

ANNUAL REPORT FOR THE YEAR 2010

OF THE

INTERNATIONAL ENERGY AGENCY IMPLEMENTING AGREEMENT FOR ENERGY CONSERVATION AND EMISSIONS REDUCTION IN COMBUSTION

prepared by the
Executive Committee Secretariat

for

Jay Keller, Agreement Operating Agent
Sandia National Laboratories - California

Program of Research

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EXECUTIVE ABSTRACT

YEAR 2010 ACTIVITIES OF THE EXECUTIVE COMMITTEE

SUMMARY OF RESEARCH ACTIVITIES

EXECUTIVE ABSTRACT

The purpose of the IEA Implementing Agreement on Energy Conservation and Emissions Reduction in Combustion program is to improve fundamental and applied combustion technology which is developed to provide predictive design capabilities for internal combustion engines, furnaces, and gas turbines. This document summarizes the progress made in agreement year 2010.

Since 1978, IEA cooperative research by program participants has focused on developing experimental and computational tools to aid combustion research and on developing advanced laser-optical diagnostic tools that permit in situ, time- and space-resolved measurements of combustion phenomena for achieving this end. The Agreement's Annex 1 has been planned to improve the modeling and simulation processes as well as the instrumentation required for the supporting experimental activities.

Programs of applied research are carried out in one or more of the following areas:

- Advanced piston engine technology;
- Furnaces and boilers;
- Fundamentals
- Advanced turbine technology

Collaborative multi nation initiatives are under way in the areas of hydrogen enriched lean premixed combustion for ultra-low emission gas turbines, fuel sprays, hydrogen-fueled internal combustion engines, nano-particle diagnostics, alternative fuels, and fuels for homogeneous charge compression ignition (HCCI) engines.

YEAR 2010 ACTIVITIES OF THE EXECUTIVE COMMITTEE

The Executive Committee (ExCo) of the International Energy Agency's (IEA) Program of Research, Development and Demonstration on Energy Conservation and Emissions Reduction in Combustion coordinates the cooperative efforts undertaken by participating institutions. The Committee met twice during the business year 2010. The first meeting took place in April. Because of flight cancellations caused by the volcanic eruptions in Iceland, most ExCo members participated via teleconference. The second took place following the Agreement's Thirty-second Task Leaders Meeting in July in Nara, Japan.

Actions taken by the Executive Committee this year include:

Task Leaders Meeting:

The Thirty-second Leaders Meeting, sponsored by the Executive Committee was held at the Nara Royal Hotel in Nara, Japan in July. Principal Investigators, Executive Committee members, and invited guests gathered to hear papers presented on the Agreement's research

Executive Committee Meetings:

Minutes of the Executive Committee's meetings of April and July have been published and distributed to IEA Headquarters and to ExCo members. The Proceedings of the Thirty-second Task Leaders Meeting were published and distributed to IEA Headquarters and Executive Committee members for distribution to participants. The Agreement's Annual Reports and 30 Year Anniversary Report are available on the public web site.

Agreement Leadership:

At its July meeting, the Executive Committee unanimously chose as Chairman, Dr. Felice Corcione of Italy to direct the Agreement's activities for the forthcoming year, 2010 - 2011. Dr. Marie Bysveen of Norway was elected vice-chair.

Future Meetings:

The Executive Committee scheduled its 2010 meetings for March 2011 at IEA Headquarters, Paris and August, 2011 in Lund, Sweden. The August meeting will be held immediately following the 33rd Task Leaders meeting and at the same location.

Executive Committee members and their alternates as of September 30, 2010 were

| | |
|----------------|---|
| BELGIUM | Dr. Philippe Ngendakumana |
| Alternate: | Dr. Barbara Pesenti |
| CANADA | Dr. Gregory J. Smallwood |
| Alternate: | Dr. Kevin Thomson |
| FINLAND | Prof. Martti Larmi |
| Alternate: | Mr. Heikki Kotila |
| GERMANY | Prof. Frank Behrendt |
| ITALY | Prof. Felice E. Corcione |
| Alternate: | Dr. Gerardo Valentino |
| JAPAN | Prof. Yasuo Moriyoshi |
| Alternate: | Prof. Eiji Tomita |
| KOREA | Prof. Choongsik Bae |
| Alternate: | Prof. Kyoungdong Min |
| NORWAY | Dr. Marie Bysveen |
| Alternate: | Prof. Ivar S. Ertesvag |
| SWEDEN | Dr. Bernt Gustafsson |
| Alternates: | Prof. Marcus Alden and Dr. Sven-Inge Moller |
| SWITZERLAND | Dr. Sandra Hermle |
| Alternates: | Mr. Stephan Renz and Dr. Peter Jansohn |
| UNITED KINGDOM | Prof. Douglas Greenhalgh |
| Alternate: | Prof. Phillip Hutchinson |
| UNITED STATES | Mr. Gurpreet Singh |

For the 2010 Agreement Year, the Operating Agent for the Energy Conservation and Emissions Reduction in Combustion Implementing Agreement was Dr. Dennis Siebers, Sandia National Laboratories, Livermore, California, USA.

Dr. Robert J. Gallagher has been engaged by the Executive Committee to fulfill the administrative responsibilities of the Operating Agent.

The Agreement's administrative liaison at IEA Headquarters, Paris is Mr. Jayen Veerapen

SUMMARY OF RESEARCH ACTIVITIES

AREA 1 ADVANCED PISTON ENGINE TECHNOLOGY

SUBAREA 1.1 INDUCTION PROCESSES

No active Subtasks

SUBAREA 1.2 FUEL-AIR MIXING

1.2K Collaborative Task
Sprays in Combustion

Finland
[Studies of Spray Shape using LES](#)

Japan
[Laser Diagnostics of Sprays](#)

Japan
[Combustion Control](#)

Switzerland
[Assessment of Modeling Approaches](#)

Japan
[Diesel Sprays](#)

SUBAREA 1.3 IGNITION

No active Subtasks

SUBAREA 1.4 FLAME PROCESSES

No active Subtasks

SUBAREA 1.5

EXHAUST PHENOMENA

No active Sub Tasks

SUBAREA 1.6

COMBUSTION PERFORMANCE AND CHARACTERISTICS OF FUELS

1.6A Collaborative Task

Homogeneous Charge Compression Ignition (HCCI)

Sweden

[PPC with Euro 6 Emissions and 50%+ Fuel Efficiency](#)

Korea

[DME HCCI Engine Combustion](#)

Canada

[Effect of Cetane Number on HCCI Combustion](#)

Japan

[HCCI with Blow Down Supercharge](#)

Japan

[Biomass Based Gaseous Fuel Combustion](#)

1.6B Collaborative Task

Advanced Hydrogen Fueled Internal Combustion Engines

U.S.

[Optical and CFD Investigations in a DI-H₂ICE](#)

Korea

[EGR in a H₂-DME PCCI Engine](#)

Canada

[Effect of Hydrogen Enrichment on Combustion](#)

Japan

[LES Analysis of H₂ Unsteady Jet](#)

1.6C Collaborative Task

Alternative Fuels

Switzerland

[Auto Ignition Models for HCCI](#)

Finland

[High Cetane Number Paraffinic Diesel Fuels](#)

Korea

[Direct Injection LPG Engine Combustion](#)

Belgium

[Reaction Kinetics of Neat Oxygenated Compounds](#)

Belgium

[Flameless Oxidation of Alternative Fuels](#)

Sweden

[Biofuel Research at Chalmers](#)

AREA 2

ADVANCED FURNACE TECHNOLOGY

SUBAREA 2.1

BURNER PHENOMENA

2.1H Belgium

[Thermal Performance of Condensing Boilers](#)

2.1I Belgium

Study of Combustion and Heat Transfer Phenomena in Industrial Furnaces Fired with Gas Burners using Preheated Air (Active Sub Task but no report available)

SUBAREA 2.2

GAS FLOWS

No active Subtasks

SUBAREA 2.3

FUEL-AIR MIXING

No active Subtasks

SUBAREA 2.4

FLAME PROCESSES

2.4F Belgium

See Alternative Fuels Collaborative Task

SUBAREA 2.5

POSTFLAME PROCESS

No active Subtasks

AREA 3

FUNDAMENTALS

SUBAREA 3.1

TURBULENT REACTING FLOWS

3.1D Japan

[Controlling Mixture Heterogeneity in PCCI Combustion](#)

SUBAREA 3.2

PHYSICAL AND CHEMICAL PROCESSES

No active Subtasks

SUBAREA 3.3

NUMERICAL MODELING

No active Subtasks

SUBAREA 3.4

DIAGNOSTICS

3.4D Sweden

[Planar Imaging of Dense Sprays](#)

3.4E Collaborative Task

Nanoparticle Diagnostics

Canada

[Soot Optical Properties](#)

Italy

[Soot LII Signal variation](#)

Canada

[Mass Concentration of Nanoparticle Emissions](#)

Italy

[Three Angle Scattering and Laser Extinction Measurements](#)

Canada

[Synopsis of 4th International LII Workshop](#)

AREA 4

ADVANCED GAS TURBINE TECHNOLOGY

SUBAREA 4.1

COMBUSTION MODELING AND VERIFICATION

4.1A Collaborative Task

Hydrogen Enriched Lean Premixed Combustion for Ultra-Low Emission Gas Turbine Combustors

Switzerland

[Combustion of Hydrogen Rich Fuel](#)

Sweden

[High Pressure Combustion at Lund University](#)

Norway

[DNS of Hydrogen Flames](#)

AREA 5

SUPPORTING ACTIVITIES

NATIONAL ENERGY POLICIES

INVITED PRESENTATIONS ON CHEMICAL KINETICS

US

[Recent Developments of Analytical Tools](#)

Canada

[NOX and N2O Formation](#)

US

[Development Status of Reaction Schemes](#)

France

[Combustion Modeling](#)

Japan

[Plasma Supported Combustion](#)

Japan

[Universal Reaction Scheme Reduction Tool](#)

Japan

[Automatic reaction Scheme Generation](#)