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ORNL

FOREIGN TRIP REPORT

ORNL/FTR-3865

DATE: February 14, 1991

SUBJECT: Report of Foreign Travel of K. R. Thoms, Group Leader, Engineering Technology Division, and F. W. Wiffen, Office of Fusion Energy, DOE (on assignment from Metals & Ceramics Division, ORNL)

TO: Alvin W. Trivelpiece

FROM: K. R. Thoms and F. W. Wiffen

PURPOSE: To participate as members of the International Panel on 14 MeV Intense Neutron Source Based on Accelerators for Fusion Materials Study, attend the initial meeting of the International Energy Agency (IEA) High Energy, High Flux Neutron Source Working Group, participate in the Fourth FFTF/MOTA Experimenters' Workshop, and discuss research of interest to the U.S. Fusion Materials Program with JAERI staff

SITES

VISITED:	1/14-16/91	Tokyo, Japan	University of Tokyo (Thoms and Wiffen)	S. Ishino
	1/18-19/91	Sapporo, Japan	Hokkaido University (Wiffen)	A. Kohyama
	1/21/91	Mito, Japan	JAERI Tokai, Oarai, and Naka sites (Wiffen)	T. Kondo S. Yamamoto Y. Seki

ABSTRACT: Both travelers were members of a nine-person U.S. delegation that participated in an international workshop on accelerator-based 14 MeV neutron sources for fusion materials research hosted by the University of Tokyo. Presentations made at the workshop reviewed the technology developed by the FMIT Project, advances in accelerator technology, and proposed concepts for neutron sources. One traveler then participated in the initial meeting of the IEA Working Group on High Energy, High Flux Neutron Sources in which efforts were begun to evaluate and compare proposed neutron sources; the Fourth FFTF/MOTA Experimenters' Workshop which covered planning and coordination of the U.S.-Japan collaboration using the FFTF reactor to irradiate fusion reactor materials; and held discussions with several JAERI personnel on the U.S.-Japan collaboration on fusion reactor materials.

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**INTERNATIONAL PANEL ON 14 MeV INTENSE NEUTRON SOURCE BASED
ON ACCELERATORS FOR FUSION MATERIALS STUDY,
UNIVERSITY OF TOKYO, TOKYO, JAPAN**

Attendees: K. R. THOMAS and F. W. Wiffen

This workshop, hosted by Professor Isino at the University of Tokyo, had originally been scheduled as a U.S.-Japan bilateral meeting. It was expanded to international participation under the sponsorship of the International Energy Agency (IEA) at the urging of the U.S., in response to the recommendation of the Fusion Policy Advisory Committee that the U.S. should take the lead in proposing an international 14 MeV neutron source. Three European Community (EC) representatives and one Canadian attended. USSR participation had been invited but did not develop. The meeting agenda and list of attendees are in Appendix B and C.

A very detailed technical review of the meeting presentations is given in the Report of Foreign Travel by Dr. D. G. Doran of Pacific Northwest Laboratory (PNL), dated January 23, 1991. He has used his long experience with U.S. and International efforts to develop a neutron source, provide background on the material presented and to give perspective to the discussions. The technical content of the meeting is not repeated here. Interested persons can obtain the report by Doran from the author, or from either of the authors of this report.

The three main groups at this meeting had quite different approaches to the issue of a neutron source. The U.S. was at the meeting to press for agreement to pursue a D-Li neutron source. All presentations supported this approach as the best way to achieve a fusion-relevant neutron source in the near term. The U.S. presentations mainly reviewed the technology developed by the FMIT project, advances in accelerator technology and target concepts since that time, and possible contributions from the Continuous Wave Deuterium Demonstrator (CWDD) and other ongoing projects in the U.S. and Canada. The Japanese gave a number of presentations that support their ESNIT study, a D-Li source concept with about half the neutron source strength formerly planned for FMIT. This study, led by JAERI, also involves the radiation effects groups at the Universities. Their focus now is on a modest accelerator, with a beam current of about 50 mA at 35 MeV. It may be possible to later upgrade the facility to the capacity needed for international use, perhaps 200 mA. The remaining one-third of the presentations by Japan were not related to the main theme of the Panel. The EC did not present any fully developed proposal for an intense neutron source. The T-H concept presented by S. Cierjacks of KfK may have potential usefulness, but details including the problems of tritium management must be addressed before the concept can be properly assessed. Cierjacks repeatedly made the point that the EC materials community will not accept the uncertainty that accompanies the use of neutrons with energy above about 14 MeV, and thus would not want to use a D-Li source. This was probably an overstatement of the EC position, reflecting that the EC had not had adequate time to prepare for this Panel.

The meeting ended with summaries that emphasized that the time is right to move on toward the planning and construction of an International Fusion Materials Irradiation Facility (IFMIF). Professor Miyahara urged us to "keep the momentum" and continue the activity, possibly under IEA sponsorship. The U.S. and Japan both accept that D-Li is the best

approach for a near-term source that could fill IFMIF requirements. The question of how or whether the EC will join in this activity is still open, as is the question of involving the USSR. The IEA Executive Committee on Fusion Materials will continue to sponsor collaboration on IFMIF. In the longer range an organization similar to ITER will be required to marshal the international collaboration needed to convert the current ideas to a full-scale engineering design and then construction project.

IEA HIGH ENERGY, HIGH FLUX NEUTRON SOURCE WORKING GROUP, TOKYO, JAPAN

Attendee: F. W. Wiffen

The initial meeting of this Working Group was held with five members and four observers in attendance. Attendees and the agenda are Appendixes D and E. Time constraints kept the meeting brief.

This Working Group was established by the IEA Fusion Materials Executive Committee to assist in the evaluation and comparison of proposed neutron source facilities. The focus is on the evaluation of the neutron flux and spectrum, and of materials response parameters for proposed concepts. The group used the time available to identify questions that will have to be addressed in their future meetings and to request more details on some of the source concepts.

The committee will develop standard methods for calculating and specifying neutron flux, spectrum, and volume information used to compare sources. Materials response calculations will include treatment of multiatomic materials (especially insulating ceramics) and must standardize treatment of the high energy tail, the 20 to 50 MeV range. Calculations and comparisons with fusion reactor materials response are planned in hopes of settling the importance of this issue. Newly developing Japanese capabilities may help with this problem. Related questions are the need for a "standard" test matrix for comparisons and the source parameters "required" by the materials (user) community.

Clarification and detail questions were passed on to KfK on some of the features of the T-H source. Feasibility questions relate to the practicality of a water jet target with beam and vacuum interactions and the issues of tritium handling in the accelerator and recovery from the water target system. Los Alamos National Laboratory (LANL) will be asked to provide more detail on the flux-spectrum-volume information they presented on the two-beam, D-Li source concept. LANL was also asked to document anticipated beam-time history for a steady state accelerator.

This working group will meet next at Culham, UK, in April in association with the IEA Low Activation Materials Workshop. Members were asked to complete their homework assignments by that time.

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FOURTH FFTF/MOTA EXPERIMENTERS' WORKSHOP, HOKKAIDO UNIVERSITY, SAPPARO, JAPAN

Attendee: F. W. Wiffen

The U.S.-Japan collaboration using the FFTF reactor to irradiate fusion reactor materials in the MOTA facility involves a large team of University faculty and students in Japan. This workshop series is one of the many routes used to coordinate their planning for the 15,000 or more samples involved in each MOTA irradiation. The agenda and attendee lists for the workshop are in Appendixes F and G.

The FFTF/MOTA program was started as part of the 10-year "Special Research Project on Fusion" which ended in March 1990. It is now the only ongoing, Monbusho-authorized project. Budget proposals for the follow-up studies that will include this project are now under development. Professor A. Miyahara who headed this collaboration will retire March 1991 and Professor S. Ishino will succeed him.

A great deal of effort has gone into the planning and preparation for the examination of specimens from the MOTA 2A experiment that will be discharged from FFTF in March 1991. Over 14,000 specimens are involved. Some will be returned to Japan for examination, but the hot cells available to this program at Oarai are limited to TEM disk size specimens and individual sample activity limits of about 25 mR/h. Examination plans were discussed in general terms but specifics were not given. Testing equipment is not operational yet in some cases but is expected to be available soon.

It is hard to judge the level of collaboration between the Japanese experimenters. They clearly collaborate on the division of space in MOTA, the use of facilities at PNL, and test facilities at Oarai. However, they may have much less collaboration on the sharing of specimens and test results, planning toward common goals, and avoiding duplication of effort.

One potentially important use of the results of the Japanese fusion material programs has developed. They have established a Fusion Reactor Materials Forum, chaired by A. Kohyama, to apply their understanding and experimental results to the practical problems of the ITER design activity. This group has met three times within less than 12 months and involves both Monbusho (University) and STA (JAERI) researchers.

Attention to the effects of reactor operating history on materials irradiation response is continuing. It has now been observed that the relatively slow shutdown of FFTF can influence material behavior. The approximately one day shutdown time occurs with a fluence near 5×10^{19} neutrons/cm², and this fluence at reduced temperatures has been found to produce an unexpected population of small loops in samples that were at 600°C during full-power operation. The effect of this on the long-term material response, including a number of reactor shutdown cycles, is not yet established.

A few problems with the irradiation experiments were discussed. In the MOTA-2A experiment an 800°C capsule is creeping out of temperature control on an irregular basis and the cause cannot yet be explained. The similar capsule in the MOTA-2B experiment under construction is being examined to eliminate any specimens that may be sources of gas

production. The schedule for completion of the MOTA-2B experiment is very tight. Two potential problems are delivery of the tritiated vanadium "mother alloy" for the DHCE experiment and the fabrication of specimens for the BEATRIX-II experiment.

The question of the future operation of the FFTF reactor was discussed, but the U.S. had no new information to present. The U.S. again presented the case for using a number of irradiation experiments in the EBR-II reactor to continue the collaboration if FFTF is shut down. The Japanese position is that they will be interested only in the use of controlled temperature capsules, not in using coolant temperature or static gas gap controlled capsules. They are under some pressure to use the JOYO reactor in Japan and would do the gas gap and coolant temperature irradiations in that facility. The Japanese again asked the U.S. to begin the detailed design of EBR-II controlled temperature experiments as soon as possible, but did not want to share the cost. They view this as a U.S. obligation, resulting from the possible shutdown of FFTF.

A large number of detailed presentations were included in this Workshop but are not discussed here. The Workshop proceedings will contain much of this material; other sources include the annual reports prepared on the FFTF/MOTA collaboration and the technical papers that will be presented at the ICFRM-5 meeting in Florida in November 1991.

DISCUSSION VISIT TO JAERI AT TOKAI, OARAI, AND NAKA SITES, JAPAN

Attendee: F. W. Wiffen

This visit, arranged and hosted by Dr. T. Kondo, was held for very general discussions of the U.S.-Japan collaboration on fusion reactor materials and other work of interest to the materials program. The HFIR irradiation program, hot cell facilities for small specimen and irradiation assisted stress corrosion cracking (IASCC) testing, testing of ceramic materials, and the Steady State Tokamak Reactor design were reviewed briefly.

The HFIR collaborative irradiation program is continuing to the satisfaction of both sides. The long down time of the reactor has caused some problems with the length of the planned experiments, and the JAERI staff are recommending some schedule changes to allow completion of this program within the planned 11-year period. JAERI expects the collaboration to continue beyond that point, with a new agreement to cover future work. The new agreement may allow more direct support of ITER goals, and Kondo would like to see the scope expanded beyond the limits of the present agreement. These issues will be discussed in detail at the Technical Meeting and Steering Committee Meeting on the HFIR collaboration in Oak Ridge in March.

JAERI experimental activities are also related to U.S. programs through the IEA activity on Fusion Materials. Both groups will participate in workshops on Low Activation Materials and on Irradiation Effects in Insulating Ceramics in 1991. JAERI (Hishinuma) is also planning an IEA workshop on Small Specimen Technology in 1991. Discussion centered on holding this in connection with ICFRM-5 in November, to reduce travel burdens.

A tour of the hot cell facilities at the JAERI-Oarai site showed the continuing effort to develop the small specimen test technology needed to get mechanical properties data from TEM disk irradiated specimens. There has apparently been little testing of irradiated material — most work has been on technique development. A number of stress corrosion, creep, and fatigue test stands were in use, but mostly for programs other than fusion.

At the JAERI-Naka site, S. Yamamoto described plans to conduct an experimental program on the in-situ measurement of the properties of ceramic materials under irradiation. Properties and materials of concern for diagnostic components in ITER will be emphasized. Two years to plan and mount the experiments was estimated. Quartz, many candidate ceramics, and metallic mirrors were mentioned. Irradiations in the 14 MeV neutron sources FNS and Oktavian are planned.

Y. Seki briefly described the DEMO power reactor design study completed in 1990. This six-month study was able to do a complete conceptual design by the effort of 50 to 60 people from Japanese industry. These were the same people who had previously contributed to FER and ITER design activities, so they required little learning time. The concept is a steady state reactor with PWR-type power conversions. The near first wall structure is designed so that the front 20 cm can be replaced every two years; the balance of the blanket is expected to last the life of the plant. The design uses a low activation ferritic steel structure with water cooling. The blanket is Li_2O with Be neutron multiplication and a He stream for tritium recovery. Publication of the study is expected soon.

APPENDIX A
ITINERARIES

K. R. Thoms

January 1991

- 11-12 Travel from Oak Ridge, Tennessee to Tokyo, Japan
- 13 Weekend
- 14-16 International Panel on 14 MeV Intense Neutron Source Based on Accelerators for Fusion Materials Study, University of Tokyo
- 17 Vacation
- 18 Travel from Tokyo, Japan to Kingston, Tennessee

F. W. Wiffen

January 1991

- 11-13 Travel from Gaithersburg, Maryland to Tokyo, Japan with weather delay in Newark, New Jersey
- 14-16 International Panel on 14 MeV Intense Neutron Source Based on Accelerators for Fusion Materials Study, University of Tokyo
- 16 IEA High Energy, High Flux Neutron Source Working Group, University of Tokyo
- 17 Travel from Tokyo to Sapporo, Japan
- 18-19 Fourth FFTF/MOTA Experimenters' Workshop, Hokkaido University, Sapporo
- 20 Travel from Sapporo to Mito, Japan
- 21 Visit JAERI at Tokai, Oarai, and Naka Sites
- 22 Travel from Mito, Japan to Gaithersburg, Maryland

APPENDIX B

Jan. 11, 1991

International Panel on 14MeV Intense Neutron Source Based on Accelerators for Fusion Material Study

January 14

Session 1 9:30-10:00 Chairman: S. Ishino/R. E. Price

1. Welcome T. Kondo (JAERI)
2. Opening Address A. Miyahara (NIFS)
3. Requirements for the 14 MeV Intense Neutron Source for Fusion Material Study
S. Ishino (Univ. Tokyo)

Session 2 10:00-13:00 Chairman: T. Kondo/D. L. Smith

1. The U.S. Approach, Plans and Options R. E. Price (DOE)
2. Overview of Japanese Activities on Accelerator-Based Neutron Source for Nuclear Fusion Research K. Noda (JAERI)
3. Need for In-Situ/In-Beam Experiments under Realistic Condition E. R. Hodgson (CIEMAT)
4. User-Developed Criteria for a Neutron Source F. W. Wiffen (DOE)
5. Needs of INS for ITER Related Material R&D T. Tanabe (Osaka Univ.)
6. IEA Source Evaluation Working Group D. G. Doran (PNL)

Luncheon 13:00-14:30

Session 3 14:30-18:00 Chairman: A. Miyahara/F. W. Wiffen

1. A Fusion Test Facility Based on CWDD D. L. Smith (ANL)
2. Accelerator System of ESNIT - Energy Selective Neutron Irradiation Test Facility
M. Odera (JAERI)
3. Design Concept for a Full-Scale D-Li IFMIF G. P. Lawrence (LANL)
4. Canadian Accelerator Program and its Relation to Fusion Research
B. G. Chidley (AECL)
5. Additional Studies Related to the Proposal for a Novel High-Intensity 14 MeV Cut Off Neutron Source Based on the $^1\text{H}(t, n)^3\text{He}$ Source Reaction S. Cierjacks (KfK)

Reception 18:00-20:00

January 15

Session 4 9:00-13:00 Chairman: M. Odera/B. G. Chidley

1. Advanced Conventional Accelerator Technology S. O. Schriber (LANL)

2. Realistic Approach to the 35 MeV Deuteron Accelerator for INS
K. Yamamoto (Toshiba) & S. Kawasaki (Saitama Univ.)
3. Feasibility Study of an Intermediate Intensity Neutron Source (SORGENTINA)
M. Martone (ENEA)
4. Generation of High Current Density H^+ and H^- Beams Y. Okumura (JAERI)
5. Superconducting Accelerator Components and Systems R. B. Clare (ANL)
6. Availability of High Power CW Tubes for the INS A. Miyahara (NIFS)
7. Design of rf System for the INS Y. Taniguchi (Denko)

Luncheon 13:00-14:30

Session 5 14:30-17:30 Chairman: H. Katsuta/E. R. Hodgson

1. FMIT Lithium Target Technology [Includes Video Presentation on Target Experiment]
S. O. Schriber
2. Concept of Beam Target and Lithium Circulation System for ESNIT Y. Kato (JAERI)
3. Multiple Targets, Multiple Beams for IFMTF G. P. Lawrence (LANL)
4. Comment on Target Technology for INS A. Isoy (ULVAC)
5. Neutron Spectra of D-Li Reaction M. Sugimoto (JAERI)

Banquet 18:00-20:00

January 16

Session 6 9:00-13:00 Chairman: H. Ono/D. G. Doran

6. FMIT Neutronics and Test Cell Design F. M. Mann (WHC)
7. Needs and Concept of Post Irradiation Examination (PIE) Facility for Small Specimen Experiments H. Matsuo (JAERI)
8. Irradiation Test Assembly Requirements K. R. Thoms (ORNL)
9. Requirements for Post-Irradiation Examination Facility H. Matsui (Tohoku Univ.)
10. Comments on In-Situ Experimentation C. Kinoshita (Kyushu Univ.)

Luncheon 13:00-14:30

Session 7 Summary & Conclusions 14:30-17:30 Chairman: A. Miyahara/R. E. Price

1. Summary of Each Technical Session
 - Session 2 T. Kondo/D. L. Smith
 - Session 3 A. Miyahara/F. W. Wiffen
 - Session 4 M. Odera/B. G. Chidley
 - Session 5 H. Katsuta/E. R. Hodgson
 - Session 6 H. Ono/D. G. Doran
2. Panel Discussions on International Sharing, Based on RTNS-II and FFTF Experiences, Cost, Funding, Siting, Facilities and PIE
E. R. Hodgson, F. W. Wiffen, M. Martone, S. Ishino, D. G. Doran, T. Kondo, A. Kohyama, and K. Sumita
3. Summary, Conclusion and Recommendations

APPENDIX C

INTERNATIONAL PANEL
PARTICIPANTS LIST
UNIVERSITY OF TOKYO
JANUARY 14-16, 1991

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APPENDIX D

IEA High Energy, High Flux Neutron Source Working Group

Members of the Working Group will meet after the International Panel as follows:

- * Date and Time: Wednesday, January 16, 1991
18:00 - 21:00
- * Meeting Place: Gakushi Kaikan (Main building)
Dinner will be served.

U.S.: D. G. Doran (Chairman)
F. W. Wiffer (Observer)
F. M. Mann (Observer/Contributor)

EC: S. Cierjacks
E. R. Hodgson

Japan: T. Kondo (Observer)
K. Noda
S. Ishino
A. Miyahara (Observer)

APPENDIX E**IEA HIGH ENERGY, HIGH FLUX NEUTRON SOURCE
WORKING GROUP MEETING**

Jan. 16, 1991

AGENDA**I. D-Li Issues****A. Spectrum requirements**

How data would be used: direct correlation
Neutrons above 14 MeV
Spectral tailoring
Multiple deuteron energies (optimum energy?)

B. Nuclear data

Evaluations
Transmutation uncertainties

C. Flux/volume

Resolve uncertainties in calculations
Minimum requirements for international facility
- Intermediate intensity
- High intensity

D. Test cell requirements(number?)**II. T-H Issues**

Flux/volume calculations
Spatial dependence of damage parameters
Gradients
Tritium system
Target system (water viable?)
Advocating laboratory

III. Spallation Issues

Code development and verification
Facility description
Advocating laboratory

IV. Beam Plasma

Monitor what activity there is, don't do anything else.

APPENDIX F

AGENDA OF THE FOURTH FTF/MOTA EXPERIMENTERS' WORKSHOP

January 18-19, 1991

at

Hokkaido University, Sapporo

OBJECTIVE AND SCOPE

Reflecting the uncertain situation of FTF operation in the near future, reconsideration of each research objective in relation to the irradiation facilities and experimental techniques most relevant to the objective seems timely and appropriate.

Nevertheless, it is equally true that the experimental planning on specimens already irradiated or to be irradiated in the FTF up to the Cycle 12 will be requested for research to be carried out for the coming several years.

The workshop is designed to summarize past achievements and future experimental plans related to the FTF/MOTA and to seek for future directions of irradiation studies not particularly restricted to the FTF. Therefore the workshop comprises sessions to discuss past and near future of the FTF Project and that to discuss new directions in the future.

Shiori Ishino,

Workshop key person of the host side

January 18 (Friday)**1.OVERVIEW**

Chairman: A.Kohyama

9:30 - 10:10

Opening remarks and overview of Japanese fusion materials research activities;
- S.Ishino

Overview of U.S. fusion materials research activities including FTF forecast and status of alternative measures

- F.W.Wiffen

2.REVIEW OF THE PROGRESS

Chairman: T.Misawa

10:10 - 11:00

Review of the FTF/MOTA operation

- F.A.Garner/D.S.Gelles

Review of the progress of materials research in the U.S. since the last workshop (Dec.1989)

- F.A.Garner/D.S.Gelles

11:00 - 11:20

(COFFEE BREAK)

11:20- 12:00

Chairman: T.Shikama

Review of the progress of materials research in Japan
since the last workshop -I-

a: Alloy development (1)	- S. Ohnuki
b: Alloy development (2)	- A. Kimura
c: Fission-fusion correlation	- N. Sekimura

12:00 - 13:30

(LUNCHEON)

13:30 - 14:45

Chairmen: M.Kiritani/F.W.Wiffen

Review of the progress of materials research in Japan
since the last workshop -II-

d: Ceramics and composites	- M. Iseki
e: Small Specimen Technique	- A. Okada
f: Welds and Joints	- K. Abe
g: Neutronics and dosimetry	- T. Iguchi
h: Irradiation database	- Y. Kohno
i: Computational studies	- Y. Katoh

14:45 - 15:30

Review of the MOTA-2B status

a: in the U.S.	- F.A.Garner
b: in Japan	- T. Muroga

15:30 - 15:45

Status of MOTA dosimetry for cycle 10 and beyond

- F.A.Garner
for L.Greenwood and H.L.Heinisch

15:45 - 16:15

(COFFEE BREAK)

3.FUTURE DIRECTIONS OF IRRADIATION STUDIES AND TECHNIQUES

Chairmen: S.Ishino/D.S.Gelles

16:15 -16:35

Establishing irradiation correlation using fission reactors with improved control

- M. Kiritani

16:35 - 17:05

Use of the facilities with surrogate spectra for the study of the fusion materials
irradiation effects

- F.A.Garner

17:05 - 17:35

Current design of instrumented in-core facilities with temperature control for material irradiation in EBR-II

- W. Lehto

17:35 - 18:00

General discussion

18:00 - 18:30

(BREAK)

18:30 - 20:30

Japanese style dinner

January 19 (Saturday)

4. POST IRRADIATION EXPERIMENTS

Chairmen: H. Takahashi/F.A. Garner

9:30 - 9:50

Present status of the automated tensile machine and its installation

- A. Kohyama

9:50 - 10:10

Availability of PIE facilities and technical support in the U.S.

- D. S. Gelles

10:10 - 10:30

Status of the IMR-Oarai facilities

- T. Shikama

10:30 - 10:50

(COFFEE BREAK)

5. P.I.E. PLANNING FOR MOTA-2A SPECIMENS

Chairmen: K. Abe/W. Lehto

10:50 - 11:10

Japanese plan including transporting irradiated specimens

- H. Matsui

11:10 - 11:30

The U.S. planning and comments to the Japanese plan

- F.A. Garner

6. POTENTIAL AREAS FOR FUTURE COLLABORATION

11:30 - 12:30

a;Japanese proposal

- H. Takahashi

b;U.S. proposal

- F.A.Garner

12:30 - 14:00

(LUNCHEON)

7. GENERAL DISCUSSIONS

Chairman: H.Matsui

14:00 - 15:30

8. SUMMARY AND CONCLUSIONS

Chairman: T.Muroga

15:30 - 16:30

Summary of each technical session

- Session Chairmen

16:30 - 16:50

Closing remarks

- S. Ishino

16:50

ADJOURN

APPENDIX G

LIST OF PARTICIPANTS

JAPAN:

ABE, Katsunori	Tohoku University
IGATA, Naohiro	Science University of Tokyo
IGUCHI, Tetsuo	University of Tokyo
ISEKI, Michio	Nagoya University
ISHIDA, Iwao	Hokkaido University
ISHINO, Shiori	University of Tokyo
KATOH, Yutai	University of Tokyo
KAWANISHI, Hiroshi	University of Tokyo
KIMURA, Akihiko	Muroran Institute of Technology
KINOSHITA, Hiroshi	Hokkaido University
KIRITANI, Michio	Nagoya University
KOHNO, Yutaka	University of Tokyo
KOYAMA, Akira	University of Tokyo
MATSUI, Hideki	Tohoku University
MISAWA, Toshihei	Muroran Institute of Technology
MUROGA, Takeo	Kyushu University
NAMBA, Chusei	National Institute for Fusion Science
OHNUKI, Somei	Hokkaido University
OKADA, Akira	Hokkaido University
SATO, Manabu	Tohoku University
SEKIMURA, Naoto	University of Tokyo
SHIKAMA, Tatsuo	Tohoku University
TAKAHASHI, Heishichiro	Hokkaido University
YOSHIIE, Toshimasa	Hokkaido University

U.S.:

GARNER, F. A.	Battelle Pacific Northwest Laboratory
GELLES, D. S.	Battelle Pacific Northwest Laboratory
LEHTO, W.	Argonne National Laboratory
WIFFEN, F. W.	U.S. Department of Energy