



## CLEAN ELECTRIC POWER GENERATION

### CLEAN ENERGY TECHNOLOGIES

### CEPG AT CETC-OTTAWA

#### Clean Electric Power Generation (CEPG)

The Clean Electric Power Generation (CEPG) Program is Canada's centre of excellence for the development of efficient stationary combustion processes and pollution abatement technologies to support industrial development both nationally and internationally.

In Canada, combustion of hydrocarbons provides approximately 80% of the energy used in stationary power generation equipment. Because fossil fuels will continue to play a vital role in our world's economy for years to come, CEPG is actively developing and deploying processes and tools that:

- increase our knowledge of combustion;
- substantially reduce the release of greenhouse gases; and
- improve the efficiency of combustion-based power generation.

The Group's research focuses on optimizing the performance of stationary equipment and evaluating and developing new products, fuels and retrofit technologies. Processes under study use conventional fuels: oil, coal and natural gas, as well as biomass and specialty fuels.

Clean Electric Power Generation (CEPG) research areas include:

- pressurized gasification;
- fluidized bed combustion;
- O<sub>2</sub>/CO<sub>2</sub> combustion



*Research facilities in Bells Corners, ON*

- computational fluid dynamics
- advanced measurement techniques
- simulation;
- mercury capture;
- fine particulates research;
- advanced control systems;
- flaring;
- fuels and byproduct characterization;
- biomass combustion; and
- isokinetic sampling.

Our researchers undertake both lab-scale and pilot-scale research from within our well equipped facilities. The facilities also include laboratories for equipment testing, laser diagnostics and fuel characterization as well as emissions monitoring capabilities and a strong computer modeling team. Field demonstrations, to promote the implementation of new technologies, are often undertaken in cooperation with private sector

companies, universities and special interest groups.

#### Availability of Services

CEPG's services are available to public and private groups with an interest in combustion for process heat, steam and power generation, including pollution abatement. Collaborative projects are usually task or cost-shared with clients. Staff specialists can assist clients in developing state-of-the-art control technologies such as expert systems and artificial intelligence. Using their advanced computational modeling skills, scientists can assist clients to increase process production and energy efficiencies. Residential and commercial oil and gas-fired heating systems, woodstoves, fireplaces and boilers can be tested and redesigned in co-operation with manufacturers, with the goal of increasing efficiency and reducing environmental emissions.

Some of our clients have used our research capabilities for:

- performance evaluation of burners
- studies on integrated emissions monitoring and control
- performance studies of low-grade fuels
- application of neural networks and other artificial intelligence systems to process control
- studies on combustion processes for power generation
- analysis of fuels and their emissions
- computational fluid dynamic modeling and simulation of industrial processes
- studies on integrated systems for residential and commercial use.

CEPG's staff serves clients from the following sectors: electrical utilities and other operators of stationary combustion facilities; oil, coal and natural gas producers; pulp and paper industry; combustion equipment manufacturers; software developers; industry associations; federal and provincial government departments; as well as standards writing organizations.

As a group we work in partnership with provincial departments and agencies, national and international agencies, Environment Canada, DOE/EPA USA and the International Energy Agency, Standards Organizations (i.e. CGSB,

ASTM, ASHRAE, ISO) as well as universities and other research institutes in Canada and overseas.

Our Energy Technology Applications Group (ETAG) can assess, design and help implement the ideal energy solutions for your organization. ETAG's mandate is to develop energy efficiency projects and apply, when appropriate, the leading-edge technologies that are being developed within the Clean Electric Power Generation group and CETC-Ottawa.

ETAG can assist with technologies ranging from current boiler and combustion technologies to renewable energy systems and fuel cells.

Other programs within the Clean Electric Energy Group include:

- Fossils Fuels and Climate Change;
- Flaring;
- FBC-Gasification;
- Advanced Controls, Simulation and Emissions;
- Fuels Assessment and Emissions;
- Combustion Measurements and Kinetics;
- Modeling;
- Instrument Controls and Analytical Lab; and
- Biomass and Renewables.



CEPG's PRESSURIZED GASIFIER

**Many concerns have been mitigated as a result of CEPG's successes:**

- finding reliable methods for burner evaluation;
- determining combustion performance and emission characteristics of coal, oil, biomass, natural gas and specialty fuels ;and
- finding the means for the increased use of alternative and renewable fuels from agricultural and wood wastes.

### Pace-setting Research

CEPG's combustion engineers and scientists focus on achieving, by new or improved technological means, optimal performance from combustion processes and equipment. Optimal performance is the key to more efficient use of resources and reduced environmental emissions.

### Analytical Capabilities

CETC-Ottawa's Analytical Services group tests the quality of fuels and combustion products and by-products according to industrial standard test methods accepted worldwide.

They also deal with characterization problems regarding all aspects of fuel production and utilization.

**To do so, this group operates such equipment as:**

- X-ray photoelectron spectroscopy (XPS);
- scanning auger microscopy (SAM);
- nuclear magnetic resonance (NMR);
- infrared spectroscopy (IR) thermo-gravimetric (TG) and TG/IR analysis;
- gas (GC), liquid (LC), ionic (IC) and supercritical fluid (SFC) chromatography;
- high-resolution mass spectrometry (MS) and gas chromatography/mass spectrometry (GC/MS);
- X-ray diffraction (powder XRD) and X-ray fluorescence spectrometry (XRF);
- inductively coupled plasma (ICP), atomic absorption (AA) and graphite furnace AA (GFAA) spectrometries;
- environmental sampling and handling of particulates, trace elements and organics and inorganic/organic leachability capabilities; and
- non-intrusive laser measurements (Coherent Anti-Stokes Raman Spectroscopy).

**Facilities supporting this research:**

- 3.6 GJ/h (1 MW thermal) flame research tunnel furnace that can be fired by coal, oil, natural gas, or other specialty fuels and burners;
- non-intrusive laser measurements (CARS, see Figure 6);
- intrusive measurements of temperature, gaseous speciation, heat transfer and radiation profiles;
- 3.6 GJ/h (1 MW thermal) circulating fluidized-bed combustor;
- 3.6 GJ/h (1 MW thermal) gas fired rotary kiln for waste conditioning and remediation;
- mini-pilot-scale circulating fluidized bed reactor for sorbent studies;
- laboratory-scale equipment for micro-analysis;
- 3.6 GJ/h (1 MW thermal) pilot scale research gasifier;
- 1.3 GJ/h (350 kW thermal) pilot-scale pressured entrained flow reactor;
- 3.6 GJ/h (1 MW thermal) bubbling fluidized bed combustor;
- two fully-instrumented appliance testing cells for residential system development, allowing efficiency and emission determinations; and
- 4 GJ/h (1.1 MW thermal) pilot-scale-grate boiler.



*CEPG currently comprises 78 employees, mainly Research Scientists, Engineers, Technologists & Technicians, along with support staff*

## Centre of Excellence for Stationary Combustion

CEPG's people and facilities combined with its research network make this group the Canadian Centre of Excellence for stationary combustion. CEPG welcomes joint projects with industrial parties and other organizations that wish to make use of its combustion research facilities and expertise.

- environmental sampling and handling of particulates, trace elements and organics and inorganic/organic leachability capabilities; and
- non-intrusive laser measurements (Coherent Anti-Stokes Raman Spectroscopy).

### Lab Facilities:

The **Clean Electric Power Generation (CEPG)** Group partners with industry to improve combustion processes for energy efficiency and emissions. Facilities for the Group include:

- A well equipped analytical laboratory
- Biomass fluidized bed reactor (from Queen's University)
- Bubbling fluidized bed combustor (3.7 GJ/h)
- Burner cold test facility
- CARS laser
- Calorimetric tunnel furnace
- Circulating fluidized bed combustor (3.7 GJ/h)
- Circulating fluidized bed combustor, bench-scale


- Circulating fluidized bed combustor, pilot-scale
- Computer modeling laboratory
- Entrained flow combustion reactor, pilot-scale
- Flame research tunnel furnace
- Flame research tunnel furnace (3.7 GJ/h)
- Flare test facility
- High efficiency residential laboratory
- Mobile emissions testing facility
- Oil laboratory for emissions testing
- Research boiler (3.7 GJ/h), pilot-scale
- Rotary kiln (1MW), pilot-scale
- Stoker fired industrial grate boiler, pilot-scale
- Vertical combustor (1.1 GJ/h)



*CEPG staff performing temperature measurements on the vertical combustor*


### Your Invitation to Work with Us

We are interested in collaborating with you. Please contact the Business Office to discuss your particular needs.

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