GA-C19572

(1/21/94)

PROGRAM STATUS

1st QUARTER – FY 1994

ITER & TECHNOLOGY

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Contract No. DE-AC03-89ER52153
General Atomics Project 3469

This Quarterly Report Under
DOE Contract DE-AC03-89ER52153
is Submitted in Compliance with Sections A and B
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JANUARY 21, 1994

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ITER & TECHNOLOGY 1ST QUARTER FY94

- **Reactor Studies**

- The ARIES-IV toroidal flow blanket final report was completed
- The shield is a good thermal energy storage option for both helium-cooled and Li-self-cooled blanket designs

- **RF Technology**

- The conceptual design for a 2"X8" distributed gyrotron window was completed.

- **Plasma Interactive Materials**

- Dedicated DiMES sample experiment exposed to six plasma shots were performed. Useful material erosion and redeposition results were obtained

**PROGRAM STATUS REPORT
CONTRACT DE-AC03-89ER52153
1ST QUARTER — FY94**

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PLASMA INTERACTIVE MATERIALS

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ITER & TECHNOLOGY PROGRAM

Reactor Studies

REACTOR STUDIES PLANNED ACTIVITIES FOR FY94

- Provide overall project management (deputy director).
- Complete the GA contributions of the PULSAR design and final report.
- Participate in the definition of the DEMO design project.
- Perform design, analysis and evaluation of high performance fusion power core components such as first walls, blankets, divertor and shield designs.
- Provide neutronics design and analysis of blanket and shield systems, including analysis of tritium and power production, neutron activation, afterheat, radiation dose, and radioactive waste handling.

PROGRAM STATUS
1ST QUARTER — FY 1994

TASK: REACTOR STUDIES

FY94 FUNDING: \$260 K

B/R NO: AT-15-03

FY94 PLAN: \$260 K

CONTRACT NO.: DE-AC03-89ER52153

GA PRINCIPAL INVESTIGATOR: C.P.C. WONG

SAN PROJECT MANAGER: C. BEIGHLEY

OFE PROGRAM MANAGER: W. DOVE

PLANNED ACTIVITIES/GOALS		ORIGINAL TARGET	CURRENT TARGET	COMPLETION DATE
1.	Complete conceptual design and evaluation of the PULSAR Tokamak Reactors	2nd Q FY94		
2.	Support the definition of the DEMO design project	←	ONGOING	→
3.	Participate in the design of the DEMO power reactor design	←	ONGOING	→

REMARKS:

PROGRAM STATUS

1ST QUARTER — FY1994

REACTOR STUDIES

HIGHLIGHTS:

- We continued to analyze the use of the shield for the thermal energy storage in the PULSAR reactor design and found that this design approach is also applicable to the Li-self-cooled V-alloy structure blanket option.
-

1. Toroidal System Studies

During the months of October, November and December we continued the work on the analysis of using the shield for thermal energy storage in PULSAR reactor design, for both the helium-cooled and Li-self-cooled blanket options. A configuration based on a nested shell concept was developed. Vanadium alloy shells containing 1 cm diameter channels circulating lithium coolant were separated with a bed of tenelon steel spheres, wetted with liquid NaK to enhance thermal conductivity. Thermalhydraulics estimates demonstrated acceptable energy discharge performance within material limits of the vanadium structure. Studies were also undertaken for time-dependent, multi-dimensional heat transfer analysis. Divertor engineering designs for both PULSAR options were initiated. Necessary gaseous divertor parameters were extrapolated from the latest ITER design.

2. Project Coordination

GA continued to coordinate the ARIES and PULSAR designs, including PULSAR project meetings, conference calls and providing support to UCLA to administer the IAEA Workshop on Fusion Reactor Design and Technology.

3. ARIES Final Report

GA's contribution to the ARIES-IV final report was completed.

4. Meetings and Workshops

An abstract describing the thermal energy storage design and analysis was submitted to the 3rd International Symposium on Fusion Nuclear Technology (ISFNT-3).

5. Russian Collaboration

We initiated discussions with our Russian colleague to work on the DEMO divertor design. A contract with Kurchatov Institute is being prepared. Our technical contact is Dr. E. Muraviev of Kurchatov Institute in Moscow.

ITER & TECHNOLOGY PROGRAM

RF Technology

RF TECHNOLOGY PLANNED ACTIVITIES FOR FY94

- Coordinate and host the 3rd Bi-annual U.S./Japan RF Technology Exchange to be held at Osage Beach, Mo., October 28–29, 1993.
- Design and fabricate a distributed window which can be used on the a 1 MW 110 GHz gyrotron being developed under the MW Gyrotron Development Program.
- Design and fabricate a Fast Wave Current Drive Antenna based upon the GA comblane concept, with the intent of using the antenna on the JFT–2M tokamak in Japan.

PROGRAM STATUS
1ST QUARTER — FY 1994

TASK: RF TECHNOLOGY

FY94 FUNDING: \$175 K

B/R NO: AT-15-04-01C

FY94 PLAN: \$395 K*

CONTRACT NO.: DE-AC03-89ER52153

GA PRINCIPAL INVESTIGATOR: R.W. CALLIS

SAN PROJECT MANAGER: C. BEIGHLEY

OFE PROGRAM MANAGER: T.V. GEORGE

PLANNED ACTIVITIES/GOALS	ORIGINAL TARGET	CURRENT TARGET	COMPLETION DATE
1. Coordinate U.S./Japan RF Technology Exchange.	4 th Q FY93		1 st Q FY94
2. Produce 2"X8" gyrotron distributed window	2 nd Q FY94		
3. Design and fabricate a FWCD comblane antenna	4 th Q FY94		

REMARKS:

*Includes \$220K carryover from prior year.

PROGRAM STATUS

1ST QUARTER — FY1994

RF TECHNOLOGY

HIGHLIGHTS:

- The 3rd Bi-annual U.S./Japan RF Technology Exchange was held October 28–29, 1993, at the Inn at Grand Glaze, Osage Beach, MO.
  - Two TE_{22,6} mode generators were fabricated in the last quarter of FY93. Both were shipped to the University of Wisconsin for measurement. The first one shipped to the University of Wisconsin was measured to have a mode purity better than 98%.
  - The conceptual design for a 2"X8" distributed gyrotron window was completed, and long lead parts are on order.
-

The 3rd Bi-annual International ECH Transmission Line workshop was held the week before the 1993 APS meeting. The dates were October 28–29, 1993 and was held at Inn at Grand Glaze, Osage Beach Mo. Eighteen scientist and engineers participated, with nineteen technical papers presented.

Two TE_{22,6} mode generators for testing the internal launchers for the MW gyrotron development program were fabricated this quarter. One unit was assembled tested and shipped to the University of Wisconsin in September. This unit had over 98% mode purity. The second unit was assembled and was tested and was found to have about 2% counter rotating mode, this unit was also sent to Wisconsin for further measurements on their far field scanning system. The first unit was sent from the University of Wisconsin to Varian to be used in checking out the mode converter that Varian will put in their new gyrotron tube.

A conceptual design for a 2"X8" distributed gyrotron window was completed this quarter. The long lead materials have been ordered the sapphire strips have been ordered and fabrication of the window frame and vacuum bellows was started in early October.

ITER & TECHNOLOGY PROGRAM

Plasma Interactive Materials

PLASMA INTERACTIVE MATERIALS PLANNED ACTIVITIES FOR FY94

- Operate and maintain the motorized DIMES sample changer system on DIII-D.
- Coordinate and conduct DIMES sample experiments exposed to the DIII-D plasma. Study effects from net erosion and plasma disruptions on different low- z materials and coatings.
- Complete the FY94 U.S./Russia, U.S./Japan, and U.S./PRC exchange tasks on DIMES samples exposed to the DIII-D plasma.
- Characterize the divertor conditions during the periods when different DIMES samples are exposed to the DIII-D plasma and disruptions. Coordinate DIMES related results from SNL-L and ANL for material characterization and modeling analysis.
- Participate in ITER PFC R&D project meetings.

PROGRAM STATUS
1ST QUARTER — FY 1994

TASK: PLASMA INTERACTIVE MATERIALS	FY94 FUNDING:	\$250 K
B/R NO: AT-15-04-01E	FY94 PLAN:	\$157 K*
CONTRACT NO.: DE-AC03-89ER52153		

GA PRINCIPAL INVESTIGATOR: C.P.C. WONG

SAN PROJECT MANAGER: C. BEIGHLEY

OFE PROGRAM MANAGER: M. COHEN

PLANNED ACTIVITIES/GOALS	ORIGINAL TARGET	CURRENT TARGET	COMPLETION DATE
1. Perform erosion/redeposition experiments on different base and coated materials.	4 th Q FY94		
2. Perform material studies in accordance with the U.S./Russia, U.S./Japan, U.S./PRC exchanges ⁽¹⁾ .	4 th Q FY94		
3. Perform disruption studies.	4 th Q FY94		
4. Fabricate and install the fiber optics reflectometer in-situ measurement experiment ⁽²⁾ .	4 th Q FY94		

REMARKS:

*Accounts for \$93K overrun of FY93 funding.

(1)Pending conversion of the 1993 and 1994 capital to operation budget.

(2)Pending potential re-instatement of the original 1994 budget of \$400K.

PROGRAM STATUS

1ST QUARTER — FY1994

PLASMA INTERACTIVE MATERIALS

HIGHLIGHTS:

- A dedicated DIMES experiment was successfully run in DIII-D. Useful material erosion and redeposition results were obtained and input for modeling analysis.
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DiMES Experiments

The first DiMES program dedicated experiment at DIII-D was performed on October 21. A DiMES sample with implanted ^{29}Si and a coating of W was exposed to six shots of ELM-free H-mode plasma. Discharges for this exposure were developed using two long ELM free periods (lower single-null) during current flattop to expose DiMES sample to divertor scrape-off-layer fluxes. Measurements of the erosion of carbon and tungsten from the DiMES sample exposed during October have been made by Sandia. Significant carbon erosion was observed, but the tungsten erosion was below the detection limit of 5 nm. However, redistribution of tungsten onto the surrounding carbon was measured. IR TV and CCD camera data were analyzed for this exposure. These results were provided as inputs to validate the REDEP and other erosion/redeposition modeling codes.

A small inward drift in strike point position during the second H-mode phase of each shot was detected when compare to the EFIT data. This shift was found to be visible on the IR camera images as well. This is being analyzed.

A DiMES probe with three embedded langmuir probes was also inserted into DIII-D for testing during plasma operations. Although two of the probes failed, one worked successfully, demonstrating the ability to do active instrumentation during DiMES experiments.

International Collaboration

This quarter Dr. Felix Weschenfelder of KFA-Jülich began a one-year postdoc at DIII-D. He will build a Thin Film Reflectometer diagnostic that will be deployed on the DiMES mechanism for deposition measurements in the divertor. Design work has begun on the modifications to the DiMES sample changer mechanism needed to support this new diagnostic. Sample Changer System.

Proposed collaboration to expose a DiMES sample prepared by PR China scientist from the Southwest Institute of Physics was accepted.

DiMES Sample Changer System

Concepts for bringing the fiber optic bundles through the DiMES shaft were considered for the reflectometer task. A conceptual design review was held and no significant objections were raised to the technical approach.