



PROJECT REGISTRATION FORM

Project Number: CFE-07-15	Task Force: Cleaner Fossil Energy
Title of Project: Coal Gasification Performance Assessments for Low Emissions IGCC Systems	
<p>Lead Partner Country: Australia</p> <p>CSIRO will lead the project and partner with research organizations in Australia and other AP6 member countries. CSIRO has already established collaborative relationships with the proposed key research participants of the project. Additional partners from Australian and international industry and research sectors will be engaged during the project to ensure the research outcomes are delivered in a form most suited to timely, practical implementation.</p>	
<p>Participating Partner Countries and Organizations:</p> <p>Peoples Republic of China: Thermal Power Research Institute (TPRI)</p> <p>Australia: CSIRO</p> <p>Other AP6 participants: Developed as part of the program.</p>	
<p>Project Manager Name: Dr. David Harris</p> <p>Address: CSIRO Energy Technology</p> <div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>Queensland Centre for Advanced Technologies</p> <p>1 Technology Court</p> <p>PO Box 883 Kenmore</p> <p>Qld, 4069</p> </div> <div style="width: 45%;"> <p>Phone: +61 (0)7 3327 4617</p> <p>Fax: +61 (0)7 3327 4455</p> <p>Email: David.Harris@csiro.au</p> </div> </div>	
Project Start Date: 1 February 2008	Proposed Project End Date: 30 June 2011
<p>Project Location(s): The initial coal gasification reactivity work will be undertaken in Australia using specialized facilities that have been established and developed as part of CSIRO's research program and collaborative programs within the Australian CRC Research program (CRC for Black Coal Utilisation and CRC for Coal in Sustainable Development). It is proposed that larger scale test work will be conducted using technology development and pilot scale facilities in China (TPRI) to extend and apply the research results to industrial scale processes. It is proposed that a mathematical modelling activity will be conducted between the participant organisations to develop a suitable interpretive model that will enable the coal gasification performance data to be applied to practical gasification systems.</p>	



Description of Project: This project builds on existing relationships between some of the leading coal gasification research groups within the AP6 partnership. CSIRO has established collaborative research links with TPRI in China and a proposal for a joint gasification research program has recently been developed for the Chinese Ministry of Science and Technology. The work proposed here, builds on this relationship to extend the foundation work program to include comparative evaluation of the gasification performance of Chinese and Australian coals using techniques and facilities developed in Australia as well as larger scale facilities available through TPRI in China. (A copy of the existing CSIRO/TPRI proposal is attached for reference). The current collaboration between CSIRO and TPRI is also being developed and extended through other activities including scientist exchange programs such as that facilitated by the Australian Academy of Technical Sciences and Engineering (ATSE). To progress the proposed collaboration, one of the key research scientists in this proposed program (Dr Daniel Roberts) will be visiting China (including TPRI) as part of the ATSE fellowship program in July/August 2007.

The project will produce key data on coal gasification and slag flow behaviour for a range of coal types likely to be considered for future gasification and IGCC applications in China and internationally. As Australia is a major coal exporter, it is also important that the performance of Australian coals in a range of technologies (broader than those that may be considered for implementation domestically) is understood so that appropriate coal/technology matching can be done and to identify and address potential performance issues. It is proposed that a mathematical modelling activity will be conducted between the participant organisations to develop suitable interpretive models that will enable the coal gasification performance data to be applied to practical gasification systems.

By integrating the technology development capabilities of the Chinese partners and the coal performance expertise available through the Australian partners, it will be possible to ensure that the research aspects of the program are well aligned with technology development and implementation pathways in the partner countries. This will allow effective integration of the important fundamental aspects of the coal gasification systems with the development of the key 'enabling' technology modules. These will be required to continue the development of current generation IGCC systems towards the low, and ultimately near zero, emissions power plant configurations required in the future and will provide a clear technology development pathway for the research and technology development activities being conducted in the proposed partnerships.

This project addresses the following application and technology development pathways for coal gasification based technologies:

- IGCC-based power generation systems to improve the thermal efficiency and environmental performance of coal based power generation. This is the first generation of IGCC technology and will form the platform for further development and implementation of low, and near zero, emission power technologies as the cost and scale of coal-derived syngas cleaning processing and hydrogen/CO₂ separation systems are improved.
- Coal gasification as a core technology for CO₂ capture and the principal pathway to hydrogen energy systems based on coal.



Project Objectives: (Please include goals/outcomes sought and performance indicators.)

The objective of the project are to:

- Develop agreed methods for the assessment of gasification performance of coals that are relevant to the key emerging gasification technologies that will be the foundation technology building blocks for a range of low emission power generation technology development strategies.
- Provide an improved understanding of the gasification reaction and slag formation and flow characteristics of important Chinese and Australian coals and their impact on gasifier design and operation issues.
- Identify the key coal performance parameters that have the most important impact on coal selection, preparation, blending and technology performance and demonstrate the impact of these properties through comparative data collected from laboratory scale measurements (CSIRO) and a pilot scale gasification test program (TPRI). A defined test program will be developed based on a suite of selected Australian and Chinese coals. Laboratory investigations will include bench scale and Pressurised Entrained Flow Reactor (PEFR) measurements at CSIRO's laboratories in Australia and pilot scale testing at TPRI in China.
- Develop a functional, interpretive mathematical modelling framework capable of incorporating the important coal performance data available from laboratory and pilot scale measurements in suitable flow and process models that can be used to estimate the impact of coal type and operating conditions on gasifier and IGCC system performance.
- This project will also provide important coal performance and syngas quality measurements and facilities to support and enhance current research programs on high pressure, high temperature syngas cleaning, processing and gas separation technologies required for low emission, hydrogen based energy systems. The combination of the laboratory and pilot scale gasification research program will create the opportunity for proof-of concept test modules being developed in other, related research programs in Australia and China to be tested with a unique set of reference coals and process conditions that have been well studied at both laboratory and pilot scale in the proposed collaborative gasification program.

**Project Deliverables and Milestones:**

- Define project scope, facilities, resources and planning schedule.
- Expansion of project to AP6 participants with similar goals.
- Identify and select coal samples and coal gasification performance measurements that will be conducted in the partners laboratories.
- Reference coal samples assembled for project sample suite (this will involve assembly of large samples for pilot scale testing in China (10-30 tonnes) and smaller samples (1-2 tonnes) for laboratory reactivity, slag behaviour and PEFR testing in Australia.
- Slag viscosity, reactivity and PEFR tests conducted on first 4 coals and key coal characterisation and performance data for modelling purposes identified.
 - – pilot scale test program specified.
- Key correlations between pilot scale performance data and laboratory data identified and impact on technology design and operation investigated.
- Key findings on coal gasification impacts on syngas quality will be integrated into the associated research programs on syngas cleaning, processing and gas separation (CO₂/hydrogen separation systems) to contribute to the development of these key enabling technologies at scale and cost appropriate for future power generation applications.
- Stage 1 (laboratory and pilot testing) report completed and technology transfer activities identified.
- Annual – technical exchange workshops for all project partners and affiliated research and industry groups.

Resources:

1) Coal gasification performance evaluation in Australia (includes laboratory and PEFR coal gasification program and slag viscosity research and testing on selected Australian and Chinese coals/blends).

CSIRO will commit research staff and facilities (comparable to those previously committed to other gasification research programs) to the new AP6 project.

2) Industry participation and resources are needed to carry out the testing of Australian Coals in TPRI pilot scale gasification facility (up to 6 coals- assuming similar number of Chinese coals to be funded by Chinese partners).

Other Information:

Attached copy of current CSIRO/TPRI agreement for initial collaboration which could form the platform for the much larger AP6 collaboration. The initial program is concerned primarily with scoping and relationship building within a collaborative, bilateral framework. There are benefits to be gained from the expansion of this arrangement with industry and governments.



ATTACHMENT

APPLICATION FOR PROJECT SUPPORT

(For Overseas Partner Only)

1. Title of Proposal / Project

Research on the technologies of pressure pulverized coal gasification with dry-feeding and CO₂ capture from syngas

2. Expected Project Period

Dec. 2006 - Dec. 2009

3. Proposed Project Manager / Organization (in China)

Name: Xu Shisen
Title: Ph.D, Senior Engineer
Position: Chief Engineer
Organization: Thermal Power Research Institute (TPRI)
Postal Address: Xingqing Road 136, Xi'an, 710032, P.R.China
Phone:86-29-82102309
Fax: 86-29-83238818
E-mail:Xushisen@tpri.com.cn

4. Overseas Project Manager / Organization

Name: David Harris
Title: Ph.D, Theme Leader Advanced Coal Technologies
Position: Theme Leader
Organization: CSIRO Energy Technology
Postal Address: Queensland Centre for Advanced Technologies, PO Box 883, Kenmore QLD 4069, Australia
Phone:+61 7 3327 4617
Fax: +61 7 3327 4455
E-mail:David.Harris@csiro.au

5. Proposed proposal / project contents including details of participants in these activities and their roles (maximum 500 words)

This proposal provides the framework for a proposed collaboration program to be developed between TPRI and CSIRO. The scope of the proposed program is indicative only at this stage and will be developed in consultation with appropriate stakeholders. The activities of TPRI and CSIRO in the project, subject to contract, are envisioned to include the following:

1. Both sides of China and Australia send one researcher each other to study several typical high ash-melting point coal samples about their characteristics of gasifying reaction and slag melting in the case of dry-fed gasification, and establish a reaction gasification properties database.
2. China send two researchers to CSIRO cooperating with Australian researchers to study the properties of membrane separation and membrane reactor.
3. Australia should help China to design a pilot scale (approx. 150 Nm³/h) testing equipment to study the membrane separating H₂ from syngas and CO₂ capture, which should have rather wide working conditions of pressure and temperature.
4. Define an appropriate research program using the membrane separation system, define operation



characteristics on the pilot scale testing equipment, and research the design scheme for membrane system enlargement that will be suitable for use in near-zero emission plant.

5. Utilizing the 36 t/d pressure pulverized coal gasifier built by TPRI to study several typical Australian coals, determine their reaction characteristics and establish their performance database. China will complete the main testing work using the facility at TPRI. TPRI will also collaborate with the Australian group to develop key design components of a novel low cost IGCC/polygeneration system capable of producing power, chemicals and hydrogen from coal, and which includes several novel gasifier and process design concepts in an integrated pilot scale (up to about 40t/day) design study.

2. Proposal / Project goals (a brief description of what is to be achieved, maximum 300 words)

The project goals will be achieved through the cooperation between CSIRO and TPRI, the goals are as follows:

- Understanding the gasifying reaction and slag melting characteristics of Chinese typical high ash-melting point coals will be setup by the international cooperation between China and Australia, and the design scheme of dry-fed gasifier for high ash-melting point coals can be put forward also.
- Data for selected Australian and Chinese coal gasifying reaction characteristics using the TPRI pilot scale facilities will be established.
- Complete a design of a novel, low cost IGCC/polygeneration system (up to approx. 40t/d) based on a dry-fed coal gasifier facility
- Using the non-equilibrium reaction boosting technology causing by membrane reactor and CO2 separation membrane, design and build a small prototype integral hydrogen production system.
- Develop an improved understanding of membrane fabricating technology for separating H₂ from syngas reaction.

3. Indicative Financial support for this proposal from your side (please provide as much information as possible, including the value of "in kind" contributions).

	Anticipated	Secured	Total
Government	200000A\$*		
Applicant's own Organization		200000A\$**	
State / Local Government			
Other Sources			400000A\$
GRAND TOTAL INCOME			

Note: * stand for to be approved ** stand for in kind contribution

4. Declaration by Project Manager / Organization

I declare that the information provided in this application is true and correct to the best of my knowledge.

Signed:.....*David Harris*.....

Date:*30/10/06*.....

Name (print): David Harris