ANNUAL REPORT
FOR THE YEAR 2009

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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Sandia National Laboratories – California

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EXECUTIVE ABSTRACT

YEAR 2009 ACTIVITIES OF THE EXECUTIVE COMMITTEE

A 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 2009.

Since 1978, IEA cooperative research by program participants has focused ondeveloping 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 2009 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 2009. The first meeting was held at IEAHeadquarters in Paris, France, in May; the second took place following the Agreement's Thirty-first Task Leaders Meeting in September in Lake Louise, Canada

Actions taken by the Executive Committee this year include:

Task Leaders Meeting:
The Thirty-first Leaders Meeting, sponsored by the Executive Committee was held at the Chateau Lake Louise in Lake Louise, Canada in September. 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 May and September have been published and distributed toIEA Headquarters and to ExCo members. The Proceedings of the Thirty-first 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 September meeting,the Executive Committee unanimously chose as Chairman, Dr. Bernt Gustafsson of Sweden to direct the Agreement's activities for the forthcoming year, 2009 - 2010. Dr. Felice Corcionw of Italy was elected vice-chair.

Future Meetings:
The Executive Committee scheduled its 2010 meetings for April 2010 at IEA Headquarters, Paris and July 2010 in Nara, Japan. The July meeting will be held immediately following the 32nd Task Leaders meeting and at the same location.

Executive Committee members and their alternates as of September 30, 2009 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 2009 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

1.2C Italy
Spray Combustion in Diesel Engines

1.2K Collaborative Task
Sprays in Combustion

Finland
Sprays in Combustion

Japan
Spray and Ambient Gas Flow for GDI Engines

Japan
Modeling of Cavitation Phenomenon

Finland
LES Modeling of Sprays

SUBAREA 1.3 IGNITION

No active Subtasks

SUBAREA 1.4 FLAME PROCESSES

1.4G Japan
Combustion Enhancement in SI Engine
Mixture Formation in an SI Engine
Measurements of Gas Flow in a 4 Stroke Motored Engine

SUBAREA 1.5 EXHAUST PHENOMENA

No active Sub Tasks

SUBAREA 1.6 COMBUSTION PERFORMANCE AND CHARACTE-ISTICS OF FUELS

1.6A Collaborative Task
Homogeneous Charge Compression Ignition (HCCI)

Sweden
PPC for High Fuel Efficiency Engine Operation

UK
Fuel Properties for HCCI

Korea
Dual Fueled HCCI Operation

Canada
Effecty of Cetane Number on HCCI Combustion

China
Active Fuel Design for HCCI

Finland
HCCI Implementation with High Cetane Number Fuel

Italy
Advanced Combustion Mechanisms for Clean Engines

UK
Innovative Biofuel Approach

1.6B Collaborative Task
Advanced Hydrogen Fueled Internal Combustion Engines

Canada
Effect of Hydrogen Addition on Burning Rate

Japan
Hydrogen Combustion in a Supercharged Gas Engine

U.S.
Mixture Formation in a Hydrogen Fueled Engine

1.6C Collaborative Task
Alternative Fuels

Finland
Task Overview

Canada
Emissions Characterization of Urban Transit Buses

Switzerland
Global Reaction Model for Designer Fuels

Belgium
Reaction Kinetics of Neat Oxygenated Compounds

Germany
Critical Evaluation of Substitution of Natural Gas by Biogas

China
DME as An Alternative Fuel for CI Engines

Finland
High Cetane Number Paraffinic Diesel Fuels

AREA 2 ADVANCED FURNACE TECHNOLOGY

SUBAREA 2.1 BURNER PHENOMENA

2.1H Belgium
Investigation on Combustion in Oil Burner Flames (Active Sub Task but no report available)

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
Kinetic Modeling of Flames

SUBAREA 2.5 POSTFLAME PROCESS

No active Subtasks

AREA 3 FUNDAMENTALS

SUBAREA 3.1 TURBULENT REACTING FLOWS

3.1D Japan
Integral Length Scale and Turbulence Viscosity in a Rapid Compression/Expansion Machine
DNS of Turbulent Premixed Combustion

SUBAREA 3.2 PHYSICAL AND CHEMICAL PROCESS

No active Subtasks

SUBAREA 3.3 NUMERICAL MODELING

No active Subtasks

SUBAREA 3.4 DIAGNOSTICS

3.4C Japan
Universal Rule of Hydrocarbon Oxidation

3.4E Collaborative Task
Nanoparticle Diagnostics

Italy
Soot Particle Formation Measurements

Canada
Investigation of Soot particle Optical Properties

Germany
Soot Formation Diagnostics

UK
Design of a High Vacuum LII System

Canada
LII Use in Measuring Nonvolatile Particulate Emissions

Italy
Nanoparticle Characterization

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

Germany
Oxyfuel and Syngas Combustion

Switzerland
Co-firing of Biomass Derived, Hydrogen Rich Syngas in a Turbine

AREA 5 SUPPORTING ACTIVITIES

ENERGY SECURITY DISCUSSION

INVITED PRESENTATIONS OF NATIONAL ENERGY STRATEGIES

Switzerland

Korea

United Kingdom

United States