides the basis for an improved extrapolation of experimental experience.

b) The Specialists' Meeting on Bellows for Sodium Systems was held in Tokyo, Japan from 5 to 9 November 1979. I would like to mention only the general recommendations of the meeting:

It was a unanimous view that the exchanged information was very useful. There is varying scale of activity being conducted on bellows for sodium systems in the IWGFR member countries presented at the meeting. Most of the participants were of the opinion that the use of expansion joints in pipe-work systems might offer technical and/or cost advantage for large commercial fast reactors. They considered that a very important decision should be taken by most countries regarding the conceptual designs of commercial demonstration fast breeder reactors within 2 or 3 years time period. It was agreed that better techniques for validation of bellows integrity by analysis were required in order to ensure all aspects of safe operation throughout component life.
Therefore, a specialists' meeting on bellows for sodium systems is justified in 2 or 3 years and participants of the meeting recommended its organization.

c) The Specialists' Meeting on Carbon in Sodium was held at AERE Harwell, UK on 27-30 November 1979. It was agreed that the Specialists' Meeting on 'Carbon in Sodium' had proved valuable, particularly in highlighting topics on which further effort is required; these are identified throughout the summary report. It was recommended that a further meeting on the topic should be held in about 3-4 years, by which time substantial additional data should be available from R & D programmes at operating reactors in the represented countries.

d) The Specialists' Meeting on Sodium Flow Measurements in Large LMFBR Pipes was held in Bergisch Gladbach (Bensberg), FRG from 4 to 6 February 1980. The meeting was jointly sponsored by IWGNPCI and IWGFR. It was agreed that the provision of experimental full scale facilities and their subsequent operation was exceedingly expensive. There are therefore, strong reasons for collaboration in this particular field. It was proposed that the IAEA should consider sponsoring a collaborative research programme on sodium flow measurements in large pipes.

e) The Specialists' Meeting on Methods for Demonstrating Structural Integrity under Normal and Faulted Conditions is under preparation. The IAEA has received an official confirmation from the UK Authorities agreeing to host this meeting. The Information Sheet was sent to all IWGFR members for comments. We hope that Dr. R.D. Smith will distribute details of the meeting with an indication of a place and exact dates for holding the meeting.

f) The Specialists' Meeting on In-Service Inspection and Monitoring of LMFBRs is under preparation. The IAEA informed the Authorities of the Federal Republic of Germany that the Agency intends to hold a specialists' meeting on this topic in May 1980 and that Dr. Daunert has suggested that the meeting be held in Bensberg where Mr. G. Hendl from Interatom would be prepared to assist in local arrangements. General information and a Preliminary Agenda of the meeting was kindly submitted to the Scientific Secretary of the IAEA by Dr. Mausbeck and distributed amongst the IWGFR members in November 1979. It is scheduled to organize the meeting at Interatom on 20-23 May 1980.

g) The Specialists' Meeting on Design for Improved Safety Characteristics is under preparation. The IAEA sent a letter to the Italian Authorities enquiring whether they agree to host the meeting in question and requesting some organization details concerning the arrangements for this meeting. It is planned to organize this meeting in October 1980 and we hope that a preliminary agenda of the meeting will be distributed by Prof. Pierantoni at the 13th AGM.

h) The Specialists' Meeting on Gas Cooled Fast Breeder Reactors is under preparation. A special letter was transmitted to the USSR Authorities in August 1979 requesting them to host the meeting at the beginning of 1980. Dr. Royen informed us also that the NEA Co-ordinating Group on GCFR Development supported this meeting and agreed to take part in the preparation of the technical programme of the meeting and requested to investigate the possibility of including the Co-ordinating Group on GCFR Development in the list of sponsors of the meeting. We hope that the USSR member of the IWGFR will distribute a preliminary programme of the meeting and inform the IWGFR if formal co-sponsorship of the meeting by the NEA Co-ordinating Group on GCFR Development is possible.
II. Symposia and Conferences

Since the last (Twelfth) Annual Group Meeting two international conferences which were endorsed by the IWGFR, were held and two large international conferences are under preparation and will be held in 1980-1981.


(2) International Conference on Breeder Reactors as a World Energy Resource and the Breeder Fuel Cycle, United Kingdom, Spring 1981.

It was recommended at the 12th AGM that BNES sponsor the Conference on Fast Reactor Fuel Cycle in Spring 1981. We hope that Dr. Smith will distribute the second draft of the agenda of this conference for further members' comments and will also inform them on the exact place and dates for holding the conference.

IAEA Symposium on Design, Construction and Operating Experience of LMFBR Power Plants, 1984. The last IAEA Symposium on this topic was held in Bologna, Italy in April 1978. The symposium was attended by more than 330 participants from 26 countries and 3 international organizations. In view of the large scale of current development programmes on LMFBR in all the IAEA Member States participating in the IWGFR and new data to be accumulated by 1984 on design, construction and operating experience of prototype and first generation commercial LMFBRs, it seems likely and timely to also organize a symposium on this topic in 1984. We would like to hear the IWGFR recommendations regarding this proposal at the 13th AGM.

III. Publications

1. With regard to the Summary Reports of the Specialists' Meetings, the following were reproduced and distributed by the Agency amongst the IWGFR members and the participants of the corresponding meetings:

a) IWGFR/28. The Summary Report of the SM on Sodium Fires and Prevention (distributed in March 1979)

b) IWGFR/29. The Summary Report of the SM on Thermodynamics of Fast Breeder Reactor Fuel Sub-Assemblies under Nominal and Non-nominal Operating Conditions (distributed in December 1979)


d) IWGFR/32. The Summary Report of the SM on Bellows for Sodium Systems was submitted for reproduction in November 1979 and we are planning to distribute it in April 1980.

e) IWGFR/33. The Summary Report of the SM on Carbon in Sodium was submitted for reproduction in December 1979 and we are planning to distribute it in May 1980.

2. The Summary Report of the Twelfth Annual Meeting of the IWGFR consisted of three parts:

IWGFR/30-1 Part I - Minutes of the Meeting (distributed in May 1979)
IWGFR/30-2 Part II - Reviews of National Programmes (distributed in July 1979)
IWGFR/30-3 Part III - Discussions on the Reviews of the National Programmes (distributed in November 1979)

IV. Preparation of other Documents in the Framework of the IWGFR Activity:

1. IWGFR/14/Rev. 1. LMFBR Plant Parameters (distributed in March 1979)
2. IWGFR/27. Compilation of Piping Benchmark Problems - Cooperative International Effort. The document was compiled by W.J. McAfee, reproduced by the United States and distributed by the IAEA in August 1979.

3. The IWGFR members were informed at the 12th AGM that representatives of the FRG, UK and USA would complete their reassessments, which were recommended by the SM on Equation of State, of sodium data and Dr. Potter would report his conclusions to the IWGFR. Mr. Vautrey agreed to ensure that the requested information by Dr. Potter on the state of work in France would be sent to Dr. Potter as soon as possible. We would like to hear Dr. Smith's comments on the status of this comparison and the recommendations of the IWGFR concerning the publication of the results of this comparison.

V. Review Articles on LMFBR recommended for Publication

The following review articles recommended by the IWGFR were published in the "Atomic Energy Review" in 1979:


Four review articles recommended by the IWGFR were prepared and submitted for publication to the editor of "Atomic Energy Review":

1. Problems of Fast Reactor Physics related to Breeding by V.V. Orlov, et.al.

After receiving comments of external referees the editor will initiate the action for publication of the review articles in 1980.

Five review articles which were recommended by the IWGFR are under preparation:

1. Fuel-Cladding Chemical Interactions by M.G. Adamson, USA.
5. Core Design and Analysis of Large LMFBR Heterogeneous Reactors by B. Sicard, France.

We would like to hear the comments of the US, UK, FRG and French members of the IWGFR on the status of preparation of these articles.

VI. Intercomparison of Design Safety Criteria of LMFBRs

The IAEA plan of work on LMFBR safety criteria and guidelines was transmitted by the Scientific Secretary of the IWGFR with his letter of 24 August 1979 for the IWGFR members' comments. It was proposed that the IAEA would organize a specialists' meeting on this topic in October 1981. This proposal as well as the IWGFR members' comments and recommendations on the activity in this field will be discussed at the 13th AGM.
FIRST REVISED AGENDA

1. Invited paper on world power needs and the role of uranium power and uranium needs and resources.

2. Invited papers (15 minutes) on national attitudes to fast reactor fuel cycles.

3. Invited paper on INFCE consequences.

4. The LMFBR plutonium fuel cycle - economics and uranium demands. (Importance of fuel cycle time, plutonium losses, doubling time and inventory).

5. Impact on fuel cycle of alternative systems (e.g. GCFR, thorium cycle, U235 enrichment).

6. Fuel management in reactor (shuffling of core and breeder, including heterogeneous cores, but excluding neutron physics papers).

7. Fuel fabrication and reprocessing (overall design, economics and performance, but excluding details of chemistry or detailed design).

8. New and irradiated fuel transport and storage.


10. Summary session
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<td>2-6 June</td>
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<td>6-10 October</td>
<td>**VIENNA, Austria</td>
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<td>20-24 October</td>
<td>STOCKHOLM, Sweden</td>
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<td>1981</td>
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<td>PARIS, France</td>
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<td>22-26 June</td>
<td>**NASHVILLE, Tennessee, USA</td>
<td>International Symposium on Comparative Health Impacts of Nuclear and Alternative Sources of Energy</td>
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<td>27-31 July</td>
<td>**KNOXVILLE, Tennessee, USA</td>
<td>International Symposium on Migration in the Terrestrial Environment of Long-Lived Radiouclides from the Nuclear Fuel Cycle</td>
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<td></td>
<td>19-23 October</td>
<td>****MADRID, Spain</td>
<td>International Symposium on the Application of the Dose Limitation System in Nuclear Fuel Cycle Facilities</td>
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* Organized jointly by IAEA and CEC
** Organized jointly by IAEA and OECD/NEA
*** Organized jointly by IAEA, WHO and UNEP
**** Organized jointly by IAEA, WHO and NEA
1. INTERNATIONAL SYMPOSIUM ON THE MANAGEMENT OF ALPHA-CONTAMINATED WASTES
(Jointly organised with the Commission of the European Communities)
VIENNA, Austria, 2–6 June 1980

The term alpha-contaminated wastes will cover all the wastes, liquid and solid, contaminated by alpha-emitting isotopes. Cladding hulls are to be considered, but the highly radioactive (high-level) liquid wastes arising from fuel reprocessing will be considered only in the context of actinide separation. Wastes that are contaminated mainly with low levels of naturally occurring alpha-emitting radioisotopes (e.g., mining and milling wastes) are also not to be a topic for the symposium.

The objective of the symposium is to present the general strategies, the options and alternatives of handling, treating, conditioning and storing the alpha-contaminated wastes in view of their final disposal. In many cases, the treatment may involve separation, recovery and recycling of certain alpha-emitters. The symposium will also provide a forum for the exchange of information on scientific, technical and regulatory aspects for the management of alpha-contaminated materials.

Experience acquired under existing management schemes and R&D programmes, as well as evaluation and studies of future solutions will be presented, covering the following topics:

a) General strategies and national policies
   programmes
   regulatory requirements

b) Treatment of liquid alpha-contaminated waste
   chemical
   physical

c) Measurement of alpha emitters in solid waste
   segregation
   spectrography
   spontaneous fission neutron emission
   neutron activation

d) Treatment of solid wastes including cladding hulls
   Incineration
     high temperature
     controlled air and pyrolysis
     fluidized bed
     molten salt
     acid digestion
     other
Other treatments
cutting
crushing and grinding
melting
chemical

Decontamination and plutonium recovery
washing and leaching
electro-polishing
Pu recovery from residues

Conditioning
compaction
immobilization
packing and shielding

e) Storage and options for disposal

f) Actinide separation and further treatments

2. INTERNATIONAL SYMPOSIUM ON THE IMPACTS OF RADIONUCLIDE RELEASES INTO THE MARINE ENVIRONMENT
(Jointly organised with the Nuclear Energy Agency, Organisation for Economic Co-operation and Development) VIENNA, Austria, 6-10 October 1980

Source term characterization of radionuclide inputs from nuclear fuel cycle activities

Physical—chemical forms of radionuclides added to the marine environment and their interactions with suspended and biotic materials

Physical dispersal of radionuclides in the marine environment

Biogeochemical behaviour of radionuclides on suspended sediments and in marine biota and transfers through various critical pathways

Impact assessment of radionuclide additions to the marine environment

Control of radioactive waste releases into the marine environment and post dumping or discharge monitoring aspects

Reduction of impacts by site selection, waste conditioning, container design, etc.

3. INTERNATIONAL CONFERENCE ON CURRENT NUCLEAR POWER PLANT SAFETY ISSUES STOCKHOLM, Sweden, 20-24 October 1980

1. Introduction

The continued and future use of nuclear power depends on confidence in the technical and public sectors that nuclear power plants are being
designed, constructed and operated safely. The Three-Mile Island accident in the United States of America has re-emphasized this and has highlighted many safety concerns. This conference is intended to clarify, discuss and assess the safety issues of current importance by bringing together the experience the international community has acquired during the past twenty years of commercial nuclear power.

Particular objectives are:

- to assess and clarify current safety issues,
- to identify ways and means to maintain and improve nuclear power plant safety,
- to provide current and continuing information exchange on safety matters between all parties concerned and
- to develop ways of increased international co-operation

2. Structure of the conference

The subject areas of the conference will be as follows:

- Evaluation of significant nuclear power incidents and their impact on nuclear power programmes
- Current trends in national nuclear power regulation and safety research programmes
- Trends in design philosophy and accident analysis to improve safety
- Conduct of nuclear power plant operations with increasing management responsibility and qualification and training of the operating staff
- Preparedness for on-site and off-site emergencies
- International co-operation in dissemination of experience, standards development, safety research co-ordination and emergency assistance, and the present and future role of international organizations
- Specific contributions on a selected number of safety topics as outlined under item 3.

The conference will comprise plenary sessions, round-table discussions and one series of parallel technical sessions.

3. Contributed papers

Contributed papers for the technical sessions are invited on the following subject areas:

- Details of incident and accident evaluation and related emergency response
- Advanced safety system design
- Design for operability in emergencies
- Operator training to prevent and mitigate emergencies
- Small-leak loss of coolant accidents
- Specification and qualification of equipment to ensure safety
- Developments in accident and post-accident instrumentation
- Radiological protection concepts in the light of new experiences

4. INTERNATIONAL SYMPOSIUM ON QUALITY ASSURANCE FOR NUCLEAR POWER PLANTS
PARIS, France, 11-15 May 1981

This symposium will be held after completion of the preparation of the quality assurance code of practice and safety guides being issued within the framework of the Agency's "NUSS Programme". After publication of all the currently planned documents relating to quality assurance it will be useful to consider how Member States are implementing or intend to implement the Agency's recommendations; initial experience of applying the code of practice on quality assurance, particularly in developing Member States, could be referred to in a critical evaluation of the code's adequacy.

The symposium will cover the following topics:

- Regulatory requirement for quality assurance in Member States;
- Experience of applying the Agency's code of practice on quality assurance in nuclear power plant projects;
- Evaluation of improvements in plant safety and reliability through quality assurance;
- Quality assurance system functions in different phases of a nuclear power plant project;
- Methods and techniques for the implementation of quality assurance;
- Cost consideration in quality assurance;
- Manpower requirements for quality assurance; and
- Training and instruction of quality assurance personnel.

5. INTERNATIONAL SYMPOSIUM ON COMPARATIVE HEALTH IMPACTS OF NUCLEAR AND ALTERNATIVE SOURCES OF ENERGY, NASHVILLE, Tennessee, USA, 22-26 June 1981

An unbiased evaluation of the impact of nuclear energy on human health is possible only on the basis of comparison with the health impacts of other sources of energy. The aim of the symposium, which is the first of its kind, is to consider the scientific foundations for such a comparison as well as factual data on hazardous effects of various energy sources on the public health.

This symposium is of particular interest to developing countries which are studying alternative sources of energy.
6. INTERNATIONAL SYMPOSIUM ON MIGRATION IN THE TERRESTRIAL ENVIRONMENT OF LONG-LIVED RADIONUCLIDES FROM THE NUCLEAR FUEL CYCLE
KNOXVILLE, Tennessee, USA, 27-31 July 1981

The migration of radionuclides in the terrestrial environment (surface and sub-surface) is one of the key elements in understanding possible impacts resulting from potential or actual releases and migration of radionuclides within, into or on the ground and into surface waters. Among the various radionuclides, the long-lived ones (transuranium elements, technetium-99, radium, iodine-129, etc.) are of particular interest from the point of view of long-term safety.

The subject of the symposium is of growing interest in connection with the increasing number of nuclear power plants and their associated fuel cycle facilities and with the establishment of repositories to meet their radioactive waste disposal needs.

The Agency co-sponsored a symposium related to this subject in 1975 (Transuranium Nuclides in the Environment). In the meantime, further research work has been done in the laboratory and in the field and new information should be available about the transport and retardation of the transuranium actinides, the longer-lived fission products and radium moving through the geosphere and the terrestrial hydrosphere by mechanisms (such as sorption-desorption, precipitation and dissolution) associated with groundwater movement and mechanisms associated with biological transport.

7. INTERNATIONAL SYMPOSIUM ON THE APPLICATION OF THE DOSE LIMITATION SYSTEM IN NUCLEAR FUEL CYCLE FACILITIES
MADRID, Spain, 19-23 October 1981

Compliance with the dose limitation system recommended in the recently issued ICRP Publication 26 has many implications for the design and operation of nuclear facilities. By 1981 experience will have been gained in the application of the system and, in particular, in the application of the "optimization" procedure to radiation protection. Therefore, a symposium to bring together the various types of specialists involved to discuss the principles underlying the optimization procedure and their practical application is timely. The topics to be covered will include: the dose limitation system; design criteria; radiological safety features for limiting exposure to external and internal radiation; monitoring and dose assessment systems; and overall design and operational experience in all phases of the nuclear fuel cycle.

Some of the general implications of the dose limitation system have been discussed at a joint IAEA/WHO/IL0/ICRP/NEA seminar held in March 1979.
### Appendix VII

**LIST OF MEETINGS ON ATOMIC ENERGY (NON-SPONSORED BY THE IAEA) WHICH MAY BE OF INTEREST TO THE IWGPR MEMBERS**

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<td>*SAN FRANCISCO, California, USA NUCLEAR ENGINEERING Conference</td>
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<td>3. 1-5 Sep</td>
<td>*DUBROVNIK, Yugoslavia International Seminar on NUCLEAR REACTOR SAFETY HEAT TRANSFER</td>
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<td>4. 3-5 Sep</td>
<td>*LONDON, UK 5th International Symposium on URANIUM SUPPLY AND DEMAND AND RELATED TECHNICAL AND POLICY ISSUES</td>
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<td>6. 14-17 Sep</td>
<td>*MEXICO CITY, Mexico International Executive Conference on NON-PROLIFERATION AND SAFEGUARDS</td>
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<td>7. 14-17 Sep</td>
<td>**AMSTERDAM, Netherlands International FUEL CYCLE Conference</td>
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<td>8. 14-17 Sep</td>
<td>**SUN VALLEY, Idaho, USA Meeting on ADVANCES IN REACTOR PHYSICS AND SHIELDING</td>
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<td>9. 15-19 Sep</td>
<td>*KIEV, USSR 5th National Soviet Conference on NEUTRON PHYSICS</td>
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<td>10. 29 Sep-2 Oct</td>
<td>**GATLINBURG, Tennessee, USA Meeting on FUEL CYCLES FOR THE 80s</td>
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<td>11. 6-9 Oct</td>
<td>**ST. PETERSBURG, Florida, USA International Conference on MATERIALS FOR NUCLEAR STEAM GENERATION</td>
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<tr>
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Detailed information may be found in "Meetings on Atomic Energy" on indicated pages

* Vol. 12, No. 1, January 1980, IAEA
** Vol. 12, No. 3, July 1980, IAEA
LIST OF MEETINGS ON ATOMIC ENERGY (NON-SPONSORED BY THE IAEA) WHICH COULD BE OF INTEREST TO THE IWGPR AND FOR WHICH THE SUPPORT OF THE IWGPR IS INVITED

1. 21-24 April 1980  
*RICHLAND, Washington, USA  
Second International Conference on Liquid Metal Technology in Energy Production

**UNITED KINGDOM  
International Conference on Breeder Reactors as a World Energy Resource and the Breeder Fuel Cycle

3. Summer, 1982  
***LYONS, France  
International Conference on the Safety of Fast Breeder Reactors

* Endorsed by the IWGPR at the 10th Annual Group Meeting in April 1977.  
** Endorsed by the IWGPR at the 12th Annual Group Meeting in March 1979.  
*** Endorsed by the IWGPR at the 13th Annual Group Meeting in April 1980.
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24 On-Line Calibration and Time Response Measurement Techniques for Process Instruments USA
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28 Fission Gases in Whole Core Accidents SM
29 A Prediction of Fatigue Life, Wear and Fretting for Flow Induced Vibrations of LMFBR Components SM
30 The Measurement and Prediction of Velocity Distributions, Pressure Fields and Forces for Typical LMFBR Components and Flow Fields SM
31 Prediction of Flow-Induced Structural Response SM
32 Flow-Induced Vibration Scale Model Testing SM
33 Pre-and-Post-Operational Vibration Monitoring of Flow-Induced Vibration SM
34 Sodium Removal and Decontamination SM
35 Mechanical Properties of Solidified Sodium Japan
36 Equation of State of Materials of Relevance to the Analysis of Hypothetical Fast Breeder Reactor Accidents SM
37 Sodium Fires and Prevention SM
38 Advance in Structural Analysis and Material Behaviour for LMFBR Applications France
39 Bellows for Sodium Systems SM
40 Carbon in Sodium SM
JUSTIFICATIONS OF PROPOSED IWGFR SPECIALISTS' MEETINGS

1. COVER GAS PURIFICATION (FISSION PRODUCTS AND CHEMICAL IMPURITIES)

Argon has to be purified:

a. To eliminate any impurity which could be damageable to the sodium system.

b. To eliminate fission products in case of important pin failures (or if vented pins are used).

2. SEALING DEVICES FOR ROTATING PLUGS

Rotating plugs for LMFBRs need a reliable gas tight system to be used.

Various possibilities exist or have been used, mainly: different types of rubber gaskets and molten alloy sealing system.

A comparison of design and experience would be very fruitful for the future.

3. CORE COOLING CRITERIA AND GAGGING

This activity is closely linked to the core support system. The core itself should be cooled to take account of the radial form factor, (e.g. to provide a constant outlet temperature).

The extent and distribution of the cooling has to satisfy a number of criteria such as cavitation, element handling, inherent system safety, hot channel evaluation.

An important problem seems to be cavitation; it can be avoided in gags etc. by various design techniques. The phenomenon is very critical to structural integrity, boiling detection, and heat transfer stability.

Correlation has been investigated with experiment and theory, and it has been found important to compare criteria, results and evaluation methods.

4. FAST REACTOR CLADDING AND CORE STRUCTURAL MATERIALS

The meeting should concentrate on both the extensive and intrinsic properties and behaviour of fast reactor cladding in the core environment. The scope should encompass high and low strain rate mechanical properties, in-reactor swelling and creep, effects of sodium and impurities, the sodium plus fuel cladding interaction effects. Mechanisms controlling properties and behaviour should be covered as well as engineering properties.

Location: Open - could be held in U.S. at HEDL.

5. FAST REACTOR FUEL ROD DESIGN AND DEVELOPMENT

This would be a broad scope meeting covering all aspects of fuel rod design, analysis, performance and intrinsic properties of the fuel and the cladding as they affect performance under steady state and off-set operating conditions.
6. SODIUM TO GAS LEAK DETECTION

The specialists' meeting will provide a forum for technical information exchange on the following topics:

- Recent (since 1971) field experience with sodium gas leaks and their detectability;
- Damage to equipment resulting from sodium gas leaks;
- Performance requirements from sodium to gas leak detectors;
- Development of advanced techniques for sodium to gas leak detection.

Location of Meeting: LMEC, Canoga Park, California

7. FUEL FAILURE DETECTION AND LOCATION

To cover the theoretical and experimental bases for measurable indications of fuel failure.

The techniques used for detection and location of defected fuel would be discussed and particular attention paid to the timescale for detection relative to that for escalation of the failure.

8. DESIGN FOR STRONG MOTION EARTHQUAKES

Possible subjects are:

1. Ground Motion
   - Seismic input characteristics; shape and magnitude of spectra
   - Attenuation with depth
   - Probabilistic procedures in the selection of SSE and OBE

2. Soil-Structure Interaction (SSI)
   - Need for non-linear SSI
   - Need for 3-D SSI
   - Embedment effects

3. Design Criteria and Verification
   - Criteria and basis for dynamic decoupling of piping and equipment
   - Load combinations and factored loads
   - Demonstration of functional adequacy by analysis
   - Criteria and basis for core components
   - Raceways (cable tray, electrical conduit)

4. Analysis Methods
   - Multi-design spectra input for piping and component analyses
   - Determining equipment spectra directly from ground and building spectra
   - Analysis for gaps/non-linear effects for core, piping, vessel components and supports
   - Modelling techniques for non-linear effects due to concrete cracking, complex (non-circular) buildings, load paths, etc.
5. Design Guidelines and Simplified Methods
   - Pipe hanger/snubber locations; effect of spring rates; alternate designs for small piping
   - Anchor support stiffness requirements
   - Procedure/guidance on combination of model and spatial components at load and stress levels for specific cases
   - 2-D vs. 3-D; advantages and guidelines/justifications
   - Simplified methods for soil-structure interaction, quasi-linear analyses for gap effects

6. Testing Programmes
   - Realistic damping factors for structures/piping/equipment
   - Seismic monitoring instrumentation and procedures
   - Guidelines for testing to demonstrate meeting functional requirements.

9. EXPLOSION CONTAINMENTS CODES AND EXPERIMENTS

   The development of codes for determining the effect of the energy releases from Bethe-Tait type excursions and their validation by special experiments using explosives in special models.

10. COMPATIBILITY PROBLEMS BETWEEN SODIUM AND CONCRETE

   This would include reaction rates between liquid sodium coming into contact with concrete at relatively low temperatures in oxygen free atmospheres and also the effect of sodium and sodium vapour on concrete containment buildings under accident conditions where sodium fires and consequent high temperatures might be expected.

11. FUEL PERFORMANCE AND SAFETY ANALYSIS

   The programmes for understanding and applying knowledge of fuel behaviour under abnormal conditions, particularly accident conditions, require an extension of the knowledge of fuel technologists and greater integration with safety analysts. In view of the general trend of programmes being promulgated throughout the nuclear community, the participants of the IAEA meeting on "Fuel Failure Mechanisms", which was held on the recommendation of the IWGFR at Battelle Seattle Research Center in Seattle, Washington, USA, from May 12 to 16, 1975, unanimously recommended that an IAEA Specialists' Meeting be devoted more specifically to fuel performance analysis and application to safety analysis, and be convened approximately two years hence the meeting in Seattle.

12. FRICTION, WEAR, FRETTING AND SELF WELDING IN LIQUID METAL SYSTEMS

   Tribological behaviour in sodium depends on:
   a. Material properties
   b. Sodium temperature
   c. Sodium impurity concentration
   d. Mass transfer characteristics (circuit details, flow rates, etc.)
   e. Contact situations (loads, speeds, dwell times)
The meeting should discuss the available experimental techniques for determining the tribological behaviour of fast reactor materials in sodium and the existing experimental data. The behaviour of materials in argon cover gas containing low levels of oxidizing impurities should also be considered. Attention should be given to tribological experience in operating rigs and reactors containing sodium. The avoidance of potential problems by suitable design and the selection of special materials to meet specific design situations should also be discussed.

13. FAST REACTOR ABSORBER MATERIALS

Changes in the physical and mechanical properties of candidate fast reactor absorber materials as a function of burn-up due to neutron irradiation are a well recognized phenomena. Gas release and interaction of absorber materials with cladding tubes due to swelling of the absorbers and due to general corrosion and grain boundary attack are also important in determining the design and performance of absorber pins. The main purpose of the meeting would be to assess the experience of absorber pin behaviour which has been obtained since the last IWGFNR meeting on this topic in 1973 and to consider the impact of this experience on absorber pin design. Mechanisms covering the absorber material properties and behaviour should be covered as well as the actual absorber pin behaviour.

14. FISSION AND CORROSION PRODUCT BEHAVIOUR IN PRIMARY CIRCUITS OF LMFBRs

The IAEA Specialists' Meeting on this topic was held on the recommendation of the IWGFNR in Dimitrovgrad, the USSR, from 8 to 11 September 1975.

The subject of the meeting was the consideration of current investigations and the experience gained on fission and corrosion products behaviour in an LMFBR primary system. There was a general view that this topic was an essential aspect in the development of practical, commercial LMFBRs and that there was an overall need to continue the studies which were carried out by all the countries on the unsolved problems which had been identified and to discuss the problem and draw the conclusions at a similar specialists' meeting in four years time.

It seems to be useful if the location and schedule of the meeting are compatible with the Second International Conference on "Liquid Metal Technology in Energy Production".

15. OPERATIONAL PROBLEMS WITH CONTROL AND INSTRUMENTATION OF LMFBRs

This topic was suggested at the IWG-NPPCI-FR Specialists' Meeting on "The Core and Primary Circuit Instrumentation of LMFBRs" held in Warrington, Cheshire, England on 27-29 January 1976. The scope of the meeting is of interest both to the IWGFNR and the IWGNPPCI and the joint sponsorship of both groups could be proposed.

16. COOLANT IMPURITY MEASUREMENT AND CONTROL

The topic was suggested at the IWG-NPPCI-FR Specialists' Meeting on the Core and Primary Circuit Instrumentation of LMFBRs held in Warrington, Cheshire, England on 27-29 January 1976.
The topic is relevant to both primary and secondary coolant circuits in LMFBRs, in which measurement and control of the major non-metallic impurities oxygen, hydrogen and carbon are of considerable importance. Oxygen and carbon are of particular importance throughout the sodium plant from the viewpoints of corrosion, tribology, fuel coolant interactions, carburisation/decarburisation. Hydrogen is of particular relevance to the secondary circuits where continuous and substantial ingress occurs from the water-side of the steam generating plant, and control and measurement is particularly relevant to water-to-sodium leak detection.

The specialists' discussions should be directed towards:

1. Impurity measurement techniques, viz oxygen, hydrogen and carbon meters and other techniques of analysis, such as use of tab specimens, sodium sampling systems etc.

2. Impurity control systems and techniques, viz largely cold trapping taking on board in-situ regeneration, but also alternatives such as other designs of crystallisers, hot trapping, diffusion, adsorption etc.

Attention should also be given to considering the plant as a whole, i.e. the implication of operational regimes of the primary circuit on the secondaries and vice versa: in this context, tritium distribution may arise.

17. METAL-WATER/STEAM INTERACTIONS IN SODIUM HEATED STEAM GENERATORS DURING START-UP AND OPERATION

The aim of such a meeting should be discussions on stability of the magnetite layer on the steam/water side of steam generators at start-up and load cycling; extrapolation of corrosion rates to long term operation etc.

18. STEAM GENERATOR SAFETY

Such a meeting has taken place already at Bensberg, FRG in 1976. A continuation of discussion and presentation of experience on this subject appears interesting in 1978/79.

19. TRITIUM: PRODUCTION, DISTRIBUTION AND RELEASE IN LMFBRs

The topic is relevant to LMFBRs in that definition of the operational regimes of the primary and secondary circuits dictates to a large degree the distribution and location of tritium throughout the system and the extent of release to the atmosphere.

20. TEMPERATURE NOISE ANALYSIS

Temperature noise analysis is a potential means of detecting local blockages and related faults in fast reactor sub-assemblies. It has an important early warning capability being able in principle to indicate the early stages of the sub-assembly incident and thus permitting shutdown systems to operate before boiling and significant damage or escalation occurs.

The meeting should consider the following aspects:

1. Experimental data from rig including the sensitivity of the technique and the influence of sub-assembly geometric factors.
ii. Data from operating reactors notably on background noise level, band-widths and variability.

iii. Theoretical development on the generation of temperature noise in the turbulent fields of the sub-assembly coolant stream and the effect of thermal conductivity on dissipation processes and the optimisation of sub-assembly design to enhance signal characteristics, e.g. turbulence promoters.

iv. Instrumentation response time.

v. Data analysis technique to increase sensitivity and/or level of information on fault characteristics.

21. LMFBR (PuO2-UO2) FUEL HANDLING, FABRICATING PROCESSES AND FACILITIES

Large quantities of plutonium are being produced, processed and accumulated. This material will have to be recycled for use in LWRs and FBRs. How this material is handled and processed significantly affects fuel cycle costs, safeguards, personnel exposure, and proliferation. This meeting would primarily address fabrication and processing technology and facilities for producing mixed oxide fuels and would cover economics, personnel exposure, production problems and solutions, specifications and high Pu-240 material.

22. DESIGN AND TESTING OF LMFBR CORE AND BLANKET SUBASSEMBLIES

The meeting would encompass experience and design practices associated with pin support experience and design practices associated with pin support (grid and wire wrap), vibration and wear, bundle duct interactions, constraints, mechanical design of duct, thermal hydraulic considerations, etc. Also, questions related to testing large LMFBR subassembly in test or power reactors should be addressed.

Location – U.S. offers to host at GE or HEDL.

23. CORE AND FUEL PERFORMANCE INSTRUMENTATION OPTIMISATION

This topic would cover the interdependence between subassembly instrumentation and fuel rating, and cost/benefit analyses as related to improved temperature and coolant flow measurement.

Location – U.S. offers to host, possibly at Westinghouse.

24. ON-LINE CALIBRATION AND TIME RESPONSE MEASUREMENT TECHNIQUES FOR PROCESS INSTRUMENTS

Topics would cover cross-correlation of instrument noise signals, analysis of instrument and sensor background noise, forced perturbation of coolant parameters, forced system power level perturbation, etc.

25. IRRADIATION DAMAGE UNITS

U.S. offers to host at Richland, Washington.
26. **FUEL (CORE) CHARACTERIZATION**

U.S. offers to host either at HEDL or LASL.

27. **BOILING NOISE DETECTION**

Local boiling can greatly jeopardize the operation of fast reactors. The detection of this phenomenon is an important problem in relation to which out-of-pile and in-pile experiments have started.

28. **FISSION GASES IN WHOLE CORE ACCIDENTS**

Specialists' Meeting on Role of Fission Products in Whole Core Accidents which was held at AEPR, Harwell, UK on 28th June - 1st July 1977, recommended that a further meeting on the subject of fission gases in whole core accidents be held in two years time.

29. **A PREDICTION OF FATIGUE LIFE, WEAR AND FRETTING FOR FLOW INDUCED VIBRATIONS OF LMFBR COMPONENTS**

The participants of the IAEA Specialists' Meeting on LMFBR Flow Induced Vibrations, which was held at the Argonne National Laboratory, Argonne, Illinois, USA on 20-23 September 1977, agreed that subsequent meetings on flow-induced vibrations would be useful for the purpose of providing a forum for the discussion of many of the topics identified in the first meeting and cited under items 35-40, inclusive. The necessary program of work (attending the first meeting, receiving briefings on the reports of the subgroups that were formed at the first meeting) for each subgroup should be presented in a report to the next meeting. Each subgroup should focus upon a single narrow topic. The papers and materials should be divided into smaller separate groups in order to maximize detailed considerations. This would allow for exchange of specific finished techniques, methods, and analytical programmes employed in investigations, as well as the results. Furthermore, a listing of symbols employed and used of the metric system in all papers presented should be required in order to better facilitate communication.

30. **THE MEASUREMENT AND PREDICTION OF VELOCITY DISTRIBUTIONS, PRESSURE FIELDS AND FORCES FOR TYPICAL LMFBR COMPONENTS AND FLOW FIELDS**

The topic was recommended by the IAEA Specialists' Meeting on LMFBR Flow Induced Vibrations. More detailed justification can be found under item 29.

31. **PREDICTION OF FLOW-INDUCED STRUCTURAL RESPONSE**

The topic was recommended by the IAEA Specialists' Meeting on LMFBR Flow Induced Vibrations. More detailed justification can be found under item 29.

32. **FLOW-INDUCED VIBRATION SCALE MODEL TESTING**

The topic was recommended by the IAEA Specialists' Meeting on LMFBR Flow Induced Vibrations. More detailed justification can be found under item 29.
33. **PRE-AND-POST-OPERATIONAL VIBRATION MONITORING OF FLOW-INDUCED VIBRATION**

The topic was recommended by the IAEA Specialists' Meeting on LMFBR Flow Induced Vibrations. More detailed information can be found under Item 29.

34. **SODIUM REMOVAL AND DECONTAMINATION**

The participants of the IAEA Specialists' Meeting, which was held at HEDL, Richland, Washington, USA on 14-16 February 1978, agreed that a useful exchange of information took place at the meeting and another meeting should be held in approximately four years time to discuss new information.

35. **MECHANICAL PROPERTIES OF SOLIDIFIED SODIUM**

Data of mechanical properties of solidified sodium are required in determining the operating torques of freeze seal valves and rotating plugs with condensed and solidified sodium in annular gaps.

Topics of interest are as follows:

1. tensile strength, as function of temperature, porosity, etc.
2. shear strength, as a function of temperature, porosity, etc.
3. adhering force to metallic wall

36. **EQUATION OF STATE OF MATERIALS OF RELEVANCE TO THE ANALYSIS OF HYPOTHETICAL FAST BREEDER REACTOR ACCIDENTS**

A specialists' meeting on this topic was held at Harwell, UK on 19-27 June 1978. The participants of the meeting recommended that a similar meeting be held in not less than two to three years. Such a meeting would review progress on the thermodynamic properties of appropriate materials.

37. **SODIUM FIRES AND PREVENTION**

A recent specialists' meeting on this topic was held in Cadarache, France on 20-24 November 1978. The participants recommended to hold a future meeting on the subject topic in four years time. "Sodium concrete" interaction and protective clothing were not discussed specifically at the Cadarache meeting and the participants agreed that these topics should be included in the programme of the next meeting.

38. **ADVANCE IN STRUCTURAL ANALYSIS AND MATERIAL BEHAVIOUR FOR LMFBR APPLICATIONS**

There are many problems in the design of LMFBR power plants. This prompted a large effort, all over the world in Research and Development. Great progress has been achieved in recent years. A few problems remain and diverging opinions are emitted. It is felt that an International specialists' meeting on the state-of-the-art in structural analysis and material behaviour for LMFBR applications would be an asset for the designers and an exchange on the general trends in research and development would promote the latest theoretical and experimental results in the conception of LMFBRs.
Tentative Agenda:

- Material behaviour in elevated temperatures;
- Material characterization;
- Structural analysis methodology;
- Recent developments in simplified analysis methods;
- Allowable stresses and strains;
- Definition of the time-temperature range where creep is significant.

39. BELLOWS FOR SODIUM SYSTEMS

The participants of the subject meeting held in Tokyo, Japan in 1979 recommended to organize a specialists' meeting on the same topic in 2 or 3 years.

40. CARBON IN SODIUM

The meeting on this topic was held at AESE Harwell in November 1979. It was agreed that the meeting had proved valuable, particularly in highlighting topics on which further effort is required; these are identified throughout the summary report. It was recommended by the participants of the meeting that a further meeting on the topic should be held in about 3-4 years, by which time substantial additional data should be available from the R&D programmes at operating reactors in the represented countries.
LIST OF MEETINGS SPONSORED BY THE IWGFR

1. Consultants' Meeting on Fast Reactor Problems (March 1967, Vienna)
2. The First Meeting of the IWGFR (March 1968, Vienna)
3. SM on Sodium-Water Reactions (November 1968, ANL, USA)
4. The Second Annual Meeting of the IWGFR (March 1969, Vienna)
7. SM on Plutonium Alpha (June-July 1969, Winfrith, UK)
8. SM on Core Instrumentation for Sodium-Cooled Fast Reactors (October 1969, Karlsruhe, FRG)
9. The Third Annual Meeting of the IWGFR (March 1970, Cadarache, France)
10. SM on Sodium Vapour Control (March 1970, Cadarache, France)
11. IAEA Symposium on Sodium-Cooled Fast Reactor Engineering (March 1970, Monaco)
12. SM on Failure Cladding Detection (October 1970, Cadarache, France)
13. SM on Fast Reactor Spectrum Measurements and their Interpretation (November 1970, ANL, USA)
14. SM on Operational Safety of Sodium Circuits (March 1971, Risley, UK)
15. The Fourth Annual Meeting of the IWGFR (May 1971, Vienna)
16. SM on Sodium-Water Reactions (May 1971, Melekess, USSR)
18. SM on Fission and Corrosion Products Behaviour in Primary Systems of LMFBRs (September 1971, Bensberg, FRG)
19. The Fifth Annual Meeting of the IWGFR (19-21 April 1972, Vienna)
20. SM on Handling and Transportation of LMFBR Spent Fuel Elements (April 1972, Rome, Italy)
21. SM on Sodium Fires (Sodium Combustion and its Extinguishment - Techniques and Technology), (May 1972, Richland, USA)
23. SM on Sodium Impurity Measurements and Control (14-17 November 1972, Cadarache, France)
24. SM on Decontamination of Plant Components from Sodium and Radioactivity (9-12 April 1973, Dounreay, UK)
25. The Sixth Annual Meeting of the IWGFR (9-11 May 1973, Vienna)
26. SM on Development and Application of Absorber Materials for Fast Reactors (4-8 June 1973, Dimitrovgrad, USSR)
27. IAEA Symposium on Fuel and Fuel Elements for Fast Reactors (2-6 July 1973, Brussels, Belgium)
28. Symposium on Physics of Fast Reactors (16-23 October 1973, Tokyo, Japan)
29. IAEA Panel on Hot-Channel Factor Calculations (22-24 November 1973, Karlsruhe, FRG)
31. The Seventh Annual Meeting of the IWGFR (18-20 March 1974, Winfrith, UK)
32. SM on Handling of the Design for and Mitigation of Thermal Transients in LMFBR Plants (17-21 June 1974, Canoga Park, USA)
33. SM on Operating Experience and Design Criteria of Sodium Valves (23-27 September 1974, Richland, USA)
34. IAEA Study Group on Steam Generators for LMFBRs (14-17 October 1974, Bensberg, FRG)
35. The Eighth Annual Meeting of the IWGFR (15-18 April 1975, Vienna)
36. SM on In-Service Inspection and Monitoring of LMFBRs (9-12 March 1976, Bensberg, FRG)
37. The Ninth Annual Meeting of the IWGFR (30 March-2 April 1976, Bologna, Italy)
38. SM on Cavitation in Sodium and Studies of Analogy with Water as Compared to Sodium (12-16 April 1976, Cadarache, France)
39. SM on High Temperature Structural Design Technology (27-30 April 1976, Champion, PA, USA)
40. SM on Aerosol Formation, Vapour Deposits and Sodium Vapour Trapping (13-17 December 1976, Cadarache, France)
56. SM on Thermodynamics of Fast Breeder Reactor Fuel Sub-Assemblies under Nominal and Non-nominal Operating Conditions (5-7 February 1979, Karlsruhe, FRG)

57. The Twelfth Annual Meeting of the IWGFR (27-30 March 1979, Vienna)

58. SM on Theoretical Modelling of LMFBR Fuel Pin Behaviour (28 May-1 June 1979, Fontenay-aux-Roses, France)

59. Symposium on Fast Reactor Physics (24-28 September 1979, Aix-en-Provence, France)

60. SM on Bellows for Sodium Systems (5-9 November 1979, Tokyo, Japan)

61. SM on Carbon in Sodium (27-30 November 1979, Harwell, UK)

62. The Thirteenth Annual Meeting of the IWGFR (9-11 April 1980, Vienna)
LIST OF MEETINGS RECOMMENDED BY THE IWGFR TO BE HELD
IN THE PERIOD AFTER THE 13TH ANNUAL GROUP MEETING
(FROM APRIL 1980 THROUGH 1981)

1. SM on In-Service Inspection and Monitoring of LMFBRs (Bergisch Gladbach, FRG, 20-23 May 1980)

2. SM on Demonstration of Structural Integrity under Normal and Faulted Conditions (Chester, UK, 3-5 June 1980)

3. SM on Core Design Features Affecting Dynamic Behaviour of Fast Reactor Cores (Rome, Italy, Spring 1981)

4. Fourteenth Annual Meeting of the IWGFR (Vienna, Austria, 31 March-3 April 1981)

5. SM on Fuel Failure Detection and Location (Karlsruhe, FRG, April 1981)


7. SM on Compatibility Problems between Sodium and Concrete (1982)
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