

Proposed Research for the ARIES Team for 1999-2000

Farrokh Najmabadi

OFES Briefing

June 9, 1998

OFES Headquarters, Germantown

Proposed topics have been developed under the Virtual Laboratory for Technology framework and discussion with physics and technology program leaders*

- **Role of Fusion in a Sustainable Energy Strategy**
(in support of IIASA Study) **(10% of effort)**
- **Advanced ARIES-RS** **(25% of effort)**
- **Neutron Source** **(60% of effort)**
- **Support for on-going examination of fusion systems as producers of hydrogen** **(5% of effort)**

- **Stellarator Power Plant** **(If additional resources become available)**

* Assumes President's budget allocations

Strategic Studies of the Role of Fusion in a Sustainable Energy Strategy Initiative

- **There is a need to make a case for fusion energy in the context of a sustainable global energy future.**
- **Study should be done by an independent organization, recognized worldwide as experts in the global strategic modeling.**
- **It would be most helpful if such a study is requested by or has the support of all ITER partners**
- **International Institute for Advanced Systems Analysis (IIASA) is an organization of choice for this study.**

International Institute for Advanced Systems Analysis (IIASA) -- Background

- **IIASA was created during the Cold War for “scientists of East and West to work together on problems that plagued all advanced nations.”**
- **IIASA charter, as a multinational organization, was signed in 1972 in London. Its headquarters is in Vienna.**
- **IIASA is supported by national members organizations (from Europe, including former Soviet republics, Japan, and U.S.)**
- **IIASA has done a fusion/fission-breeder comparison study**
- **IIASA current director is Gordon MacDonald**
- **For more information see <http://www.iiasa.ac.at/>**

Strategic Studies of the Role of Fusion in a Sustainable Energy Strategy Initiative

- **Bob Conn has contacted Gordon MacDonald.**
- **MacDonald has shown interest in a fusion study.**
- **A draft statement of work is prepared. Pending OFES comments, it will be sent to IIASA for MacDonald's feedback.**
- **IIASA has its own internal funding. Therefore, only modest resources would be required by IIASA for this study.**
- **ARIES Team will compile and provide the necessary information for IIASA study.**
- **July ITER council meeting at Vienna is a good time to visit IIASA.**

Advanced ARIES-RS

- **ARIES-RS is the vision for the advanced tokamak program and is used to plan R&D directions.**
- **ITER EDA will concentrate on developing lower-cost options using advanced modes to achieve a higher performance.**
- **Focus of the program on advanced tokamaks has resulted in major progress which will be continued in the next few years.**
- **A re-visit of ARIES-RS is warranted to assess “how good” advanced tokamaks can be using higher performance physics and technology.**
- **This effort will provide timely information to the program and compliment the ITER low-cost options activity.**

Neutron Source Study -- Rationale

- **Scoping studies have indicated that fusion neutron sources may lead to attractive, near term products for the fusion program, leading to new clients and to additional resources for fusion development.**
- **An integrated conceptual design is warranted at this time to produce a technically credible argument for non-electric application of fusion.**
- **Such study will provide the necessary information to help OFES and FESAC decide on giving non-electric application of fusion a visible role in the program direction.**

Neutron Source Study -- First Phase

- **Define what fusion should deliver to be competitive in these markets:**
 - **Technical requirements of fusion neutron sources (e.g, flux, fluence, availability, cost, competition potential)**
 - **Extrapolation from present data base**
 - **Cost, RAMI, and safety & environmental issues**
- **Concurrently, consider the potential tokamak and alternatives to fulfill role of a fusion neutron source.**
- **Technical requirements and time-scale/cost of the competition will be used to choose one or two concepts for further study.**
- **This phase to take about 6 to 9 months.**

Neutron Source Study -- Second Phase

- **Depending on the results of the first phase, one or two studies will be launched. For example:**
 - 1) **A low neutron flux and a low neutron fluence device (small extrapolation from present technology) and**
 - 2) **A high neutron flux and a high neutron fluence device (larger extrapolation)**
- **This division differentiates between application and between the time needed to develop a concept. It is quite possible that the first device would be the precursor to the second device.**
- **This phase will take about 15 to 18 months.**

Stellarator Power Plant Study

- **Major worldwide stellarator program with two proof-of-performance stellarator experiments, LHD and W7X.**
- **Five years ago, SPPS study by the ARIES Team provided the impetus for advanced compact stellarators. SPPS represents a factor of two improvement over conventional stellarators. SPPS was a “part time” study aiming at identifying the potential of advanced stellarator.**
- **Considerable progress has been made in advanced stellarators which may lead to more attractive stellarator power plants.**

Stellarator Power Plant Study

- **An stellarator power plant study is warranted when a proof-of-principle, advanced stellarator program is launched in U.S. Such a study will help guide the experimental R&D.**
- **If a proof-of-principle stellarator program is launched in US and if additional resources (beyond President's budget levels) are provided, a low-level effort can be initiated in coordination with the physics community.**
- **During the next two years, this effort will provide preliminary feedback to the stellarator community. In addition, it will set the ground work for a detailed stellarator study after the neutron source study.**