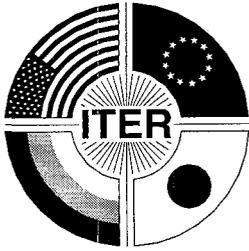




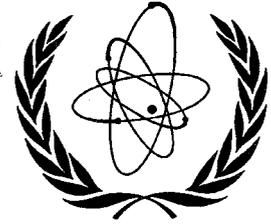
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## INTERNATIONAL THERMONUCLEAR EXPERIMENTAL REACTOR

**ITER EDA NEWSLETTER**

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## **ITER ENGINEERING DESIGN ACTIVITIES SUCCESSFULLY COMPLETED**

The long-term goal of harnessing the energy of nuclear fusion has moved a bit closer, as could be seen at the commemoration of a landmark scientific achievement at IAEA Headquarters in Vienna. During the week 16–20 July 2001, several meetings related to the successful completion of the ITER Engineering Design Activities (EDA) took place at the IAEA. Among them were the final meeting of the ITER Council, the closing ceremony to commemorate the EDA completion, the final meeting of the ITER Management Advisory Committee, a briefing on issues related to ITER developments, and discussions on the possible joint implementation of ITER.

During the EDA, which had been conducted under the auspices of the IAEA, hundreds of leading scientists and engineers from many countries participated in the scientific research aimed at completing the engineering design of the ITER machine. The results of their efforts provide the first comprehensive design of a fusion reactor based on well-established physics and technology. With extensive industrial involvement, seven ITER EDA large R&D projects, which constitute the core of the EDA R&D, have demonstrated that the main ITER components can function properly. The ITER design documents are sufficient to provide the necessary technical basis for a construction decision.

The Engineering Design Activities have been an excellent demonstration of international collaboration involving hundreds of scientists and engineers from around the world. Coming from government and private laboratories, universities and industry, they have designed a reactor that can repeatedly produce 500 MW of fusion power for hundreds of seconds.

The demanding technical challenges of the EDA and its international collaborative nature have led to the breaking of new technical ground in fusion science and engineering. In addition to the technical results, the required work has demanded and enabled new modes of closer collaboration between countries in pursuing this large international project.

In the months ahead, there will be intergovernmental negotiations towards the realization of the joint implementation of the ITER design, including the issues of sharing the costs and the site selection for the construction of the ITER machine. Canada has already offered a site located near the Darlington Nuclear Power Station on the shore of Lake Ontario, and sites at Cadarache, France, and in Japan may also be offered. The direct construction costs would be of the order of US \$3.5 billion and construction may start in 2003. The ITER machine would test plasma burning and demonstrate the feasibility of using energy generated by nuclear fusion, its safety and its environmental acceptability.

## CLOSING CEREMONY

The closing ceremony to commemorate the successful completion of the ITER EDA was held on 18 July at the IAEA Headquarters.

The ceremony was chaired by IAEA Director General Dr. M. ElBaradei. Speaking at the start of the ceremony, he commended ITER's progress as an "excellent demonstration of international collaboration". The completion of the EDA through the work of scientists and engineers worldwide represents "no small achievement", he said, adding that he was pleased to note the IAEA's longstanding association with ITER and its predecessor projects since their inception.



*Dr. M. ElBaradei*

He also noted the publication by the IAEA of the Nuclear Fusion journal since 1960 and the organization of periodic international conferences on fusion-related issues since 1961.

The ITER Parties had asked the IAEA to continue its assistance during the next phase in the ITER developments, the Co-ordinated Technical Activities (CTA), which, inter alia, will adapt the design to a specific site. Dr. ElBaradei confirmed that the IAEA would be ready to continue to provide services in support of such activities. Closing his speech, he said "The IAEA is pleased to be associated with the ITER Project, which could help to facilitate the successful development of clean, safe, abundant fusion energy. We congratulate you on the robust engineering design and on the excellent international co-operation that you have achieved."



*At the Ceremony (from the left): IAEA Deputy Director General Dr. W. Burkart, ITER Council Chair Acad. E.P. Velikhov, IAEA Director General Dr. M. ElBaradei, ITER Council Vice-Chair Dr. Y. Yoshikawa, and IAEA Division Director Dr. D. Sood*

The Chair of the ITER Council, Academician E. Velikhov of the Russian Federation, briefly reviewed milestones in global fusion co-operation. He noted that at the second Geneva Conference on the Peaceful Uses of Atomic Energy in 1958, several technologically advanced countries presented information on the new field of fusion research, which indicated the long-range possibility of harnessing fusion reactions to provide an abundant, clean energy source.

In the 1970s, the tokamak device, invented by Russian scientists, emerged as a leading candidate to become a fusion reactor. The IAEA responded in 1978 by launching the International Tokamak Reactor (INTOR) project, which paved the way for the International Thermonuclear Experimental Reactor (ITER) collaboration.

In 1985, General Secretary Gorbachev of the Soviet Union proposed to President Mitterand of France and then to President Reagan of the USA that a fusion reactor be jointly designed and built. Their positive responses led to the establishment of the collaboration between the four initial ITER Parties (the European Union, Japan, the Soviet Union and the United States of America). The IAEA took a leading role in finalizing this collaboration, which became the ITER Conceptual Design Activities, and in 1988 the first ITER Council Meeting was held in Vienna.

After the successful conclusion of the Conceptual Design Activities, the ITER Parties began the Engineering Design Activities in 1992. The IAEA provided the auspices for both these ITER activities. Later, Canada and Kazakhstan joined ITER as partners through Europe and Russia, respectively. After nine years of efforts by the Joint Central Team and Home Teams, the Engineering Design Activities ended on 21 July.

The Delegations of the current ITER EDA Parties, together with representatives of Canada, have already initiated discussions which are anticipated to lead to the joint implementation of the ITER Project. Joint technical work is now under way to define potential site-specific design adaptations. Canada has formally offered a site for the construction of ITER in Clarington, Ontario; other site proposals are also expected. A decision to build ITER could come as soon as 2003, following the choice of a site and the commitment by the ITER participants of suitable funds. Then the construction phase (about 10 years) may start. This would be followed by an operation phase lasting roughly 20 years. ITER will be one of the world's largest scientific and technical collaborations with the involvement of industry. If successful, ITER could be followed by a demonstration power plant for fusion-generated electricity.

Dr. Umberto Finzi, speaking for Euratom, expressed satisfaction at the completion of the ITER Engineering Design Activities, recognizing the scale of the scientific, technical and managerial challenges that had been successfully addressed. He thanked the IAEA for its consistent support and assistance to the ITER venture, and confirmed the interest of the European Union to move forward with its international partners towards a decision on joint construction of ITER as the next step in establishing fusion as an energy option for the long term.

In his brief statement, H.E. Ambassador Nobuyasa Abe, Resident Representative of Japan to the International Organizations in Vienna, commended the completion of the ITER Engineering Design Activities, as the fruit of a long international collaboration. He recollected that science and technology had entered a new era, and contributed to the benefit of mankind. He expected that the further success of ITER could play a significant role in coping with the energy problem, which is linked to global environmental issues.

Mr. Ira N. Goldman, Science Attaché at the US Mission to the International Organizations in Vienna, said, on behalf of the USA, which had been an important contributor to the ITER Project until a few years ago, that the US Government and the US fusion programme wished to congratulate the ITER EDA Parties and the ITER EDA Director and Joint Central Team for their successful work over the past few years since the US withdrawal. Further, expressing his own view, he said "The successful completion of the ITER EDA, emphasizing, in particular, both the cost reductions and forward-looking design, along with the preparatory actions by the ITER Parties aimed at negotiations on hosting and constructing, including the first site offer, would also seem to address the issues raised by the US Congress when it decided to end US participation in the project three years ago. I personally hope that this will be recognized by our Congressional leadership, and that a dialogue could begin between the US Department of Energy and the relevant congressional committees to consider the possibility of US participation in future ITER activities."

The ITER EDA Director, Dr R. Aymar, thanked the IAEA Director General and the other speakers for their statements commending the successful work leading to the completion of the ITER EDA. He referred to the nine years of intensive joint work by the ITER Joint Central Team and Home Teams, and to the dedication of each of their Members, which had allowed the ITER Parties to have now at their disposal all the results they were expecting when the ITER EDA Agreement was signed. Indeed the ITER design met all detailed objectives set up for it, with margins in physics and technology to allow for uncertainties, while satisfying an affordable cost target. There was now a consensus through the scientific community that, with the EDA achievements, the fusion development programme was technically ready and able to proceed to ITER construction in an international framework. It remained to the Parties to agree on joint implementation and there was no technical justification for a delay in decision.

He pointed out that all the Team Members should be proud of and congratulated for their achievements. This indeed had not been easy work: bringing scientists and engineers from different parts of the world with different cultures, habits and experience to work together efficiently in an integrated way was no less a challenge than the demanding technical issues facing the Project. Insurmountable difficulties were often forecasted by outsiders. It should now be recognized that the new modes of close collaboration, set up for EDA, pooling worldwide expertise among physicists, technologists and industrialists, have in some crucial cases been more effective in problem solving than could have been expected from purely national teams. Therefore a joint implementation of ITER can now be envisaged with confidence provided the potential ITER Parties support the full integration of teams and efforts.

He added a last word to thank the Agency for its continuous assistance to ITER, in addition to the support already mentioned by the IAEA Director General, such as the operation of the ITER Joint Fund which relied on the excellent caretaking of the IAEA Trust Fund and the publication of the ITER Newsletter and of all top-level ITER documentation which provided much needed public information worldwide.

The participants in the ceremony were invited by the IAEA to toast on the successful completion of the EDA with a glass of champagne.



*Acad. E. Velikhov with Members of the Japanese Delegation*

## FINAL MEETING OF THE ITER COUNCIL

After nine years of intensive effort, the International Thermonuclear Experimental Reactor (ITER) project — which originated as a joint undertaking by the European Commission, Japan, the Soviet Union and the United States of America under the auspices of the International Atomic Energy Agency - has successfully completed its Engineering Design Activities (EDA).

Upon completion of the EDA, the ITER Council, the governing body of this venture, with representatives of the European Union, Japan, and the Russian Federation, assembled for its last meeting on 18 and 19 July at the IAEA Headquarters in Vienna.

It was the unanimous view of the Parties that the ITER EDA objectives have been entirely accomplished. The Parties' representatives commended the IC Chair, the IC Co-Chair and the ITER Director for their efforts towards the successful completion of the EDA.

The Council approved the Final Report of the ITER EDA and took note of the Director's Status Report (see separate article). The Council noted with great satisfaction the "ITER Technical Activities Report" presented by the Director and, having heard the positive views of the Parties based on their in-depth domestic assessments, and following discussions, approved for transmission to the Parties the Director's report on the ITER design as summarized in the "Summary of the ITER Final Design Report".

The ITER design documents contain information on the first comprehensive design of a fusion reactor based on well-established physics and technology. They would be sufficient — when complemented by site-specific adaptation of the design — to serve as the necessary technical basis for a construction decision.



*Participants in the final meeting of the ITER Council*

The Council expressed its appreciation to the Director, the Joint Central Team and the Home Teams for fulfilling the task set for them and for the quality and depth of the work completed.

The Council took note of the MAC Report and Advice, and accepted its recommendations. The Council considered the MAC obligations as fulfilled and expressed its sincere thanks to the MAC Chair and the MAC members for their consistent contribution to the administration of ITER during the EDA.

The Parties' representatives thanked the IAEA for its vital role in the progress of ITER and in the development of fusion in general for the benefit of all humankind.

The Council asked the Chair and Co-Chair, in consultation with the Parties, to send letters of recognition to all individuals who have contributed to the success of the EDA.

It was the common view of the ITER Council that, at a time of increasing global pressure on energy resources and global environmental concerns, the time is ripe to undertake the next step in the development of fusion energy. This will establish fusion as an option for large-scale energy supply with intrinsic safety and environmental benefits in the long term.

## **BRIEFING ON THE COMPLETION OF THE EDA**

At the beginning of July the IAEA issued the following invitation:

### ***MEDIA ADVISORY***

*The International Atomic Energy Agency invites you to a Briefing on*  
**Successful Completion of the International Thermonuclear  
Experimental Reactor Engineering Design**

Tuesday, 17 July at 14.00

at the Vienna International Centre (VIC)  
Board Room C-04 (C-Building)

The IAEA will host the commemoration of a landmark achievement in fusion energy research. Under IAEA auspices, several hundred scientists and engineers from Europe, Japan, Russia, and the USA participated in the design of the International Thermonuclear Experimental Reactor (ITER), a device which will be capable of generating 500 MW of fusion power for hundreds of seconds. The commemoration marks the completion of the Engineering Design Activities (1992–2001). If successful, ITER could lead to the construction of a demonstration fusion power plant that generates large amounts of electricity.

At the briefing, Dr. M. Yoshikawa, Chairman of the ITER Management Advisory Committee, will speak on the role of fusion energy in the future. Academician E.P. Velikhov, Chairman of the ITER Council, will speak about the history of the ITER project and ITER Director Dr. R. Aymar will talk about ITER objectives and parameters. A panel discussion and question and answer session will follow.

In spite of the high season of summer vacations, the response to this invitation was very good. More than one hundred IAEA staff members, members of the Missions to the IAEA, representatives of media and Vienna University staff and students attended the briefing.

The briefing was moderated by Dr. Derek Robinson, Director, Culham Laboratory, UK, who is now also Vice-Chair of the International Fusion Research Council (IFRC), Advisory Body to the IAEA.

In addition to the speakers listed above, Dr. Werner Burkart, IAEA Deputy Director General, Department of Nuclear Sciences and Applications, briefed the audience on IAEA activities related to fusion.

For the participants' information, various booklets were provided, as well as IAEA publications related to ITER, and other printed material on fusion in general and on ITER in particular. In the main lobby of the Vienna International Centre there was an exhibition of posters from the JCT and from the Parties on the ITER EDA and on fusion in general.



*At the briefing*

The IAEA organizers of the briefing would like to express their deep gratitude to the speakers and to the organizations and persons who provided the briefing with information material.

## **DISCUSSIONS ON IMPLEMENTATION OF ITER**

Delegations from Canada, the European Union, Japan and the Russian Federation held their second meeting in Vienna to further the joint discussions that are anticipated to lead to agreements to implement the ITER Project. This meeting follows a successful first meeting in Moscow in June.

At the meeting, held on 17–19 July, significant progress was made, including:

- Development of an overall indicative work programme with milestones, which sets out the plans to conclude an international agreement by the end of 2002 to implement ITER.
- Establishment of the framework for the support of negotiations and preparation for ITER implementation by an international team of scientists and engineers working out of offices in Garching, Germany, and in Naka, Japan.
- Formation of a standing sub-group of experts to support the negotiations process.

The participants agreed to meet again in Toronto in October to further their discussions.

## SOCIAL EVENTS

The participants in the meetings related to ITER and held in Vienna during the week 16-20 July, had several additional opportunities for informal contacts and discussions at social events related to ITER. This purpose was served by the luncheon hosted by IAEA Deputy Director General W. Burkart, and the dinners given on behalf of the European Commission of the Government of Japan.



*At the reception*

Further, a reception on the occasion of the completion of the EDA was held at the Permanent Mission of the Russian Federation to the International Organizations in Vienna.



*Hosting the reception (from left): First Deputy RF Minister on Atomic Energy V. Vinogradov, ITER Council Chair Acad. E. Velikhov, and Ambassador G. Berdennikov, RF Resident Representative to the International Organizations in Vienna*

## ITER EDA STATUS

This note summarizes the progress made in the ITER Engineering Design Activities in the period between the Toronto ITER Council Meeting in February, and July 2001, as reported to the ITER Council by the Director.

### **Overview**

The Project has concentrated on the finalization of the entire ITER documentation structure (ITER Final Design Report) in time for the end of the EDA and on the basis of the comments received from the Parties' domestic assessments. The synoptic summary paper of the Final Design Report has also been finalized for distribution to the ITER Council.

The top-level technical documents (Plant Design Specifications, Plant Description Document and annexes, Design Requirements and Guidelines Level 1 and annexes) have been completed and a compact disc has been prepared for distribution to the Parties at this ITER Council meeting. The remainder of the documentation as well as drawings are also nearly completed and will be delivered to the Parties shortly.

The Director has continued to hold discussions with the Home Team Leaders in order to prepare for the integrated organization of the International Team and Participants Teams during the Negotiations (Co-ordinated Technical Activities, CTA).

### R&D Progress

The fabrication of the TF Insert was completed in the RF and delivered to JAERI in May 2001. It is now being installed in the CS MC test facility and its testing is expected to start in September. The tests of the TF Insert will be completed by the end of this year. Early next year, the Nb3Al insert will be installed and tested in the test facility. The whole programme is expected to be completed by July 2002.

The TF Model Coil has been installed in the TOSCA test facility, and tests will start in July 2001. The testing will be continued until the end of this year.

During the nine years of the EDA, 815 R&D Task Agreements were developed and performed successfully under collaboration among the JCT and Parties. The achievements of the R&D tasks are summarized in the "ITER Technology R&D", which will be published in July 2001 in the journal Fusion Engineering and Design (ref. ITER Technology R&D, ITER JCT and Home Teams, Fusion Engineering and Design 55 (2001) 97 - 358). The R&D results support the design of ITER and give confidence in its feasibility. The effectiveness of international collaboration was also tested during these R&D efforts, with a very constructive outcome.

### Safety

The second meeting of the ITER Parties' Designated Safety Representatives took place in Tokyo, 21-22 May 2001. Discussions focused on progress in preparation for siting, including regulatory aspects, scope of regulatory examination and required documentation, and quality assurance, codes and standards to be applied to ITER. It was agreed that the international nature of ITER must be respected, which will require a level of understanding by all project participants of the regulations and processes to be applied to ITER at any site. The scope of the generic safety approach and the Generic Site Safety Report appears to be a reasonable basis for potential host teams to prepare for the regulatory application tailored to the specific site, and the need was confirmed for site-specific interaction between the Design Authority and those potential host teams. For more information about the results of the meeting, see an article on this subject in the June 2001 ITER EDA Newsletter (Vol. 10, No. 6).

Also at this meeting, it was agreed that proper activities for quality assurance (QA) must be executed, referring to ISO standards and other well-recognized standards. This QA programme needs to cover all interfaces between the ILE and its regulator for safety important items and between the ILE and its suppliers for all items.

### Joint Central Team and Support

The status of the JCT at the start of July 2001 is summarized in the table below. Since the last ITER Council meeting, there have been small changes in the number of staff and their distribution among Parties: one Canadian staff member left Garching and ITER, being replaced by another at Naka; three Japanese staff members left the JCT (one from Garching, two from Naka) with an additional one joining the team at Naka.

**JCT - Status by Joint Work Site and Party at 1 July 2001**

	Garching	Naka		Total
by Site	43*	50		93*
	EU	JA	RF	
by Party	37*	31	25	93*

\*) includes two Canadian staff members provided through the Canadian association with the EU Party.

The JCT numbers have been supplemented by VHTP's (~3-4 PPY from RF, and ~4-5 PPY from EU, on average in the past year) and other temporary attachments to the JCT.

The estimated cumulative PPY effort on site to 1 July 2001 is shown below by JWS and by Party.

**PPYs JCT on-site to 1 July 2001**

	Garching	Naka	San Diego		Total
by Site	350	383	266		999
	EU	JA	RF	US	
by Party	335	293	185	186	999

The Visiting Home Team Personnel scheme continues to function well as a means to enhance JCT/Home Team interaction and to offer some flexibility. As noted at IC-10, some VHTPs are being assigned by the RF in lieu of further JCT secondments. They are therefore accorded zero PPY credit and are noted in the RF contribution to JCT resources.

**Cumulative VHTP effort (PPY) from July 1998 to July 2001**

	EU	JA	RF	US (to 7/99)	Total
Garching	4.95	0	3.0	-	7.95
Naka	4.17	5.5*	3.5	0.0	13.17*
San Diego (to 3/1999)	0		0.0	-	0
Total	9.12	5.5	6.5	0	21.12

\* includes two visiting scientists

**Task Assignments**

The status of existing Task Assignments was reported to the ITER Council in a separate paper. The total resources contributed by the three Parties for the period July 1992- July 2001 are 549,094 IUA for technology R&D and 771.81 PPY for design tasks. Including the US contribution up to July 1999, the total becomes 657,284 IUA and 942.52 PPY, respectively.

**R&D Task Agreements Summary per Party**

Party	R&D resources 7/1992 - 7/2001	Design resources 7/1992 - 7/2001
EU	231,841	290.68
Japan	224,650	267.38
Russia	92,603	213.75
Total	549,094	771.81
US*	108,190	170.71
Grand Total	657,284	942.52

\* US contribution up to 7/99

The task status is summarized as of 13 July 2001. Some six hundred Technology R&D Task Agreements have been completed or are to be completed with receipt and/or acceptance of their Final Reports. For Design Task Agreements, the work has been completed and the results were incorporated into the ITER Final Design Report although some final reporting is still outstanding. An overall total of 531 have been completed and concluded. The table overleaf summarizes the status of R&D and Design Task Agreements, showing their numbers over the entire period of the ITER EDA.

### Number of Task Agreements (cumulative)

	R&D Number	Design Number
Task Agreements committed (EU,JA,RF)	642	531
Task Agreements completed	594	531
Final reporting to be completed	48	0
<i>US (to 7/99)</i>	<i>173</i>	<i>162</i>

#### ITER Physics

The seven ITER Physics Expert Groups are still in full operation and the arrangements for continued interaction with US fusion scientists on generic issues of tokamak physics being focussed on by ITER are proceeding smoothly. A new framework, called the International Tokamak Physics Activity (ITPA), is being planned following an initiative by the IFRC, advisory body to the IAEA. It was proposed that the new framework after July 2001 should have a structure and membership similar to ITER Expert Groups, with the additional participation of US physicists.

### EDITORIAL

The July 2001 ITER EDA Newsletter issue completes the series which started in 1992. Deviating from the established procedures and practices, the drafts of all articles of this issue were not prepared by various authors, but by Boris Kuvshinnikov, ITER Office Vienna. These drafts were then reviewed by the ITER Contact Persons (CPs), as had been done for all the articles published during the EDA. Most of the photographs in this issue are by courtesy of Dr. N. Kornev, former member of MAC.

Throughout the years of the EDA, the role of the CPs in making the ITER Newsletter accurate, precise and informative, has always been extremely important. Therefore, the ITER Office in Vienna wishes to extend thanks to the following CPs for their constant support and advice during the EDA:

**EU:** E. Canobbio, M. Drew  
**Japan:** A. Kitsunezaki, H. Takatsu, Y. Okumura  
**RF:** L. Golubchikov  
**US (until 1999):** M. Roberts  
**ITER Director's CP:** M. Drew, P. Barabaschi

The ITER Office would also like to thank all the authors of the articles published during the EDA (see attached list) for their positive response to the requests for articles.

At its preparatory meeting, held on 16 July 2001 in Vienna, the Co-ordinated Technical Activities (CTA) Board recognized the value of having an ITER Office located at the IAEA in Vienna and decided that this Office should continue its activities as specified in the Attachment to the Terms of Reference for the CTA and agreed upon by the IAEA.

One of the provisions included in the Terms of Reference is publication of the CTA Newsletter and the ITER Office is looking forward to continuing the co-operation so well established during the EDA with all those involved in the CTA. The editorial policy of the Newsletter will not be changed and its "Editorial Board" will consist of the Negotiators' Contact Persons and the Point of Contact with the International Team Leader: P. Barnard (Canada), J.-P. Rager (EU), Y. Okumura (JA), V. Korzhavin (RF), and P. Barabaschi (IT).

ITER Office Vienna  
B. Kuvshinnikov, C. Basaldella

**LIST OF AUTHORS OF ARTICLES PUBLISHED IN THE ITER EDA NEWSLETTER  
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Basaldella, C.	Gormezano, C.	Mitin, D.	Spears, W.
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Boucher, D.	Hassanein, A.	Nakamura, H.	Takatsu, H.
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Cheng, E.T.	Janeschitz, G.	Pinkau, K.	Tomabechei, K.
Chernov, V.	Janev, R.	Portone, A.	Toschi, R.
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Daenner, W.	Khripunov, V.	Raeder, J.	Wakatani, M.
Dautovich, D.	Kishimoto, H.	Rebut, P.-H.	Wesley, S.
Dietz, K.J.	Kitsunezaki, A.	Riccardi, B.	Wienke, H.
Dillon, P.A.	Knouse, K.	Rigoni, I.	Yoshikawa, M.
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Donné, A.J.H.	Koonce, J.	Rozov, V.	Yousef, M.
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Ellis, W.	Kukushkin, A.S.	Ryter, F.	
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