2002 SPECIFIC MONITORING REPORT ON THE SPECIFIC PROGRAMME FOR RESEARCH AND TECHNOLOGICAL DEVELOPMENT

IN THE FIELD OF

“CONTROLLED THERMONUCLEAR FUSION”

6 May 2003
This Report is part of the series of the annual monitoring reports prepared relating the EC Framework Programme and the Euratom Framework Programme, and their constituent Specific Programmes as well as to the European Research Area (ERA) area related activities (ERA).

The Commission has over the years given increasing emphasis on the evaluation of Community RTD activities. Furthermore, with the overall Reform of the Commission, evaluation activities placed in the heart of the decision making process.

In line with this continuous effort for improvement, a revised programme monitoring scheme was introduced in 2001, based on the system launched in 1995 which involved independent external experts in the monitoring activities. The new mechanism aims at a better synergy between the monitoring of ERA and specific programmes and of the Framework Programme.

The timely response by the Programme management to the recommendations produced by the experts will be enhanced, providing the basis for a quick response mechanism to programme developments, as the follow up of experts recommendations will be receiving still more attention.

This report is the fourth covering the Fifth Framework Programme; the report also highlights progress in relation to implementation of ERA to the launch of the Sixth Framework Programme and results and impact of previous Framework Programmes. The report should help reinforce establishment of best practices and identify the scope for further improvements in implementation of policy and the programmes.

---

**The report consists of two parts:**

**Part A:** External monitoring report prepared by the following independent external experts:

- Dr Giovanni Bisoffi
- Dr Björn Brandt
- Dr Arto Timperi

**Part B:** Responses of the Programme management to the external monitoring report.
PART A:

Report of the 2002 Specific Programme Monitoring Panel

Part A expresses the views of the external monitoring experts
# TABLE OF CONTENTS

1. EXECUTIVE SUMMARY .......................................................................................................................... 5
2. PANEL METHODOLOGY ........................................................................................................................ 7
3. INTRODUCTION .................................................................................................................................. 8
4. ANALYSIS AND FINDINGS .................................................................................................................. 9

## 4.1 ANALYSIS AND SYNTHESIS OF RECOMMENDATIONS AND THEIR FOLLOW-UP FROM THE 1999 TO 2001 MONITORING EXERCISES

1. Strategy and objective ........................................................................................................................... 9
2. Implementation, management and processes .......................................................................................... 10

## 4.2 MONITORING OF THE IMPLEMENTATION IN 2002

1. Follow up of 2001 Recommendations ................................................................................................. 10
2. The Attainment of Objectives in Terms of Implementation as Set Out in the Workprogrammes for 2002 ........................................................................................................................................ 11

### 4.2.1 Follow up of 2001 Recommendations

- Science and Technology ......................................................................................................................... 11
- Industry .................................................................................................................................................. 12
- Socio-economic Aspects ........................................................................................................................ 12
- Public Awareness .................................................................................................................................. 13
- Women and Science .............................................................................................................................. 13
- Age Profile in Fusion ............................................................................................................................ 13
- Mobility and training (including MC fellowships) ................................................................................. 13
- International Cooperation ...................................................................................................................... 14
- ERA ...................................................................................................................................................... 14
- Candidate Countries ............................................................................................................................. 15
- Fast Track ............................................................................................................................................ 16
- Fusion as part of overall Energy Strategy ............................................................................................. 16

### 4.2.2 The Attainment of Objectives in Terms of Implementation as Set Out in the Workprogrammes for 2002

- Science and Technology ......................................................................................................................... 11
- Industry .................................................................................................................................................. 12
- Socio-economic Aspects ........................................................................................................................ 12
- Public Awareness .................................................................................................................................. 17
- Mobility ................................................................................................................................................ 17
- Science and Technology ........................................................................................................................ 16
- Industry .................................................................................................................................................. 17
- Socio-economic Aspects ........................................................................................................................ 18
- Public Awareness .................................................................................................................................. 18
- Mobility and training (including MC fellowships) ................................................................................. 18
- International Cooperation ...................................................................................................................... 18
- ERA ...................................................................................................................................................... 18
- Committee Structure ............................................................................................................................. 18
- Accommodating the Reduced Budget under FP6 ............................................................................... 19
- Monitoring Methodology ...................................................................................................................... 20
- Fusion as part of overall Energy Strategy ............................................................................................. 20

5. CONCLUSIONS AND RECOMMENDATIONS .................................................................................... 20

## 5.1 GENERAL CONCLUSIONS, MAJOR TRENDS, MAIN STRENGTHS AND WEAKNESSES ENCOUNTERED

## 5.2 RECOMMENDATIONS

1. Recommendations on the Specific Programme ................................................................................... 20
2. Recommendation on the Monitoring Methodology .............................................................................. 21

6. ANNEXES .......................................................................................................................................... 22

## 6.1 BUDGET FOR SP .................................................................................................................................. 22

## 6.2 ABBREVIATIONS .................................................................................................................................. 23

## 6.3 DOCUMENTS PROVIDED TO THE EXPERTS BY THE PROGRAMME MANAGEMENT

## 6.4 COMMON MATRIX: ANALYSIS AND SYNTHESIS OF RECOMMENDATIONS AND THEIR FOLLOW-UP FROM THE 1999 TO 2001 MONITORING EXERCISES

## 6.4.1 STRATEGY AND OBJECTIVE

## 6.4.2 IMPLEMENTATION, MANAGEMENT AND PROCESSES

## 6.4.3 IMPACT OF POLICY AND PROGRAMMES

## 6.4.4 OTHERS
1 EXECUTIVE SUMMARY

Thermonuclear fusion R&D is a ‘Key Action’ in the Fifth Framework Programme (Euratom), embracing all the research activities undertaken in the Member States aimed at harnessing fusion energy, and with the long-term objective of the joint creation of prototype reactors for safe, environment compatible, economically viable power production. The programme is carried out by a highly experienced and closely coordinated ‘ensemble’ of researchers from national Institutions, which have Contracts of Association with Euratom.

A Programme Committee (CCE-FU), whose members are directly appointed by the governments of the countries in Euratom, advises the Commission on the steering of the fusion programme as a whole, while the European Fusion Development Agreement (EFDA) organises the cooperative work among the Associations on JET (Joint European Torus), as well as co-ordinating fusion technology R&D and contributions to international co-operations. Since the CCE-FU and the EFDA Steering Committee carry out a monitoring of the scientific and technical aspects of the execution of the programme, emphasis was given, in the monitoring exercise of the present panel, to an assessment of the work directly involving the Commission Services, which is not subject to a specific assessment by these committees or their sub-committees. However, the panel has also provided an overall assessment of strategy, objectives and implementation of the whole programme, following the mandate established by the Commission.

The year 2002 was marked by significant steps forward in the preparations for a decision on whether to proceed with ITER (International Thermonuclear Experimental Reactor), which should be the ‘Next Step’ in fusion R&D on the route to fusion power. The formal negotiations on the possible joint implementation of ITER with international partners continued throughout 2002. The Commission submitted offers by the French and Spanish governments to host ITER on their territories: the panel strongly feels the need to take a decision on a European site as soon as possible, so as to keep the European option a very strong one.

The panel finds that, in parallel with ITER and in view of the future prototype reactor, a very good European level of R&D in key technologies and in other approaches similar to the Tokamak line, should be absolutely maintained in the Associations, with appropriate financial resources: the Commission should set up a strategic plan for the necessary accompanying programme of fusion research and for the construction of ITER.

As far as industry is concerned, the panel finds that wider cooperation with the programme is desirable, and recommends that the transfer of technologies and expertise between industry and the fusion programme be strengthened through a continuing and significant increase in the involvement of industry in the programme.

At the programme organisation level, the fusion committee structure has been streamlined to improve co-ordination, particularly in view of a possible decision on ITER construction. The panel appreciates this, while recalling that it is important that the Commission prepares for further modifications as soon as a decision on ITER is taken: In this context, a strong individual leadership, as in industry, is needed as a complement to the committee ‘bureaucracy’, which is of course necessary but should be minimised as much as possible.

The Commission is recommended to gather and provide fresh data from the Associations on their staff structure, its age profile, the distribution of women in all roles and levels, with a view to initiating action to reduce any imbalances.

As far as the new Associations in the candidate countries are concerned, the Commission should continue its efforts to assist their increased participation in the programme, and to help them in using the available instruments for acquiring tasks and receiving support.

The Commission should enhance the effectiveness of the organisation of public awareness activities, involving an active engagement of all Associations. This is particularly important in relation to the decision making and start up of the ITER project. Provisions in the Contracts of Association and the capacities of EFDA should also be exploited.
The panel finds that the Commission guidelines for the monitoring process are clear and comprehensive. However they are not well suited to the situation in the fusion programme, which is very different from all other programmes (eg specific requests regarding statistical information on Calls etc). Adapted guidelines should be developed for the fusion monitoring.

Moreover, the present panel strongly supports a general system of two-yearly monitoring, with possibly more limited reports in alternate years, or a midterm review type monitoring. The panel feels this would be a more efficient use of the Commission’s resources.

In conclusion, the panel finds that the fusion programme is very professionally managed, in general and at the level of the Commission services in particular. The Commission is recommended to take greater advantage of this example programme when describing and promoting the European Research Area (ERA), of which it represents an excellent, long standing example.
2 PANEL METHODOLOGY

The external monitoring has been undertaken in accordance with the legislative requirements given in Article 5 of the Council Decision of 22 December 1998 on the 5th EC Framework Programme and on the Euratom Framework Programme, and with Article 4 of the Council Decision of 25 January 1999 adopting the Specific Programme in the field of nuclear energy (Euratom). Annexes I and II of this Council Decision specify the objectives and Research and Technological Development (RTD) priorities of the Key Action on Controlled thermonuclear Fusion [1.1, 1.3].

The Commission has asked a panel of three independent experts to monitor the implementation of the Fusion Programme in the year 2002 along the methodological Broad Guidelines of 8 November 2002 [2.02]. The year 2002 is both the last year of implementation of the Fifth Framework Programme (1998-2002) and the first of the Sixth Framework programme (2002-2006 which was adopted mid-2002) and has been especially designed to help the implementation of the European Research Area. In this context, and in view of the Five Year assessment (1999-2003) to be launched in 2003, the 2002 monitoring exercise should focus on the following main issues:

- Analysis and synthesis of recommendations and their follow up and results, from the 1999 to 2001 monitoring exercises,
- Monitoring of the implementation in 2002,
- follow up of expert recommendations from the 2001 monitoring exercise,
- the attainment of objectives in terms of implementation of operational objectives set out for ERA,
- preparation of the Sixth Framework Programme, in particular the aspects contributing to the realisation of the objectives of the European Research Area,
- as this is the last annual fusion monitoring report the expert group has placed special emphasis on recommendations for the programme implementation in FP6.

Panel members were Arto Timperi (chairman), Giovanni Bisoffi and Björn Brandt. In preparing this report the experts were assisted by Nicolette Walshe of AEA Technology plc, UK.

Having used the information provided to the experts, i.e. the documents listed in annex 6.3, and having had intensive discussions with staff of DG Research (Pablo Fernandez Ruiz, Director of Directorate J from mid-March 2002, Hardo Bruhns, head of Unit J.6, acting Director of Directorate J until mid-March 2002, Umberto Finzi, Principal Advisor to the Director General on matters concerning fusion, Jean-Pierre Rager, head of Unit J.5, Douglas Bartlett, and Rosa Antidormi) the experts have met four times in the period from 8 November 2002 to 12 February 2003 (on which latter day the main parts of the monitoring report were finalised). In addition, interviews were held with some members of the programme committee (CCE-FU) from Finland, Italy and Sweden. Paul Vandenplas, vice chairman of the CCE-FU and member of the Committee on Fusion Industry (CFI), has also been interviewed by the whole panel. Panel members individually had detailed discussions with approximately 45 people: key staff of the Associations, fusion researchers from candidates countries and also from industry and EFDA.

As usual in the monitoring exercise of the Fusion Programme, the actual mandate (working method) of the Panel is substantially different from the other programmes of DG RTD. The Programme is executed by a highly experienced and closely coordinated 'ensemble' of researchers from the national Institutions, each with a Contract of Association with Euratom. The CCE-FU, whose members are directly appointed by the governments of the countries in Euratom, advises the Commission on the steering of the fusion programme as a whole, while the European Fusion Development Agreement

\footnote{Note: document numbers, as listed in Annex 6.3 are indicated in []).}
(EFDA) organizes the cooperative work among the Associations on JET, as well as co-ordinating fusion technology R&D and contributions to international co-operations. Both the CCE-FU and the EFDA Steering Committee carry out a monitoring of the scientific and technical aspects of the execution of the programme.

Some special emphasis was therefore given, in the 2002 Monitoring Exercise, to assess the work directly involving the Commission Services, which is not subject to specific assessment by any of the committees. However the Panel also provided an overall assessment of strategy, objectives and implementation of the whole Programme, following the mandate established by the Commission for the Monitoring Exercise of year 2002.

The Panel valued the broad range of documents made available by the Commission services before and during the monitoring exercise. The whole set of documents, together with thorough discussions within the Panel, with fonctionnaires of the Commission Services, interviews with Italian, Swedish and Finnish members of the Associations as well as EFDA and EFET members, and exchange of messages with others enabled the panel both to extensively assess the work carried out by the Commission Services themselves and to analyse strategies, objectives and implementation of the overall Programme.

Particular emphasis was given this year to: 1) the role of the Candidate Countries (in view of the forthcoming enlargement of the European Union); 2) the relationship with industry, in view of industry’s crucial role in the near future construction of ITER and taking advantage of the specific competence of one of the Panel members in this field. In respect to point 1) a questionnaire has been prepared by the Panel and circulated among several contact points of the NAS: the Panel report includes the conclusions from this survey (section 4.2.2.9).

3 INTRODUCTION

Fusion R&D is a ‘Key Action’ in the Fifth Framework Programme (Euratom), embracing all the research activities undertaken in the Member States aimed at harnessing fusion energy, and with the long-term objective of the joint creation of prototype reactors for power stations to meet the needs of society: operational safety, environmental compatibility, economic viability. Fusion energy research is one of the priority thematic areas of the Sixth Framework Programme (Euratom), with an overall aim ‘to make progress towards demonstrating the scientific and technological feasibility of fusion energy and assessing its sustainable qualities’.

The demonstration of the technical feasibility of fusion power in the next decades requires, first of all, a positive decision on the ITER Project as an essential step towards the development of a prototype power plant. It is however widely acknowledged that, although ITER is feasible at the present level of R&D, the construction of reactors for electricity production on a commercial scale further ‘requires reasonable technical progress, practical developments and optimisation of the system’ (as stated in the Report from the Fusion Power Coordinating Committee, 9-10 April 2002).

All the EU member states, plus Switzerland and the candidate countries associated to Euratom, participate in the fusion programme, which supports all research into magnetic confinement fusion in the EU. The Commission therefore manages a single, integrated programme in which the research activities in the various member states are co-ordinated and complementary.

Highlights of the activities in 2002 include:

- **Preparation for fusion R&D during FP6**: The Council of Ministers has adopted decisions on FP6 and the Specific Programme for Euratom. The Commission Services have drafted the detailed Work Programme. The existing means of implementing the programme will be retained. However, with a restricted budget of 750 million euro of Community funds, including an amount of up to 200 million euro for ITER, there will be changes in the level of support for the Associations.

- **Progress in relation to ITER**: The year has been marked by significant steps forward in the preparations for a decision on whether to proceed with ITER, which should be the ‘Next Step’ in fusion R&D on the route to fusion power. A working document by the Commission for the Council of Ministers on the cost to Europe of implementing ITER was received with interest when it was presented in March. The negotiating directives granted to the Commission by the Council of

A - 8
Ministers were broadened in May 2002 to include site and cost sharing aspects. The formal negotiations on the possible joint implementation of ITER with international partners have continued throughout 2002. The Commission has submitted formal offers by the French and Spanish governments to host ITER on their territories. Extensive technical evaluations of these sites have been undertaken. Various scientific and technical tasks in preparation for ITER construction and operation have been carried out in the laboratories of the Euratom fusion Associations and by industry. In January 2003 the USA signalled its intention to rejoin the ITER negotiations, and the government of China formally requested to participate in the negotiations.

- **The ‘Fast Track’ to fusion energy:** On the initiative of the Council Presidency, a group of independent experts examined (at the end of 2001) the possibility of a fast track approach, to demonstrate the technical feasibility of fusion power on a 20-30 year timescale. They concluded that a compressed timescale could be achieved by reducing the number of future generations of experimental machines after ITER from two to one, and that the prompt realisation of ITER is an essential step for a fast track approach. In addition to ITER further materials research is required, and in particular, the experts recommended a high-energy, high intensity neutron source to test and verify the performance of materials subjected to extensive neutron irradiation.

- **The JET facilities:** Successful operation under the auspices of the European Fusion Development Agreement (EFDA) has continued. The further operation of JET in 2003 and 2004 is included in the extension of the duration of EFDA by two years which has been agreed by all its members.

- **The specialised European devices** have undertaken a wide variety of physics investigations in support of the operation of the Next Step, exploiting their different configurations and capabilities. The major thrust of the technology activities has also been directed towards the Next Step, including technical work related to the two European candidate ITER sites.

- At the level of **programme organisation**, the fusion committee structure has been simplified to improve co-ordination, particularly in view of a possible decision on ITER construction. Latvia, which was already associated to the Euratom Framework Programme, signed a Contract of Association at the beginning of the year.

- **International collaborations** (in addition to ITER) have been extended through the signing of a new agreement with the Ukraine.

### 4 ANALYSIS AND FINDINGS

#### 4.1 ANALYSIS AND SYNTHESIS OF RECOMMENDATIONS AND THEIR FOLLOW-UP FROM the 1999 to 2001 MONITORING EXERCISES

The present panel has carefully analysed the reports of the three previous panels. The recommendations of previous panels and their follow-up are summarised in a table, which is presented in Annex 6.4 to this report. Before discussing the specific headings below the panel would like to make two very general comments concerning the recommendations of earlier panels. Firstly, all the reports have similar recommendations expressed in similar words. This reflects the fact that one cannot expect too dramatic an evolution during one year (with steady progress and without any dramatic scientific breakthroughs), which is a very limited fraction of the timescale for the development of fusion. The present panel strongly supports a system with two-yearly monitoring, with possibly more limited reports in alternate years. The panel feels this would be a more efficient use of the Commission’s resources.

Secondly the present panel finds a strong bias in previous reports towards recommendations dealing with very fundamental issues at highest political level such as the various decisions relating to ITER. There is less focus on the more detailed management questions relating to organisation and efficiency, industrial cooperation, handling of applications etc. which should be central in the monitoring of the programme. This can also partly be explained by the particular nature of the fusion programme. Unlike other programmes, fusion researchers are all working together towards a common long term aim. No calls for proposals and a much greater degree of continuity in the programme distinguishes the fusion programme from more or less all the other programmes.
The present panel will try to avoid repeating most of the previous ‘strategic’ recommendations even though most of them still are valid. While continuing to support these strongly, we intend to focus more on operational recommendations which might help to improve the efficiency of the programme. The discussion of previous recommendations will thus be very brief.

4.1.1 Strategy and objective

The most important recommendations in 1999 – 2001 focus on the need for a decision on ITER according to the time frame foreseen. This decision has not yet been taken even though great progress towards this goal has been achieved, which is described more in detail elsewhere in this report (section 4.2). The timing of the decision is not under Commission control, but dependant on decisions at the highest political levels (Council of Ministers and ITER partners).

The recommendations also strongly encourage the search for a site in Europe. The panel finds that the Commission has promoted the European case effectively and brought together the necessary data. The recommendations for 2000 and 2001 also stressed that Europe should be prepared to proceed alone if a global decision on ITER were to fail. The panel does not see any Commission activities specifically preparing for this scenario, which seems to have been overtaken by events.

The continued use of the JET facilities and the importance of the activities in the Associations are stressed in all three reports. The panel finds that this is in line with the work programme executed. All reports stress the importance of materials development activities, especially the preparation for the International Fusion Materials Irradiation Facility (IFMIF). There has been progress and a next phase of engineering validation and engineering design activities will start during FP 6. The panel finds that progress has been achieved. This is especially important for the ‘Fast Track’ approach (see below).

4.1.2 Implementation, management and processes

All earlier panels have stressed the need for a strong unified management and organisational structure including the need for a top level manager. The Commission has in its reply referred to the reorganisation of DG Research which brought all energy research into a single Directorate. It has also referred to the ongoing preparations for a European legal entity in support of ITER and an international ITER legal entity. The present panel notes that earlier recommendations to create a fusion directorate have not been followed. The panel acknowledges with some regret that this is unlikely to be a realistic way forward for the management structure of the fusion programme in the immediate future. On the other hand, it is most important that the Commission work towards the establishment of an appropriate strong management structure for the ITER project.

4.2 MONITORING OF THE IMPLEMENTATION IN 2002

4.2.1 Follow up of 2001 Recommendations

The 2001 SPMP put forward 11 recommendations. The 2002 panel acknowledges the significant progress achieved with respect to all these recommendations. However, fusion being a long term project, most recommendations remain valid for the future. The tasks have not been finished and could not be finished in 2002. Here we briefly summarise our observations on last year’s recommendations:

**Recommendation 1. (ITER)** While negotiations on the joint implementation of ITER proceed at a convincing pace, as acknowledged by the European fusion programme through the CCE-FU, the prospect of a solely European project seems to have been overtaken by the events.

**Recommendation 2. (European mandate of negotiations enlarged to include ITER site, organisational and cost sharing issues)** This has been fulfilled. In particular, a detailed cost analysis has been prepared by the Commission Services.

**Recommendation 3. (Europe should take the lead)** The Commission has submitted formal offers by the French and Spanish governments to host ITER at Cadarache (F) or Vandellòs (ES)

**Recommendation 4. (Fast Track)** The Fast Track option prepared a scenario, following ITER, which is still open and valid. However the European Commission found it inappropriate to undertake detailed studies and discussion on it during the ITER negotiations on the Next Step.
Recommendation 5. (strong unified management and organisational structure) The management structure within ITER is being followed up. Progress towards the establishment of a European Legal Entity is being made.

Recommendation 6. (use of the JET facilities) The Euratom Programme in FP6 explicitly includes the continued use of the JET facilities, including its phasing out during the realisation of the ITER Project.

Recommendation 7. (role of the Associations) FP6 foresees an accompanying programme, at the level of the Associations, which is planned to be undertaken in parallel to the construction of ITER. Particular emphasis has been given in it to the physics and technology issues for the reactor prototyping phase and to alternative designs and concepts.

Recommendation 8. (materials development activities) The completion of the IFMIF design within FP6 is planned. Material development activities are an essential part of the accompanying programme at the Associations’ level.

Recommendation 9. (socio-economic, environmental and safety studies) According to the FP6 workprogramme, the Associations will undertake further study of the socio-economic, environmental and safety issues related to the implementation of thermonuclear fusion as a future energy source.

Recommendation 10. (age profile of the professionals) A few Marie-Curie fellowships and the national fellowship schemes at the Associations have continued to bring into the programme a limited number of scientists and technicians of the younger generation.

Recommendation 11. (co-operation with industry) Cooperation with industry continued at the level made possible by the limited budget of the Programme.

4.2.2 The Attainment of Objectives in Terms of Implementation as Set Out in the Workprogrammes for 2002

4.2.2.1 Science and Technology

The Commission Services monitored, through the STAC, during the year 2002, the overall progress in fusion physics and technology, with particular attention to the work benefiting from the higher levels of support (so called ‘preferential support’). Therefore the Panel wishes to emphasise just a few points on these activities.

No essential technical breakthroughs are expected to be necessary in the thermonuclear fusion pathway although the complexity of the device and the international management are challenges which should not be underestimated. This is a very encouraging situation to further promote the successful conclusion of ITER negotiations. However, in the longer term, the prototyping of reactor blankets and the development of radiation resistant and low activation materials needs to be vigorously pursued. Researches on superconducting magnets, vacuum vessels, blanket and shielding, heating and current drive systems, fuel cycle and diagnostics are receiving the appropriate attention as well. Through the construction of the Wendelstein 7-X ‘stellarator’ and operation at existing installations, both the preparation of ITER operations and the study of toroidal field confinement schemes are also being continued. The delay in the planned start of operations of Wendelstein 7-X to about 2009 (due to unforeseen technical and manufacturing difficulties, particularly with the superconducting coils) will not have any consequences for the preparation for ITER operations. Secondly, JET is a unique opportunity to continue Tokamak-plasma operation with tritium. The JET machine is being fully exploited under EFDA. It continues to be a fundamental tool for planning, executing and analysing experiments, highly coordinated among the Associations’ scientists and with the machine operators. JET has been an invaluable means of gaining experience and tools in view of the world-wide cooperation needed for ITER.

As a third point, structured activities in the physics concepts, which improve the understanding of fusion devices, continued to receive attention and support especially at the level of individual Associations. These activities include a specific preparation for the ITER machine, the conceptual definition of a demonstration reactor and facilities alternative to the classical Tokamak configuration. These issues received appropriate attention, in the Panel’s view, with respect to priority and timescale. In particular, it was appreciated that those issues in the non-Tokamak configurations, which
are relevant to the development of a fusion reactor, are appropriately emphasised by the CCE-FU as ‘synergic with ITER developments’ (CCE-FU meeting minutes, 1 February 2002).

In view of the imminent decision on the construction of ITER, the Panel wishes to emphasise in particular in the 2002 monitoring exercise, the progress in material technology, which will be an essential complementary activity during the construction and experimental phase of ITER in the path towards the realisation of a commercially available fusion reactor.

The Panel was pleased to note that the CCE-FU, at its meetings of 29 May and 24 September 2002, continued to recommend funding priority to a large number of experiments on radiation resistant and low activation materials. These are fundamental for the development of commercial reactors, but might be also useful in the forthcoming construction of ITER, and could enable the improvement of its initial target performance.

In this framework, the year 2002 has seen a continuation of a successful series of very important results achieved during recent years in approaching this goal.

Structural materials were produced and are going to be tested at neutron spallation sources; a near full size model of an ITER toroidal field was successfully tested (FZ-Karlsruhe, D); progress has been made on diverter materials (ASDEX Upgrade, D), on gyrotrons and related windows (Tore Supra, F), on unification of modelling codes (under EFDA coordination).

It was remarked during the interviews of JET, EFDA & Industry representatives that more emphasis should be put on the ITER remote handling development and design integration, which should be considered in good time. The JET experience shows that all remote handling procedures take much more time than expected.

4.2.2.2 Industry

It is generally regarded as very positive that the fusion community is so integrated and unified in its thinking. The community has been working for the same objective already for a number of years. There are however inherent risks in such a closely knit community which could result in a lack of openess, low interaction with other research and industry and few people joining and leaving the community. We do not see this as a major problem at present but the responsible bodies should be aware of the risk, follow the development and actively promote external exchange for mutual benefit with industry and other relevant research fields.

During interviews with representatives from industry, the view was expressed that the fusion programme has a rather academic character, which is not well adapted to the construction and operation of ITER. Involvement of industry at all levels (scientific, technological and political) should be significantly enhanced. Had industry been involved earlier in the development, many problems could have been avoided and the design process could have gone faster.

Industry representatives commented that the spin-offs of the fusion programme have been fairly limited. Spin offs are interesting and useful, but necessarily a side-benefit to the long term aims of the fusion programme. What is more important is to ensure a transfer of technologies and expertise between industry and the fusion programme. In this way the fusion programme can help to enhance European industrial competitiveness in the longer term.

4.2.2.3 Socio-economic Aspects

The future social, environmental and economic impact of fusion power has been the subject of studies carried out by the Commission, by EFDA and by the Associations. These studies include the evaluation of economic costs and of social acceptability of fusion, in comparison with other energy sources and should help in evaluating its potential to contribute to sustainable energy generation.

Supplementing the technological activities, these studies will inform decisions for the future orientation of the programme. - The integration of fusion research in a common energy research directorate is also a step in this direction.

The Commission has, in a report on ‘Clean and Efficient energies for Europe’, examined the social and economic impacts of the non nuclear energy research programme. The panel regrets that the Commission has not been in a position to integrate fusion research in that report. The association of fusion with ‘clean and efficient energy’ would promote the positive development of fusion, even if the practical implications in the case of fusion lies in the more distant future.
The above report finds that the technology transfer is poor. This is in part true also for the fusion programme and might, as in the case of non-nuclear energies, require a more focused approach to research diffusion, cooperation with industry and commercialisation.

4.2.2.4 Public Awareness
Public awareness is very important to obtain momentum and political support for the research efforts. The activities devoted to improving public awareness and understanding have further expanded in 2002. Some highlights of the work of the Commission are presented in the self-assessment report and the panel finds the programme well balanced. The panel recommends that this activity is expanded even further to prepare for the decision on ITER. This should be done on the basis of a strategic plan instead of putting together a number of ‘ad hoc’ activities. This is commented on in more detail in section 4.2.3.4.

4.2.2.5 Women and Science
The fusion research must operate in line with, and support, wider EU-objectives - in particular equal opportunities for women. Increasing their participation leads to a greater pool of available competence for researchers and managers running projects.

The gender issue needs to be studied more in-depth, and more operative means to correct problems have to be applied. More data about the present situation and trends are needed to enable efficient and effective measures to be taken.

The effectiveness of any measures to encourage the active participation of women at all levels in the fusion programme can only be assessed if there are good data on the evolution of their involvement over the years. There is a clear need to collect more data to clarify the present situation and trends concerning the participation of women in the fusion programme. The panel suggests that this should include data on age, seniority and salary by gender. This would enable a number of important questions to be answered:

- Does the seniority profile for women match what would be expected given their age profile? (Do women get promoted in line with their experience?)
- Does the salary profile for women match what would be expected from their age and seniority profiles? (Are women paid proportionately more as they gain experience?)

The aim would be to encourage a recruitment policy for ITER that works to increase the proportion of women, especially in the higher ranking posts. There may be a need to start immediately encouraging women to seek the experience and training that will make them eligible for higher-level appointments within ITER. It is also important that the Commission actively promotes the recruitment of women in the Community staff. At present almost all senior staff within fusion are men!

4.2.2.6 Age Profile in Fusion
Earlier panels have found that the community is ageing and measures have to be taken to correct this problem. It is of course only part of a more general problem dealing with young citizens lacking interest in natural sciences and engineering, but it also has to be addressed at the fusion level. The realisation of a project like ITER would, as the Commission states, attract brilliant, young physicists and engineers but more specific actions might be appropriate. An operative goal for an increased number of post-doctoral positions such as Marie Curie grants should be set up and Associations should be encouraged to achieve this level. The very good mobility programme within fusion could give more emphasis to young researchers and to women, for instance by actively encouraging them to participate.

4.2.2.7 Mobility and training (including MC fellowships)
Mobility and training were continued to be recognised as an integral part of the key action ‘Controlled Thermonuclear Fusion’ in the Council Decision dated 1.2.1999, laying the basis of the 5th Framework Programme within the Euratom Treaty.

The Mobility Agreement among the Associations constitutes an efficient mechanism to promote participation of fusion researchers in joint (JET or ITER) or large scale experiments, as well as for smaller scale collaborations between laboratories participating in the fusion programme. The Steering Committees of the Associations assess the appropriateness of the scientific scope in a framework of collaboration among Associations, while the Commission services take care of the administrative
procedures. The mobility scheme has been extensively verified over the years and has proven to be an extremely valuable tool. The CCE-FU, in its meeting on 1 February 2002, endorsed the proposal of the Commission services to extend the Agreement until the end of year 2004, with the explicit intention of using this tool to also support participation in ITER negotiations. The Panel welcomes the decision of the CCE-FU in this respect to increase the financial ceiling by about 30%, with respect to what had been originally proposed. Both the number and length of individual visits in the Mobility Agreement is increasing with respect to the latest years’ data, which speaks for the very relevant success of the scheme applied in the Fusion Programme.

4.2.2.8 International Cooperation

The Fusion programme and ITER development is a good example of true international co-operation. Fusion research is the kind of research that no nation or organisation could perform alone, and joint efforts are definitely required. There have not been many projects in the world that are bringing the EU, Russia, Japan, Canada and USA together. The recent announcement by China that it intends to join ITER, and that by the USA that it will re-join show that ITER is developing into a genuinely world-wide collaboration. This situation makes the fusion programme different from most of the other programmes in the EU framework programme and needs special considerations.

4.2.2.9 ERA

The Commission has in its proposal for the creation of a European Research Area (ERA) characterised the European research situation as a lack of funding, an insufficient environment to stimulate research and exploit results and a fragmented nature of activities and dispersal of resources. The ERA aims at creating a free movement of knowledge, researchers and technology and a concentration on a small number of more targeted topics. The European fusion programme has already reached a stage of coordination and integration that is comparable to a European Research Area. This coherent, fully integrated nature of the fusion programme has thus been recognised in previous External Monitoring reports, which have also highlighted it as a successful example of a European Research Area. The European Union has previously abstained from exploiting this excellent example. It can of course be stated that the relative EU contribution to the total fusion investment is larger than what would be expected in other areas. This however does not diminish the value of this successful example as one can foresee more focused EU activities with strong union participation in the future. The 6th framework programme is also, to a higher degree than previous programmes, directed to large scale European cooperation similar to the Fusion programme. The adoption of the subsidiarity principle leads to a national responsibility for most of the publicly funded research but the fusion programme is of a size and complexity which necessitates a common European effort, supported by the Commission. The programme combines a focused action on a well defined thematic area of research using powerful financing instruments (Contracts of Association and EFDA, a multilateral agreement between the Commission and the Associations) to promote integrated projects and networks of excellence, which bring together the research actors in appropriate configurations and with critical mass. The exploitation of the JET facilities under EFDA is a particularly good example. Since 1 January 2000, JET has been operated by the UK Atomic Energy Authority on behalf of all the European fusion research laboratories under the EFDA. Task Forces of scientists and engineers from associated laboratories across Europe come to JET to carry out experiments in the JET programme. This demands a very high degree of co-ordination in planning, executing and analysing experiments by researchers from all the participating laboratories and the machine operators. The experience gained, and tools developed, for the operation of JET will be invaluable in establishing the world-wide co-ordination needed for the operation of ITER. Since the early 1950s, a number of powerful research infrastructures and laboratories which are used by an extensive network of scientists have been developed and deployed within Europe by European Intergovernmental Research Organisations (EIRO). Together, they represent European spearheads in some of the most crucial basic and applied research fields. Their primary goal is to plan an active and constructive role in promoting the quality and impact of European Research. The Commission should
ensure that fusion benefits from the activities of EIRO in tackling joint problems in a coordinated way as for instance common problems for international organisations and their staff, public awareness activities, mobility schemes, industrial spin offs etc.

4.2.2.10 Candidate Countries

Special attention was given in 2002 to the participation of the newly associated states in the Fusion Programme.

At present four of the candidate countries (Czech Republic, Hungary, Latvia, Romania) have signed Fusion Contracts of Association with Euratom and the multilateral European Fusion Development Agreement (EFDA). They therefore participate fully in the programme. As in the member states, all the fusion R&D activities in each country are co-ordinated by its Association. The total value of these Contracts of Association in the candidate countries was about 3.5 million euro in 2002, of which the Community contribution was between 25% and 40%. The total value of the tasks/contracts attributed to these Associations for the years 2000-2002 within the technology workprogramme was about 1.9 million euro. The Romanian, Czech and Hungarian Associations also participate in the JET Experimental Campaigns.

The Panel wishes to emphasise, among others, the principal role exerted by the Commission Services in promoting a contract of Association with the University of Latvia, which entered into force in December 2001. This happened with a contextual approval of preferential support for a collaborative experiment between the new Association and the Portuguese Association, using the latter’s Tokamak ISTTOK, of a liquid metal limiter, which has recognized relevance in addressing the problem of power exhaust. This cooperation opportunity was pointed out primarily by the Commission Services. Contracts placed during FP5 with organisations in the candidate countries which do not yet have a Contract of Association (Bulgaria, Slovak Republic and Slovenia), have a total value of about 0.75 million euro in the area of fusion physics and 1 million euro in fusion technology. Community support under these contracts is at a rate between 25% and 30%.

During the Monitoring Exercise, a questionnaire has been sent out to the national contact points of the six candidate countries associated to EURATOM. The Panel was very pleased to receive a reply from all of them. The most interesting results of this survey can be summarised as follows:

1. Shared satisfaction both on the information received from the Commission on the Fusion Programme, its objectives and its overall evolution, and on the Commission’s management. Two replies out of six express some concern in understanding, as a newcomer, the Commission management of the Programme, the complexity of the administrative structure, the ways of acquiring tasks and receiving support.

2. The encouragement received by the newly Associated States (NAS) from the Commission and the Associations has been positively valued, with comments ranging from ‘sufficient’ to ‘determinant’.

3. The NAS find it in general difficult to express a view on the role of industry (including SMEs) since they have either no direct relationship with industry at all, or the 25% funding is insufficient for a start-up in the link to industry, or the link is limited by the rather academic type of activity of the particular Association.

4. As far as they judge themselves able to assess, they regard the quality of work of the Commission in the Negotiations towards ITER as very good.

5. The bureaucratic workload is either not commented (3 out of 6) or judged to be reasonable or rather high (the rest). Two replies express appreciation for the transparency and efficiency of the funding mechanism.

6. Miscellaneous items emerging from the various replies: the mobility scheme is appreciated, as well as the new committee structure, although the old one was efficient too; some documents from the Commission would be appreciated, which could help in assessing the technological problems relating to ITER construction for non-specialists in general and for industry in particular; extension of the mobility scheme to the countries which do not have yet a contract of association, as a mean of encouraging new scientists to join in the fusion field.

In view of strengthening the ERA, the importance of a closer involvement of the Associate Countries in the Programme is furthermore emphasised in the FP6 workprogramme, examined by the Panel members.
The Association contracts and the cost-sharing actions with the NAS have generally a limited impact on the total Programme budget, whereas they contribute fresh blood of qualified scientists and good research subjects to the Programme. The new “preferential support” scheme, contributing up to 100 k€/year per Association for collaborative projects, is of particular advantage to the Associate Countries, whose budget is generally more limited, and constitutes an incentive to their active involvement in the common research activities. The Panel views this initiative of participation encouragement with particular favour, a deeper involvement of these countries being of increasing importance in the light of the imminent enlargement of the European Union.

4.2.2.11 Fast Track
In late 2001 the Research Ministers asked for an investigation of the feasibility of a ‘fast track’ to fusion power production. A group of independent experts, chaired by Prof. David King (Chief Scientific Advisor to the UK Government), discussed this idea and reported their conclusions back to the EU Council Presidency.

According to the experts, a fast track approach could demonstrate the technical feasibility of fusion power on a 20-30 year timescale. The ‘conventional’ roadmap foresaw a timescale of about 50 years towards the commercial scale. The fast track would compress this by reducing the number of generations of experimental machines after ITER from two to one.

They also expressed the view that a high intensity neutron source is required to test and verify material performance when subjected to extensive neutron irradiation of the type encountered in a fusion reactor. This aim is being pursued within the framework of the International Fusion Materials Irradiation Facility (IFMIF). It is planned to complete the design of IFMIF during FP6. The experts recognised that the Fast Track would initially require additional resources, as more activities would be done in parallel, but the overall amount of funding to reach the final goal could be substantially reduced. The experts highlighted the prompt realisation of ITER as an essential step for a fast track approach.

The External Advisory Group on 'Controlled Thermonuclear Fusion' (EAG-FU) for the period 1998-2002 submitted its final opinion at the end of 2002. This opinion welcomes the ideas expressed in the report on the 'Fast Track' proposal. A new Advisory Group which will cover all Energy R&D issues (ie fission and non-nuclear as well as fusion) has been created for FP6.

The monitoring panel of 2001, the relevant committees, and the Commission support the fast track proposal. Also the present panel finds that this is a highly interesting and very valid initiative. However, turning this idea into reality requires decisions at the highest political levels, both within the European Union and together with the other ITER partners and a further and more detailed analysis of the options and possibilities will be needed at the appropriate time. The time does not seem ripe to take any major decisions about the fast track (before any decision to proceed with ITER), but it is important to keep the option open. It is recommended to create a new high level group with participation from all ITER partners at some stage, probably after ITER has been approved. This initiative should be taken by the Commission.

4.2.2.12 Fusion as part of overall Energy Strategy
Even though it is likely to take decades before the fusion could be used as an energy source, future energy scenarios should already include it. All the generation of energy in the future will have to be sustainable. Fusion energy is a part of the overall energy development strategy and its role as a potential energy source should be considered.

Some crucial technologies could be cross-utilised in many of the energy development projects (material technology, control technology etc.). The technology developed for ITER could benefit from other energy projects and vice versa, eg the material technology in the biomass combustion chambers, which is very demanding. Co-operation with other energy projects would provide spin-offs in both directions.

4.2.3 Preparation of the Implementation of the Specific Programme under the Sixth Framework Programme (advisory structure, workprogramme...)

4.2.3.1 Science and Technology
The Work Programme for the 6th FP in the Associations entails subjects mentioned in paragraph 4.2.2.1, although proper flexibility is maintained in the desired case of an approval of the ITER project together with a decision on its siting (especially if ITER will be sited in Europe).
The 6th Framework Programme foresees that the construction of ITER will be accompanied by a robust research programme which, while paving the way to the technological challenges of the prototype reactor, will maintain the possibility to continue some strategic investigations on plasma physics and technology in the home institutions. This is not only necessary for the technical fulfilment of the European fusion programme, but also for the crucial need of further reinforcing the scientific communities working in these fields at the Associations level.

4.2.3.2 Industry

In the Work Programme for the 6th FP the role of industry in supporting the fusion research should be understood more clearly. The industrial research should proceed simultaneously with the physics research. There should be clear industry projects in parallel to the research programme. This is important when the decision to build ITER is getting closer. The needs of industry should be recognised in the fusion strategy and the involvement of industry at all levels (scientific, technological and political) should be significantly strengthened.

It is important to ensure a transfer of technologies and expertise between industry and the fusion programme. In this way the fusion programme can help to enhance European industrial competitiveness in the longer term. Industry is used to undertaking large projects and could provide very useful help when appreciated by the research programme of fusion. The person appointed to be the Head of ITER for the construction phase should have considerable industrial experience in large scale industrial projects. The panel proposes the following in order to improve the co-operation with industry:

a. There should be strong industrial participation in the ITER team, but persons with industrial experience are also necessary at the Commission management level.

b. The current organisation of the fusion programme and the ITER project is well adapted for R&D, but not to design and construction. For the design and construction phases the organisation models for ITER should be very close to those of industry.

c. In terms of management and planning of the fusion programme, the role of industry should be strengthened. Industry could play an important role in planning and in preparing strategies. Industry should be involved in R&D and design from the earliest possible stage because industry could provide advice on several issues, where industry has superior experience to the fusion community. The participation of SMEs through the associations could prove extremely useful, although at present SMEs do not have sufficient resources and efficient enough mechanisms to work with the Commission or EFDA directly.

4.2.3.3 Socio-economic Aspects

Further studies on socio-economics based on the results of the existing Power Plant Conceptual Studies will, according to the Commission, start in 2003. This is an important activity, which should be undertaken in close collaboration with global and national authorities, taking into account the large scale nature of the fusion research and the very complex decision-making processes.

The socio-economic studies should also include research on fusion research, especially the very complex decision-making processes. Independent researchers should be given access to as much material as possible after a certain period of time to contribute to the political history of fusion research to the benefit of the society at large and future generations. Funding should be set aside for such studies.

In the case of fusion research, the aims of safety and environmental compatibility are incorporated in the objectives of the research, as defined by the Council Decision on FP5. During FP5, previous studies on the safety and environmental aspects of fusion power have been extended in scope and detail. Safety and environmental assessments are also an integral part of the ITER design process. The Commission’s proposal for the next Framework Programme foresees further studies in these areas. Such studies are important, also to prepare national government on a decision on ITER, and a new report should thus be prepared as soon as possible. It should also be presented in such a way that it might be understood by the general public.

4.2.3.4 Public Awareness

The panel has in section 4.2.2.4 suggested that the activities in this area should be promoted through a strategic plan. Such a ‘public awareness’ plan should also take into account activities carried out by
the associations. The dissemination of results and the diffusion of information to the public should be an integral part of the activities carried out by the Associations. The panel recommends that the Commission should encourage EFDA to create a small working group with the task of analysing the need for activities in relation to the decision on ITER.

The main activities should be carried out by the Associations and they should be encouraged to devote more effort to public awareness by introducing it as an important activity in the contracts of association. At present it is not included in those documents. A certain percentage of the funding for fusion should be set aside for information activities and Associations should establish contacts with national agencies responsible for energy policy in the various countries.

4.2.3.5 Mobility

The Euratom Programme for year 2003 intends to further promote the mobility of researchers, with a clear view to the successful creation of the European Research Area. The Panel, while welcoming the exceptional effort made by the CCE-FU in 2002 in this matter, fully supports and encourages the steps taken in this direction.

4.2.3.6 International Cooperation

As mentioned in section 4.2.2.8, the Fusion programme and ITER development is a good example of true international co-operation. The fusion research is the kind of research that no nation or organisation could perform alone, and joint efforts are definitely required. This multi-nationality and geographical distribution increases costs, and demands very careful, coordinated control. Modern electronic communication tools should be used even more than at present.

The ITER project is one of the logistically most complex international research projects ever planned. The cooperation will also be very costly due to the global nature, with large distances and different cultures. This necessitates the development of advanced technological networks using IT and telecommunications to minimise travel. Europe should, as a leading actor representing a large number of participating countries, establish a model system for efficient co-operation including for example teleconferences, virtual meetings and intranet dialogues.

ITER site negotiations have progressed well during the last two years. There are four site proposals and two of them are in EU. The site selection should be agreed ASAP. After the decision on the site the international teams can join forces and fully concentrate on the design and construction of ITER.

4.2.3.7 ERA

The panel recommends that the Commission use the example from the fusion programme to a much larger degree when describing and promoting the European Research Area. The substantial experience from many years of true European coordination should help avoid unnecessary mistakes when building up new integrated large scale programmes. The administratively relatively simple and well functioning fusion organisation could to a larger degree be utilised when designing the activities in other areas. The mobility programme within fusion is an excellent example.

4.2.3.8 Committee Structure

Following previous discussions at SWG meetings and advice of the EFDA-SC, the CCE-FU reached a consensus on the restructuring and reduction of the sub-committees. The principle was approved that a single advisory layer, covering both physics/technology and finance/administration, would be consulted by both the CCE-FU and the EFDA-SC. STAC and AFAC were proposed as subcommittees of both CCE-FU and EFDA-SC in science/technology and finance/administration respectively. The Commission Services contributed substantially to that.

The Panel warmly appreciated the efficient work of the CCE-FU and the Commission Services in streamlining the sub-committee structure. It believes, however, that the international cooperation on the ITER project, when approved, will probably require a further reorganisation. This will follow an inevitable change of mentality, which the strong support to the common project, together with the necessary prolongation of the national collaborative research, will certainly impose. In this respect, the initial work of the Commission services on the European Legal Entity, developed in close contact with the SWG of the CCE-FU, is seen with particular favour by the Panel also as a means of preparing the interface between the present still rather complex European fusion programme structure and the strong but agile organisation which will be required by the international ITER project itself.

It was generally acknowledged through the contacts of the Panel members within the fusion programme that the subcommittee structure is appreciated in this phase. The subcommittees represent
lively groups of individuals, culturally homogeneous, appropriate both for detailed discussions before
the CCE-FU and for providing the good working environment to new members joining in.
However, a complicated committee structure is not well adapted to the next phase, i.e. the
construction of ITER. It is therefore important that the Commission tries to streamline the committee
structure once again. It was noted during several interviews that many of those involved in the
programme feel that there should be more ‘personal’ responsibility instead of ‘committee’
responsibility and the panel feels that this issue should be considered in order to increase the
efficiency.

4.2.3.9 Accommodating the Reduced Budget under FP6
The budget allocated to fusion in the Council Decision on the Sixth Framework Programme is 750 M€
of Community funds. Of this, an amount of up to 200 M€ is for ITER. As a result of the budgetary
constraints under which the programme will operate in FP6 the ‘Rules of Participation’ for fusion
have been modified. The uniform annual financial contribution towards the current expenditure of the
Associations and contracts of limited duration will be reduced to 20%, and the higher level of support
for the capital costs of specifically defined projects to which priority status has been awarded will
become 40%.
It should also be noted that other EU programmes provide 50% Commission funding and research
councils often provide 100% external funding. This change puts the Associations in a difficult
situation and was pointed out by the several persons interviewed. On the other hand, the extra support
of up to 100 k€ will give all associations an incentive to increase their cooperation. This should be of
particular importance to the development of the smaller associations.
Adequate means have to be applied to maintain the strong European coordination, which has
demonstrated its usefulness over the years. Depending on a decision on ITER, the community support
to the associations has to be adjusted and the phasing out of a number of activities is certainly
necessary.
In selecting projects to be awarded priority status, increased emphasis will be placed on direct
relevance to the Next Step/ITER. There will also be a new scheme to encourage specifically defined
projects enhancing the mutual co-operation between Associations. In addition to joint development
projects, this scheme is intended to support the joint exploitation of JET or other devices and
facilities, as well as other activities which meet the priorities of the programme through collaboration.
The current expenditure for such projects will be eligible for 40% support, rather than 20%. The extra
20% of support for these projects will have a ceiling of 100k euro of Community funds per
Association.
It has been stated by the Council of Ministers that the financial implications of the possible
implementation of ITER up to the end of 2006 are covered within the foreseeable resources in
Euratom for the 6th framework programme. The costing of the ITER project and the distribution of
costs between the various partners is an extremely complicated task, both when it comes to
calculating the figures and distributing the costs. The Energy Directorate within DG Research has to
provide the commission and the ministers with adequate information to enable well founded decisions
to be taken.
The recommendation of the SWG/FTC to the Commission also seems appropriate:
- to take immediate steps to prepare for a decision on the setting-up of the European Legal
  Entity (ELE) in the form of a JOINT UNDERTAKING to steer the contribution to the
  implementation of ITER;
- to develop a framework for the overall European fusion programme integrating the European
  activities directed to ITER and the Accompanying Programme, including long-term
technology.
An outline of this framework should be ready at the time when a Council Decision on ITER
will be sought. Subject to this Decision, it should be implemented at the beginning of FP7.
4.2.3.10 Monitoring Methodology
The present panel strongly supports a system with two-yearly monitoring, with possibly more limited reports in alternate years. The panel feels this would be a more efficient use of the Commission’s resources.

Monitoring is to a very large degree based on contacts with and information from Commission representatives. This is natural and the self assessment reports have for instance significantly simplified and improved the work of the monitoring panel. However, the panel feels the need for increased contacts also with interest groups as participating industry and national associations. This would result in a more decentralised, ‘bottom up’ approach and probably some additional costs for travel etc. but the resulting picture of the programme would be more complete.

4.2.3.11 Fusion as part of overall Energy Strategy
It is likely to be several decades before fusion (if successful) helps in producing energy for the world. In the meanwhile the world has to live. Fusion, fission, and renewables have all the same output (product) – energy. Therefore they should be all considered and combined, since they shall all be probably needed in the future. The fusion community and researchers in other energy research field should establish better contacts for their mutual benefit. This development could also be promoted through the new Commission organisation within DG Research.

5 CONCLUSIONS AND RECOMMENDATIONS

5.1 General Conclusions, major trends, main strengths and weaknesses encountered

Briefly summarising its findings the panel concludes:

The year 2002 was marked by significant steps forward in the preparations for a decision on ITER, which should be the ‘Next Step’ in fusion R&D on the route to fusion power. In addition there is a very good European level of R&D in key technologies, which should be maintained and developed in the associations. The programme has been very professionally managed by the Commission and the committee structure has been streamlined in view of a possible decision on ITER construction but further measures might be needed. The fusion programme has a rather academic character and will need a significant increase in the involvement of industry in the future programme.

5.2 Recommendations

5.2.1 Recommendations on the Specific Programme

1. The panel recommends that the Commission set up a strategic plan for the necessary accompanying programme of fusion research and for the construction of ITER.

2. The panel strongly feels the need to take a decision on a European site as soon as possible. Otherwise the strong European case will be very much weakened.

3. The panel recommends that the Commission should employ adequate resources from industry to ensure the effectiveness of ITER construction. The panel also recommends considering how industry could be a part of planning and preparing strategy. Industry could be involved in continuous R&D and design. Industry could provide advice on several issues, where it has superior experience in comparison to the fusion community.

The transfer of technologies and expertise between industry and the fusion programme should be strengthened through a larger industrial involvement in the programme, both in terms of people in the programme, and projects.

4. It is important that the Commission once again tries to streamline the committee structure. A strong individual leadership, as in industry, is needed as a complement to the committee ‘bureaucracy’, which of course is necessary, but should be minimised as much as possible to produce an effective and streamlined organisation.
5. Given the potentially important contribution of fusion to the future sustainable energy mix, the Commission should ensure that fusion is fully integrated into any future studies of energy research strategy.

6. The Panel finds that a very good European level of R&D in key technologies for the step following ITER and for some strategic analyses of a few basic alternative concepts in thermonuclear fusion should be absolutely maintained at the Associations, with appropriate financial resources.

7. A comprehensive plan to enhance public awareness activities, involving an active engagement of all associations, should be produced to introduce the ITER project in parallel to the decision and the start up. Contracts of Association should also include provisions relating to these issues.

8. In view of the forthcoming start up of the ITER project, the Commission is recommended to gather and provide fresh data from the Associations on their staff structure, its age profile, the distribution of women in all roles and levels, with a view to initiating action to reduce any imbalances.

9. The panel recommends that the Commission take advantage of the example from the fusion programme to a much larger degree when describing and promoting the European Research Area. The administratively relatively simple and well functioning organisation including the mobility programme within fusion is an excellent example.

10. The Commission should increase its efforts to better clarify to newly associated members the management of the Programme, the rather high complexity of the administrative structure, the ways of acquiring tasks and receiving support.

5.2.2 Recommendation on the Monitoring Methodology
The panel finds that the Commission guidelines for the monitoring process are clear and comprehensive. However they are not at all adapted to the situation in the fusion programme, which is very different from all other programmes. New, separate guidelines should be developed for the fusion monitoring.
However, the present panel strongly supports a system with two-yearly monitoring, with possibly more limited reports in alternate years. The panel feels this would be a more efficient use of the Commission’s resources. The annual monitoring in a long term project like fusion is maybe not necessary. The annual monitoring exercise burdens the limited Commission fusion staff very much.
## ANNEXES

### 6.1 BUDGET FOR SP

#### European Expenditure on Fusion Research in 2001

<table>
<thead>
<tr>
<th></th>
<th>Expenditure Mio EUR</th>
<th>Community Share Mio EUR</th>
<th>Community Share %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Associations</td>
<td>382.4</td>
<td>104.7</td>
<td>27</td>
</tr>
<tr>
<td>EFDA, excl. JOC &amp; Art. 7</td>
<td>25.1</td>
<td>14.1</td>
<td>56</td>
</tr>
<tr>
<td>JOC</td>
<td>56.9</td>
<td>42.6</td>
<td>75</td>
</tr>
<tr>
<td>Other Expenditure</td>
<td>47.6</td>
<td>47.6</td>
<td>100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>512.0</strong></td>
<td><strong>209.0</strong></td>
<td><strong>41</strong></td>
</tr>
</tbody>
</table>

#### Notes:

1. The Community share includes the participation of Switzerland and the Newly Associated States in the financing of the Community Fusion Programme.
2. Against the heading “Associations” is included expenditure of about 0.482 Mio EUR (Commission share of 0.135 Mio EUR), which took place under cost sharing contracts in Member States that had no Association in 2001.
6.2 Abbreviations

ASDEX Axis-Symmetric Divertor EXperiment
CCE-FU Consultative Committee Euratom-Fusion
CEA Commissariat à l’Energie Atomique (France)
CFI Committee on Fusion-Industry
CIEMAT Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas (Spain)
DEMO DEMOnstration reactor
EFDA European Fusion Development Agreement
ERA European Research Area
EURATOM EUROPean ATOMIC energy community
FP Framework Programme
FPMP Framework Programme Monitoring Panel
FZK Forschung Zentrum Karlsruhe (Germany)
IEA International Energy Agency
IFE Inertial Fusion Energy
IFMIF International Fusion Material Irradiation Facility
IPP Institut für Plasmaphysik (Germany)
ITER International Thermonuclear Experimental Reactor
JET Joint European Torus
JET-EP JET Enhanced Performance
KEP Key Element Phase
PROTO PROTOtype reactor
RTD Research and Technological Development
SEAFP Safety & Environmental Aspects of Fusion Power
SEAL Safety & Environmental Assessment of fusion power Long term: follows on from SEAFP and has a broader scope
SERF Socio-Economic Research on Fusion
SPMP Specific Programme Monitoring Panel
SWG Special Working Group
TAC Technical Advisory Committee
6.3 Documents provided to the experts by the programme Management

FUSION PROGRAMME MONITORING FOR 2002

1. Legal documents
1.4. Council Decision of 6 June 2002 concerning the Sixth Framework Programme of the European Atomic Energy Community (Euratom) for research and training activities, also contributing to the creation of the European Research Area (2002 to 2006).
1.5. Council Decision adopting a specific programme (Euratom) for research and training on nuclear energy (2002-2006)
1.6. Draft FP6 participation rules (Euratom) - “Presidency compromise text”
1.7. Draft Euratom Work Programme for FP6 (fusion part)
1.8. Euratom Work Programme for FP5 (revision of August 2001)

2. Background documents
2.1. Self-assessment of the Key Action Fusion by the Commission Services.
2.3. 2001 External Monitoring Report on the Specific Programme for Research and Technological Development on Controlled Thermonuclear Fusion.
2.4a Comments by the Programme Management on the 5-year Assessment.
2.5. 2001 Annual Monitoring Report on the RTD activities conducted under the EC and Euratom Framework Programmes.
2.6. Minutes of Research Council 11 March 2002 (see note about ITER, page 8)
2.7. Minutes of Agriculture Council 27 May 2002 (see decision about ITER, page I)
2.8. The European Research Area : providing new momentum (Communication from the Commission, COM(2002)565)

3. Specific documents – core data
3.4. Communication by the Commission on the energy Green Paper
3.5. List of bilateral and multilateral agreements concerning fusion.
3.6. The cost to Europe of ITER Joint Implementation according to various hosting scenarios (Working document from the Commission Services to the Council).


3.8. Streamlining of the fusion committee structure (Doc CCE-FU 15/7)

3.9. Slides on the fusion programme (presented to experts on 8 November 2002).

3.10. Organigramme of DG RTD (version of 16/09/02).

3.11. Report by the Fusion Power Co-ordinating Committee of the IEA (March 2002).

3.12. Report to the CCE-FU by the CFI Chair (May 2002).


3.16. Final report of the ITER EDA by the ITER Council

3.17. Status of ITER Negotiations, Nov. 2002 (extract from a document prepared for a meeting on possible Chinese participation - status information is on pages 35-52).

3.18. Information on Cadarache (France) as a possible ITER site.

3.19. Information on Vandellos (Spain) as a possible ITER site.


3.22. Energy Research Website Statistics (Sep02)

3.23. History of the level of use of the Mobility Agreement 1987-2002


3.25. List of contacts in the Associations and EFDA (members of STAC, FPC, CFI, plus members of CCE-FU, and Heads of research Unit for information).


3.27. Clean and Efficient Energies for Europe (Impact of FP4 projects), EUR 19464

3.28. Diagrams of former and present fusion committee structure

3.29. Distribution of major contracts for W7X construction (data from IPP)

3.30. Summary of EU socio-economic research on fusion (July 2001)

3.31. Safety and environmental impact of fusion (report for EFDA, April 2001)

3.32. Documents relating to a proposal for a cost-sharing action from Slovenia

3.33. Contract of Association 2003 for ENEA (Italy)

3.34. Contract of Association 2003 for VR (Sweden)

3.35. EAG-Fusion Final Opinion 2002
6.4 COMMON MATRIX: ANALYSIS AND SYNTHESIS OF RECOMMENDATIONS AND THEIR FOLLOW-UP FROM the 1999 to 2001 MONITORING EXERCISES

<table>
<thead>
<tr>
<th>ISSUES</th>
<th>RECOMMENDATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1999</td>
</tr>
<tr>
<td>6.4.1 STRATEGY AND OBJECTIVE</td>
<td></td>
</tr>
<tr>
<td>1.</td>
<td>ITER should proceed and it should be included in the Sixth Framework Programme. For this to be achieved, it is essential that the timeframe given in the 'tentative ITER schedule' (see Appendix 1) be adhered to. Otherwise the fusion programme will lose its impetus, expertise and continuity.</td>
</tr>
<tr>
<td>2.</td>
<td>Directions D of the Research Directorate General be further reorganised to provide the strong unified management support necessary for a programme of the size and importance of the fusion programme and to drive it towards the 'Next Step'; the only way to do this is to ensure that a single person formally has overall responsibility for the entire fusion programme, including strategic, scientific, technical and financial aspects.</td>
</tr>
<tr>
<td>3.</td>
<td>The search for solutions which would make an ITER site in Europe possible should be continued to ensure that Europe’s leading position in fusion research is maintained. However, potential sites in Canada offer unique benefits and should be investigated in parallel with possible sites in Japan to ensure a site is available on the required timescale.</td>
</tr>
</tbody>
</table>

Recommendations 1, 2, 3 are about the future content and organisation of the European Fusion R&D beyond FP5.

The Commission services take note of the

ITER should proceed and should become a part of FP 6. This requires decisions to be taken very soon as indicated in the tentative ITER schedule (see Appendix 1).

While it should be realised preferably as an international collaboration, Europe should be ready to proceed in any case.

In view of the official French offer of Cadarache as an ITER site to be expected in 2001 all possible efforts be made to realise it there. The Panel strongly encourages the Commission to be proactive in cooperating with the French government in the preparation of a full detailed proposal within the year 2001, with a view to adopting it as the European proposal.

The Commission’s proposal for the Specific Programme (Euratom) for FP6 foresees that a decision on the joint implementation of ITER could be sought in the period 2003-2004, so that construction could effectively start during the period 2005-2006.

A proposal for a decision to proceed with ITER is anticipated still within 2003 or early 2004 and the construction could start during the period 2005-2006.
Panel’s recommendations about future fusion R&D activities and managerial organisation. The full co-ordination of European research activities on fusion, that is praised by the Panel, is already in line with the more coherent use of public instruments and resources fostered by the Commission in its Communication on the “European Research Area”.

Regarding an ITER site in Europe, several potential locations have been explored under FP4 which, technically speaking, would be good candidates. However, as acknowledged by the Panel, the selection of such a site should follow possible Member State initiatives that are beyond the competence of the Commission and, as by now, have not been taken. Formal site offers by Canada and Japan are expected during the year 2001.

<table>
<thead>
<tr>
<th>ERA</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>4.</td>
<td>All efforts to extend the useful working life of the JET facilities should be undertaken. Not only does this provide maximum support to ITER, it will also fill, or at least reduce, the gap between the current JET capabilities and the operation of ITER, so helping to maintain the momentum of the fusion programme. The initial operation of JET with Task Forces from the Associations has been promising and should be further developed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>The Associations, anticipating a positive decision on ITER in the foreseeable future, should prepare for the strong supporting effort needed for a successful programme focused on the construction of an ITER device. Their fusion relevant machines should continue to provide maximum support to ITER and broaden the scientific basis for fusion development.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>The materials development activities should be pursued and extended as it is given to the Commission by the Council of Ministers on 16 November 2000, allows a necessary preparatory step to be undertaken. Negotiations on a legal framework for ITER have started. The French authorities have announced that they propose to consider Cadarache as a candidate European ITER site. The Spanish Science Ministry is to launch a study which, if successful, could result in a formal ITER site offer.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>The use of the JET facilities be continued and that the enhanced performance (JET-EP) be realised as planned. The Associations continue to prepare themselves for the strongest possible support needed for a successful construction and operation of ITER; dynamic and strong Associations are a necessary prerequisite for the training of young researchers, for the continuing development of innovations, for links to related scientific and technical fields and for the future exploitation of JET and ITER. The operation of JET in the EFDA framework has been successful during 2000, and the proposal to enhance the capability of the device has been approved by the CCE-FU. The Commission Services foster the important role of the Associations in helping to establish the scientific and technical basis for ITER. A decision to proceed with ITER would</td>
<td>The use of the JET facilities should be continued as far as possible under FP6 in order to obtain further results relevant for ITER and reduce the time gap between the end of JET operation and the start of ITER operation. This is important to retain the present coherence of the programme and of the ERA of fusion. The Commission recognises the pioneering role of JET as an example of a major joint project, and the model it provides of how a device like ITER could be operated. The Commission proposal for FP6 includes the continuing exploitation of the JET facilities in the framework of the European Fusion Development Agreement (EFDA), in view of completing the exploitation of the enhancements currently under way. The use of the JET facilities will have to be suspended at an appropriate time to enable the corresponding resources to</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
essential for the long term success of fusion as a useful energy system.

7. The work on a 14 MeV neutron source designed for testing fusion reactor materials should be continued and developed.

Recommendations 4, 5, 6, 7 are about activities on JET and in the Associations.

Since the end of the Joint Undertaking on 31 December 1999, the JET facilities are operating in the EFDA framework and all efforts are made to ensure the success of the operations in this new structure. In parallel, an enhancement of the capability of the device, still the most performant fusion experiment in the World, is presently under discussion, in particular within the Programme Committee, the CCE-FU. The Associations are greatly contributing to enhance the scientific and technical basis for ITER.

Within the “Long term technology” area, studies are under way to assess what type of neutron source (including a “spallation” source) could be used for testing radiation resistant and low activation material. If such a source could be shared with users others than the “fusion” scientists, it would improve the affordability and the overall scientific benefit of an essential tool for future fusion development.

decision to proceed with ITER would reinforce the need for them to further concentrate their roles on ITER relevant tasks, as identified by the Panel.

Planning for the operation of JET beyond 2002 is well advanced. The scale of the enhancements will depend on the level of the fusion budget in the next FP. A Special Working Group of the CCE-FU is examining the future role of the Associations in support of ITER.

be redirected to the Next Step / ITER.

The present planning for FP6 foresees exploitation of the JET facilities as long as is compatible with the resources required for ITER.

Decision on possible further operation to be taken in 2004.

The role of the Associations is essential for all aspects of the programme. Associations should continue working in plasma physics and alternative designs in order to support the European scientific leadership.

The essential role of the Associations is recognised in the proposals for FP6, which call upon them to continue their work in fusion physics and plasma engineering, fusion technology, and investigation of socio-economic aspects of fusion.

The Commission’s proposal for FP6 states that the Associations will execute the accompanying programme essential to ITER.

<table>
<thead>
<tr>
<th>Policy/intervention instruments</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The panel supports the Fast Track proposal, in the report of the King Group, which was also positively received by the Council of Ministers. It recommends that it should be studied in detail and should be realised. This could save substantial public funds and a lot of valuable time.</td>
<td></td>
</tr>
<tr>
<td>The support for a fast track to fusion power production is welcomed by the Commission Services. In particular, the Commission is being working to</td>
<td></td>
</tr>
</tbody>
</table>
implement the first of the important recommendation of the King Group emphasising the prompt realisation of ITER. The possibility of implementing some or all of the other recommendations in the recent (December 2001) report of the Fusion Fast Track Experts Group will depend on decisions to be made about ITER, and on availability of funds. The activities presently being carried out on ITER and the planned activities on materials, including IFMIF, are consistent with the fast track approach.

| International cooperation | Europe should take the lead, promoting European sites, supporting the on-going international negotiations, funding its percentage of the financial requirements for ITER construction and operation. This clear lead from Europe could be expected to generate a positive response from both existing and potential partners. The European negotiators have played a leading role in the negotiations which have significantly progressed towards an agreement on the conditions for the joint implementation of ITER. In January 2002, the French Minister for Research asked the EU that the French proposal to realise ITER in Cadarache be taken into account, and requested that the conditions under which a European site could be proposed for ITER construction be defined. Technical work on Cadarache as a possible site has progressed considerably and has led to the launch of the licensing procedure with the French authorities. The case for a European site for ITER has been further strengthened by the notification of a decision by the Spanish Government to offer a candidature for the European siting of ITER at |
| SMEs | Cooperation with industry should be further strengthened. The size and complexity of the ITER project requires industrial expertise and methods of large-scale project management. The capability of EU industry for the construction of ITER should be further developed through joint activities and exchange of professionals. The recommendations from the ad-hoc group report ‘Staffing Needs and Policies in the Community fusion programme’ should be updated and the relevant proposals should be implemented as soon as possible, in anticipation of a positive decision on the construction of ITER. This report was presented to the CCFP already in 1995, but has for various reasons not been essential: cost estimates for systems that might be constructed for ITER are based on evaluation studies made by industry. Participation of SMEs is crucial. | The co-operation with industry, which has developed considerably in recent years, should be further intensified. The involvement of SMEs and the exploitation of spin-offs should be supported. The Commission, in conjunction with the actions of the Committee on Fusion Industry (CFI), has progressed in providing information to industrial partners for the large scale involvement which will be needed in the construction of ITER. The co-operation with industry has been essential: cost estimates for systems that might be constructed for ITER are based on evaluation studies made by industry. Participation of SMEs |
been followed up by the Commission.

The re-establishment of the Committee on Fusion Industry (CFI) is an important step in preparing industrial partners for the large scale involvement which will be needed in the construction of ITER.

At the request of the CCE-FU, the Commission on Fusion-Industry (CFI) is preparing a position paper on the EU preferred contributions to ITER construction. The interests of EU industry in the various ITER “procurement packages” are a key input to this discussion.

In ITER construction will be promoted through networking/clustering with the Associations. Further intensification of industrial involvement in fusion will follow any decision to proceed with ITER construction.

<table>
<thead>
<tr>
<th>Innovation (including patenting)</th>
</tr>
</thead>
</table>
| The **materials development activities** should also be further pursued intensely under FP6, since they are necessary for the long-term success of fusion reactors. The design of the International Fusion Materials Irradiation Facility (IFMIF) should be completed under FP6, since it is urgently needed for testing fusion materials for DEMO.

A phase of Engineering Validation and Engineering Design Activities (EVEDA) for IFMIF during FP6 is under discussion with other Parties participating to the IEA Implementing Agreement on Fusion Materials. The EU contribution would be implemented in Associations and industry under European Fusion Development Agreement (EFDA). This next phase would focus on the development of a reference design and on fabrication methods; fabrication and test of prototypes; cost estimates with the involvement of industry; and the preparation of the licensing process for the construction.

After a transition period following the Key Element Phase (KEP) of the International Fusion Materials Irradiation Facility (IFMIF) be finished and followed by a decision to proceed by entering the detailed engineering design phase during the next Framework Programme.

The Programme Management fully recognises the importance of the development of materials, both for the Next Step and the longer term. The Key Element Phase of the International Fusion Materials Irradiation Facility, which is currently in progress, is a necessary step before proceeding to any decision on construction.

The **materials development activities** be further pursued intensely as they are essential for the long term success of fusion as a useful energy system. The present Key Element Phase (KEP) of the International Fusion Materials Irradiation Facility (IFMIF) be finished and followed by a decision to proceed by entering the detailed engineering design phase during the next Framework Programme.

IFMIF-KEP is in progress. Materials R&D is one of the main elements of the technology programme in the Commission’s proposal for the next Framework Programme.
Element Phase for IFMIF, the EVEDA phase is planned to start in 2004. The evaluation of the options for materials testing will be completed by the end of 2002. In 2004, the next design phase of IFMIF will begin.

<table>
<thead>
<tr>
<th>Gender awareness</th>
</tr>
</thead>
<tbody>
<tr>
<td>8. In view of the importance of public acceptance of fusion power, current activities to foster greater public awareness should be continued and strengthened.</td>
</tr>
<tr>
<td>9. Current socio-economic studies should be continued and the results of these studies should be used in support of nuclear fusion publicity activities. Recommendations 8, 9 are about increasing the public awareness and acceptance of fusion energy.</td>
</tr>
</tbody>
</table>

Public awareness

- Activities to enhance public awareness and acceptance of fusion power at all levels (the wider public as well as parliaments and governments) be continued and strengthened considerably. The Commission should increase the visibility of fusion in their presentation of Community RTD. EFDA should collect and disseminate ‘Best practices’ from successful Associations to the entire Fusion community. Documents for distribution to decision-makers or the general public should be written in such a way that they, as far as possible, are understandable by the layman. It is especially important that all documents contain a short summary which fulfils this criterion.

The strengthening of public relation efforts is ongoing, with EFDA now playing an increased role in ensuring the close collaboration between the Associations and in initiating new actions, such as the exhibition at the recent Convention on Climate Change at the Hague.

The 2001 Monitoring Panel will be provided with information about a number of recent public awareness actions (mainly from EFDA) which have been initiated during 2001. A new recruit to DG RTD (J.6)
| Socio-economic aspects | Current socio-economic, environmental, and safety studies, including studies comparing the different future energy options by independent organisations, be continued vigorously. These studies are important as a means to increase public awareness of fusion as well as for its general development. In addition to the socio-economic, environmental, and safety studies being made under FP5, this area has been made one of the three major lines of the Associations’ programmes in the proposal for the next FP. | For fusion to be adopted successfully, society needs to be assured of its safety, feasibility and economic viability. It is therefore important that socio-economic, environmental and safety studies be further strengthened under FP6. The results of these activities should be used to enhance public awareness and acceptance of fusion power and its future importance. An important element complementing the Associations’ scientific and technical work in FP6 will be investigations of socio-economic aspects, focusing on evaluation of economic costs and social acceptability of fusion energy, in addition to further studies on safety and environmental aspects. The Commission Services fully support the view that public awareness and acceptance of fusion power is an important area of activity. Further strengthening of actions in this area, particularly within the framework of EFDA and the Associations, is foreseen. The Commission Services will undertake these activities during FP6. Further studies on socio-economics based on the results of the existing Power Plant Conceptual Studies will start in 2003. |
### 6.4.2 IMPLEMENTATION, MANAGEMENT AND PROCESSES

| Procedures and tools in general | The Commission formally requested an extension of its negotiating mandate at the meeting of the Council of Ministers on 11 March 2002. This extension was granted by the Council on 27 May 2002, and enables the Commission to negotiate with the other ITER partners on siting and cost issues.  

The extended mandate was granted in May 2002. Negotiations at international level have proceeded. |
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Launch of activities (calls for proposals, information to proposers, application tools…)</td>
<td></td>
</tr>
<tr>
<td>Evaluation and selection of proposals (evaluation manual, time to contract…)</td>
<td></td>
</tr>
</tbody>
</table>
| Management Information System/ Internal IT system | Noting the recent reorganisation of the Research Directorate General, the Commission should ensure the strong unified management structure necessary for a programme of the size and importance of the fusion programme and to drive it towards the ‘Next Step’. The only way to do this is to ensure that there is a clear and unique overall responsibility for the entire fusion programme, including strategic, scientific, technical and financial.  

The reorganisation of DG Research has weakened the management structure of the Fusion Programme. A strong unified management and organisational structure will be necessary as soon as a decision is made on ITER. At that time, the current structure should be strengthened by creating a Fusion Directorate within the Commission. The panel also recommends an appropriate European Legal Entity be established |
aspects. The Panel feels that this requires the full capacity of a top level manager.

The recent reorganisation of DG RTD has brought all energy research into a single Directorate (Directorate J). The Programme Management recognises the need for appropriate organisational arrangements to co-ordinate the efforts of the European Fusion Development Agreement (EFDA) and the Associations in preparation for a decision on the Next Step. A Principal Advisor in charge of fusion matters, reporting directly to the Director General, acts in concertation with the Director of Directorate J.

under the umbrella of the Commission to represent Europe in ITER. EFDA could, for instance, be transformed into such a legal entity.

The negotiations currently taking place between the ITER partners concern the juridical and institutional conditions of the establishment of an ITER Legal Entity and negotiations for its joint implementation. The Commission will determine the most appropriate form for a European Legal Entity which will have responsibility for the European contribution. Such an entity will need a strong unified management and organisational structure. The management structure within the Commission will be considered in the context of the overall management of ERA activities and the specific ITER needs. The prospect of implementing a fast track approach will be taken into account, subject to the budget in future Framework Programmes. The Commission will ensure a unified and strong management of the fusion programme at all times.

Reorganisation of the committees has been proposed to the CCE-FU. Reorganisation towards the structure needed to respond to the ITER construction needs (European Legal Entity) is in preparation for presentation to the CCE-FU before the year’s end.

<table>
<thead>
<tr>
<th>Specific cases/programmes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dissemination of information and results</td>
</tr>
<tr>
<td>Evaluation and monitoring</td>
</tr>
</tbody>
</table>
funded under FP5, with the result that is sometimes difficult to follow the broad guidelines and core indicators drawn up with these programmes in mind. Nonetheless, the Panel have found the guidelines helpful and would not recommend making any changes to these guidelines.

**Human resources**

10. In view of the age profile of the professionals currently at the forefront of fusion research, all possible efforts should be made not only to bring in 'new blood', but also to develop and extend the expertise and capabilities of the young scientists already working in this field.

Recommendation 10 is about attracting bright new scientists and engineers in the field. All Associations have established informal or formal links between relevant research laboratories and Universities, and make use of the Marie Curie grants foreseen in the Programme. The use of JET in the new framework of EFDA enables scientists and engineers, initially trained in the Associations, to be directly involved in the exploitation of JET and therefore to extend their expertise in fusion research.

In view of the age profile of the professionals currently active in fusion research, all possible efforts be made to bring in 'new blood' and also to develop the expertise of young scientists already working in this field. Following far reaching decisions on the future programme, attractive professional prospects and adequate positions should be promptly created.

The Commission encourages the links between Associations and Universities, which provide an efficient mechanism to introduce young researchers into the fusion community. The Marie Curie grants and the Mobility Scheme provide mechanisms by which these young researchers (particularly those from the smaller Associations) can participate in the large experiments. This activity is ongoing.

In view of the age profile of the professionals currently active in the programme, efforts should be made to bring in new young scientists and technicians, and to develop their expertise. This also requires timely decisions on the future programme towards the “Next Step”, to create enthusiasm and to open attractive professional careers.

The Commission encourages the Associations to make proposals for Marie Curie grants which provide an efficient means to attract, young researchers into the fusion community. One of the strong points of the fusion Mobility Scheme is that it provides a mechanism by which researchers from the all Associations (particularly also those in the newly associated states) can work on the large experiments and facilities of the fusion programme. This is especially valuable in promoting the expertise of younger researchers. The realisation of a project like ITER would attract brilliant, young physicists and engineers. This is linked to a decision on ITER construction.
<table>
<thead>
<tr>
<th>6.4.3 IMPACT OF POLICY AND PROGRAMMES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impact assessment (incl. TIP)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>6.4.4 OTHERS</td>
</tr>
</tbody>
</table>
PART B:

Responses of the Programme Management to the external Monitoring Report
## Responses by Commission Services to the 2002 Fusion Monitoring Report

<table>
<thead>
<tr>
<th>Experts Recommendations</th>
<th>Commission Services’ Responses</th>
<th>Services’ Commitments (if any)</th>
<th>Deadline</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The panel recommends that the Commission set up a strategic plan for the necessary accompanying programme of fusion research and for the construction of ITER.</td>
<td>The Special Working Group of the CCE-FU was established to develop concepts and proposals concerning structures needed for an efficient steering of the European participation in the joint implementation of ITER, and the re-organisation of the programmatic structure of the European fusion programme. It has taken the view (inter alia) that European fusion research should remain a fully integrated programme, that the European fusion programme, in particular with a view to the implementation of ITER, should be designed to exhibit long-term stability in the decades to come, and that an appropriate accompanying programme to ITER is required in Europe. The Commission has taken these recommendations into account during negotiations with the other ITER parties.</td>
<td>A plan for the R&amp;D programme which will accompany ITER is in preparation. It will be developed in further detail when the key decisions about ITER (in particular its location) are taken.</td>
<td>Dependent on the timescale for decisions on the implementation of ITER.</td>
</tr>
<tr>
<td>2. The panel strongly feels the need to take a decision on a European site as soon as possible. Otherwise the strong European case will be very much weakened.</td>
<td>The Commission presented a Communication to the meeting of the Council on 12/13 May. This Communication underlines the Commission’s view of the importance of the Union taking actions to maximise its chances of achieving the siting of ITER in Europe. The Council welcomed this communication, and underlined the importance of siting ITER in Europe. Following the Council meeting, the Commission set up (in June 2003) a high level group of independent experts to analyse the sites proposed in Europe for ITER with a view to report to the Commission on maximising the possibilities that ITER is based in Europe.</td>
<td>The Communication to the Council proposes, in particular, a consensual and well-defined process for the identification of the European ITER candidate site. The Council supports this process. The Group of chairmen (a sub-committee of the CCE-FU) has been charged ‘to consider the relative merits (in particular scientific and technical of the European candidate sites for ITER in the framework of the overall European fusion activities’. The Group started its discussions in May 2003.</td>
<td>Dependent on the timescale for decisions on the implementation of ITER.</td>
</tr>
<tr>
<td>Experts Recommendations</td>
<td>Commission Services’ Responses</td>
<td>Services’ Commitments (if any)</td>
<td>Deadline</td>
</tr>
<tr>
<td>--------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>3. The panel recommends that the Commission should employ adequate resources from industry to ensure the effectiveness of ITER construction. The panel also recommends considering how industry could be a part of planning and preparing strategy. Industry could be involved in continuous R&amp;D and design. Industry could provide advice on several issues, where it has superior experience in comparison to the fusion community. The transfer of technologies and expertise between industry and the fusion programme should be strengthened through a larger industrial involvement in the programme, both in terms of people in the programme, and projects.</td>
<td>The Committee on Fusion-Industry (CFI) was created by the CCE-FU with tasks which include ‘to suggest ways to favour the cooperation, and to foster the best possible gradual transfer of knowledge, between the fusion research institutes and industry’. A majority of the CFI members (including the Chairman) are senior figures from European industries with a strong interest in energy issues. The CFI has given advice to the CCE-FU on procurement and management for ITER, and this has been used by the Commission, representing the EU, in the negotiations with the other ITER participants on the possible joint implementation of ITER. An ‘awareness’ workshop for European industry on ITER is envisaged to be organised when firm information on the possible joint implementation of ITER is available.</td>
<td>The joint implementation of ITER will provide the opportunity, and the need, for greater industrial involvement in fusion R&amp;D. The Commission is endeavouring to ensure that this is reflected in the organisational and managerial structures which will be established for the implementation of ITER.</td>
<td>Ongoing</td>
</tr>
<tr>
<td>4. It is important that the Commission once again tries to streamline the committee structure. A strong individual leadership, as in industry, is needed as a complement to the committee ‘bureaucracy’, which of course is necessary, but should be minimised as much as possible to produce an effective and streamlined organisation.</td>
<td>Following a decision to proceed with ITER, a European Legal Entity will be established as the sole interface to ITER, managing the European contribution in cash and kind. The creation of this entity will provide an opportunity for a further reorganisation of the ‘comitology’, adapted to the new circumstances, if this is necessary.</td>
<td>The exact form of any further streamlining will be dependent on whether or not ITER is built in Europe, and the adaptations which will be made to the European fusion programme.</td>
<td>Dependent on the timescale for decisions on the implementation of ITER.</td>
</tr>
<tr>
<td>5. Given the potentially important contribution of fusion to the future sustainable energy mix, the Commission should ensure that fusion is fully integrated into any future studies of energy research strategy.</td>
<td>The Commission agrees that all the energy research supported by DG Research should fall within an overall energy strategy, and therefore fusion should be included in any studies related to such a strategy. This has already been pursued in recent years, for example, with EWOG and in the Green Paper on security of energy supply.</td>
<td>Studies will integrate non-nuclear, fission and fusion, where appropriate.</td>
<td>Ongoing</td>
</tr>
<tr>
<td>Experts Recommendations</td>
<td>Commission Services’ Responses</td>
<td>Services’ Commitments (if any)</td>
<td>Deadline</td>
</tr>
<tr>
<td>-------------------------</td>
<td>--------------------------------</td>
<td>--------------------------------</td>
<td>----------</td>
</tr>
<tr>
<td>6. The Panel finds that a very good European level of R&amp;D in key technologies for the step following ITER and for some strategic analyses of a few basic alternative concepts in thermonuclear fusion should be absolutely maintained at the Associations, with appropriate financial resources.</td>
<td>The work programme for the Sixth Framework Programme includes activities in these areas. For the longer term, the CCE-FU has established a Special Working Group to provide expert advice on these matters.</td>
<td>The framework within such activities will be undertaken in the future (i.e. beyond the Sixth Framework Programme) is dependent on the key decisions which will be taken about ITER.</td>
<td>No fixed deadline</td>
</tr>
<tr>
<td>7. A comprehensive plan to enhance public awareness activities, involving an active engagement of all associations, should be produced to introduce the ITER project in parallel to the decision and the start up. Contracts of Association should also include provisions relating to these issues.</td>
<td>The Commission recognises the importance of public awareness activities, particularly in view of the possible construction of ITER in Europe. The Commission and all Associations undertake public awareness and dissemination activities.</td>
<td>The activities of the Associations in these areas will continue to be addressed within the EFDA framework.</td>
<td>Ongoing</td>
</tr>
<tr>
<td>8. In view of the forthcoming start up of the ITER project, the Commission is recommended to gather and provide fresh data from the Associations on their staff structure, its age profile, the distribution of women in all roles and levels, with a view to initiating action to reduce any imbalances.</td>
<td>Given the long-term nature of fusion R&amp;D, and the number of highly skilled specialists who will be required for ITER, the Commission views this as a matter of great importance.</td>
<td>An update to the previous study, which was completed in 1996, is being planned.</td>
<td>A preliminary assessment should be completed by the end of 2003.</td>
</tr>
<tr>
<td>9. The panel recommends that the Commission take advantage of the example from the fusion programme to a much larger degree when describing and promoting the European Research Area. The administratively relatively simple and well functioning organisation including the mobility programme within fusion is an excellent example.</td>
<td>The fusion programme has some distinct features which lead to significant benefits from co-ordination and integration on a European scale. While recognising that these features are not shared by all the other areas of research funded within the Framework Programmes, the Commission agrees that fusion is an example of a successful European Research Area.</td>
<td>The Commission is endeavouring to highlight the advantages that result from the European Research Area which already exists in fusion.</td>
<td>No fixed deadline</td>
</tr>
<tr>
<td>10. The Commission should increase its efforts to better clarify to newly associated members the management of the Programme, the rather high complexity of the administrative structure, the ways of acquiring tasks and receiving support.</td>
<td>The Commission has already been successful in bringing into the fusion programme those candidate countries already associated to Euratom. This effort needs to be deepened, and widened to those countries who will associate to Euratom in 2004.</td>
<td>The effort is ongoing, and a recent reinforcement of the manpower of the fusion staff will allow it to be intensified.</td>
<td>No fixed deadline</td>
</tr>
</tbody>
</table>