PRESS RELEASE

6 June 2014

EIPO awards $11 million in research grants to support innovations for the Power Generation sector

The Energy Market Authority (EMA) announced today the award of research grants totalling more than $11 million to six research teams as part of the Power Generation Grant Call launched by the Energy Innovation Programme Office (EIPO). The six projects aim to address industry-relevant challenges that enhance availability, reliability, and overall system efficiency of the power generation sector in areas such as condition monitoring, generation efficiency enhancements, mitigating haze-related risks, and expert decision support system.

2. The six projects are:

No.	Project Title	Host Institution	Industry Partner(s)
1.	An Enhanced Condition Monitoring System for Gas Pipes Using Fibre Optic Sensors	Nanyang Technological University	SP PowerGrid Ltd EINST Technology Pte Ltd
2.	Liquefied Natural Gas (LNG) Power Generation from Gas Turbine and Stirling Engine	Nanyang Technological University	Aspin Kemp & Associates
3.	An Integrated Solution for Optimal Generation Operation Efficiency through Dynamic Economic Dispatch	National University of Singapore	YTL PowerSeraya Pte Ltd Power Automation Pte Ltd
4.	Improving Tembusu Multi-Utilities Complex Cogeneration Plant Reliability and Availability through Expert Operation Decision Support System and Enhanced Predictive Condition Monitoring System	Yokogawa Engineering Asia Pte Ltd	TP Utilities Pte Ltd (A subsidiary of Tuas Power Ltd)

No.	Project Title	Host Institution	Industry Partner(s)
5.	Mitigation of Haze Effect on Gas Turbine Performance	Nanyang Technological University	Tuas Power Generation Pte Ltd (A subsidiary of Tuas Power Ltd) Sustainable Energy Association of Singapore
6.	Developing A Fibre Optic Sensing Solution For Gas Pipeline Monitoring	SP PowerGrid Ltd	ST Electronics (Satcom & Sensor Systems) Pte Ltd Institute for Infocomm Research

(Please refer to the Annex for more details of the six projects.)

Catalysing Energy Innovation through Research and Development

3. This inaugural Power Generation Grant Call encouraged various innovative ideas by industry and academia. The proposals were rigorously evaluated through a two-stage process involving both international technical experts and an evaluation panel.

4. Mr Chee Hong Tat, Chief Executive, EMA and co-Executive Director of EIPO said, "The power generation sector is a critical part of Singapore's economy. In the past two years, the sector has added almost 3,000 MW of new capacity, which has reduced wholesale electricity prices by more than 30%. The Grant Call provides an excellent opportunity for EMA to work with industry players and the research community to come up with innovative ideas and solutions, so that we can continue to provide a safe and reliable power supply for Singaporeans."

5. An established power firm in Singapore, Tuas Power Ltd responded to this Grant Call by collaborating in two of the eventual winning projects. Mr Lim Kong Puay, President and Chief Executive Officer of Tuas Power Ltd said, "The worst haze in Singapore's history last year impacted our plants performance. The launch of the Power Generation Grant Call was timely and allowed us to partner researchers and technology solution providers to tackle our immediate challenges associated with haze and system operations. The research will improve Tuas Power's market competitiveness, and importantly, the findings would benefit Singapore's broader power sector."

6. Two grant calls by EMA are currently open. The new Smart Grid Grant Call focuses on improving our grid resilience, and the Gas Technology Grant Call focuses on enhancing the operational readiness and resilience of our gas network and LNG infrastructure. Both will close on 18 July 2014. More details on Smart Grid Grant Call and Gas Technology Grant Call are available at **https://rita.nrf.gov.sg/ewi/ElRPSmartGrid2014/default.aspx**; and **https://rita.nrf.gov.sg/ewi/ElRPGasTech2014/default.aspx** respectively.

7. Funding for the grant calls will be drawn from the S$140 million under the Energy Innovation Research Programme (EIRP) of EIPO. Formerly known as the Clean Energy Research Programme (CERP) since 2007, the EIRP is a competitive funding initiative aimed at supporting interdisciplinary and commercially-relevant research and development efforts.

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About the Energy Innovation Programme Office (EIPO)

Formerly known as the Clean Energy Programme Office (CEPO), EIPO is the inter-agency programme office responsible for developing and executing strategies and policies for the development of the energy sector. Led by the Economic Development Board (EDB) and the EMA, EIPO reports to the Energy Innovation Executive Committee co-chaired by Chairman EDB and Permanent Secretary, Trade and Industry.

About the Energy Market Authority

The Energy Market Authority (EMA) is a statutory board under the Ministry of Trade and Industry. Our main goals are to ensure a reliable and secure energy supply, promote effective competition in the energy market and develop a dynamic energy sector in Singapore. Through our work, the EMA seeks to forge a progressive energy landscape for sustained growth.

Annex

Power Generation Grant Call Winning Proposals

1. An Enhanced Condition Monitoring System for Gas Pipes Using Fibre Optic Sensors

Host Institution: Nanyang Technological University (NTU)

Project Background:

In Singapore, gas pipes are used to carry natural gas for distribution to power plants, refineries and other end users. These gas pipes are laid through densely populated urban areas and rural areas. For underground gas pipes, it is difficult to monitor and detect dangerous gas leaks, and locate defects along the gas pipes in a timely manner. For above-ground gas pipes, there are challenges associated with the accessibility of gas pipes in rural areas and the need to monitor on a 24/7 basis. It is therefore important to establish a real-time condition monitoring system for the natural gas pipes in order to ensure early detection of leaks.

Outcomes and Benefits:

The project aims to design and develop an enhanced real-time condition monitoring system for gas pipes in Singapore. The use of condition monitoring allows pipes owners to conduct timely preventive maintenance and respond swiftly to avoid the consequences of gas leaks (e.g. explosions caused by leaked gas). The project will focus on research, design and development of an advanced architecture of fibre optic sensors together with an optimal number of sensors, and an intelligent data mining and analytics system that enables early detection and location of gas leaks due to damages along the gas pipes.

Principal Investigator:

A/Prof So Ping Lam obtained his PhD from Imperial College London and has more than 25 years of experience in the power supply industry. His areas of expertise include power system stability, operation and control, power quality, power line communications, distributed generation, and energy management. His current research focuses on intelligent energy distribution, intelligent building and home energy management, micro-grids, and smart grids. A/Prof So has published 30 journal papers and 65 conference papers. He is currently an Associate Professor at the School of Electrical & Electronic Engineering of NTU.

Co-Principal Investigator:

A/Prof Chan Chi Chiu Julian, NTU, Singapore

Collaborators:

Dr Tan Khay Ming Eddie, EINST Technology Pte Ltd, Singapore

Mr Cen Jinfeng Royce, SP PowerGrid Ltd, Singapore
Prof Selim M. Shahriar, Northwestern University, USA
Prof Peng Gang-Ding, University of New South Wales, Australia

2. Liquefied Natural Gas (LNG) Power Generation from Gas Turbine and Stirling Engine

Host Institution: Nanyang Technological University (NTU)

Project Background:

Liquefied Natural Gas (LNG) is stored at -162^{o}C, and must be re-gasified before use by power plants. The cold energy released by re-gasification of LNG and the hot energy supplied by exhaust gas from gas turbine can potentially be applied to power a Stirling engine. A Stirling engine is an engine that operates via continuous cyclic compression and expansion of gaseous material at different temperature levels to produce mechanical energy. This powers a generator to produce electricity.

Outcomes and Benefits:

The research aims to design a more efficient, combined power generation system by coupling gas turbine with Stirling engine (leveraging on temperature differentials to convert heat energy to mechanical energy). This innovative project could enable on-site power generation at the LNG terminal, as the readily available cold energy allows the optimum conversion of heat energy to mechanical energy necessary for power generation. This encourages the efficient use of energy, reduces the amount of energy drawn from the grid and operating costs for the terminal.

Principal Investigator:

A/Prof Duan Fei completed his Ph.D. at University of Toronto, Canada, and then worked there as postdoctoral fellow and research associate. He was a Visiting Scientist at Institute of Fluid Mechanics at Friedrich-Alexander-University, Erlangen-Nuremberg, Germany. His current research focuses on thermodynamics and heat transfer. A/Prof. Duan is currently an Associate Professor in School of Mechanical and Aerospace Engineering at NTU.

Co-Principal Investigators:

A/Prof Choo Fook Hoong, NTU, Singapore
Dr Swapnil Dubey, NTU, Singapore

Collaborators:

Mr Jason C. Aspin, Aspin Kemp & Associates, Canada
Prof Seth Sander, University of California, Berkeley, USA

3. An Integrated Solution for Optimal Generation Operation Efficiency through Dynamic Economic Dispatch

Host Institution: National University of Singapore (NUS)

Project Background:

Currently, power plants leverage on various off-the-shelf equipment (e.g. sensors and meters) by different vendors for monitoring and control of their systems. The resultant system is usually not tightly integrated which results in overall system-wide efficiency gaps.

Outcomes and Benefits:

This proposal aims to enhance overall plant efficiency through development and integration of advanced metering, control and system-level optimisation. Advanced analytics will also be employed for predictive monitoring and analysis to improve overall plant efficiency. The system will also be tested on the operational plants of the industry collaborator, YTL PowerSeraya. If successful, the developed solution will be highly scalable and has the potential to be extended to other power plants.

Principal Investigator:

Prof. Wang Qing-Guo has over 30 years research experience in modeling, estimation, prediction, control, optimisation and automation for complex systems, including but not limited to, industrial and environmental processes, energy systems, medical engineering, and financial markets. He has published more than 300 technical papers, of which 230 are in international journals. He was in the Thomson Reuters list of highly cited researchers in 2013 (one of 250 in Engineering worldwide). He authored or co-authored six books and co-holds six patents in USA and Singapore. Prof. Wang is a Professor at the Department of Electrical & Computer Engineering of NUS.

Collaborators:

Dr Liu Jidong, YTL PowerSeraya Pte Ltd, Singapore
Mr Tan Kok Poh, YTL PowerSeraya Pte Ltd, Singapore
Dr Yu Ming, Power Automation Pte Ltd, Singapore

4. Improving Tembusu Multi-Utilities Complex Cogeneration Plant Reliability and Availability through Expert Operation Decision Support System and Enhanced Predictive Condition Monitoring System

Host Institution: Yokogawa Engineering Asia Pte Ltd

Project Background:

Today, power generation companies need to ensure that their assets are running reliably through minimising impact from both human errors and equipment failure. However, it is increasingly challenging to monitor the conditions of all critical equipment as components offered by different vendors often operate “in-silos”. Without tight integration, data provided to current decision support systems will not be comprehensive, rendering them ineffective in supporting less experienced operators in handling exceptional and unusual situations in the plant, and in managing the maintenance of the equipment.

Outcomes and Benefits:

This project aims to demonstrate new methodologies and processes to overcome the technological limitations in existing decision support systems and predictive condition monitoring systems. The project will deliver an integrated system capable of capturing best practices of operators, self-learning new behaviour patterns, and identifying new vibration signatures from the different suites of equipment through a semi-automated mechanism. The integrated solution will allow operators to detect equipment issues early, thus giving them ample response time to normalise the assets to avoid an overall fault/failure. If successful, the solution could be adopted by other power generation companies to capture knowledge that improves standards in human reliability, equipment reliability, and plant availability in the power industry.

Principal Investigator:

Mr Sankar Selvaraj’s expertise lies in the area of Process and Energy Optimisation. He has successfully led many applied research projects related to Asset Performance and Energy Efficiency for chemical process industries, through close collaboration with industries and research institutes, by combining statistical analysis with latest technology developments. He holds a Master degree in Chemical Engineering from NUS, is a Singapore Certified Energy Manager (SCEM) and Project Management Professional (PMP). He also holds several local and overseas patents. Mr Selvaraj is currently the Head of the Business Solution Department at Yokogawa’s Research Centre in Singapore.

Collaborators:

A/Prof Lakshminarayanan Samavedham, NUS, Singapore
Mr Goh Soo Chan, TP Utilities Pte Ltd, Singapore
Mr Lawrence Ng, TP Utilities Pte Ltd, Singapore
Mr Pyay Hpone Aung Belgi, TP Utilities Pte Ltd, Singapore

5. Mitigation of Haze Effect on Gas Turbine Performance

Host Institution: Nanyang Technological University (NTU)

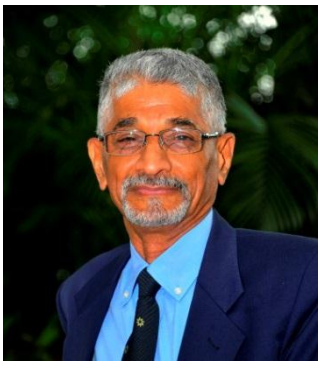
Project Background:

In recent years, the trans-boundary haze experienced in Singapore has reached unhealthy levels, affecting the health of the public and even the performance of all air-breathing critical assets like gas turbines of combined-cycle gas turbine (CCGT) power plants. In particular, some CCGT power plants had experienced a drop in performance of up to 30% in 2013 when Singapore experienced its worst haze in history. It is therefore critical to find a solution to mitigate the drop in performance of CCGT plants when Singapore is affected by extreme haze conditions.

Outcomes and Benefits:

The primary objective of this research proposal is to remove PM 10 particulate from the ambient air on demand when its concentration becomes detrimental to the performance and internal rotating components of power plant gas turbine. The developed solution will be applicable to all CCGT plants. If successful, the solution could be extended to the air handling systems employed in public places like schools and hospitals.

Principal Investigator:



Er E.T. Mohan Dass has nearly 44 years of experience in areas such as thermal power plant design, construction, operation and maintenance, as well as mechanical and hydraulic engineering, design and manufacture of flue gas cleaning systems, just to name a few. His other expertise and skill sets are in project management and power plant investment financial modelling. He is a Singapore-registered Professional Engineer and UK-registered Chartered Engineer. He is currently a Senior Scientist (Energy) with Energy Research Institute at Nanyang Technological University (ERI@N), Singapore.

Co-Principal Investigators:

Mr Choo Fook Hoong, NTU, Singapore
Dr Thomas Baikie, NTU, Singapore
Dr Narasimalu Srikanth, NTU, Singapore
Dr Anshuman Tripathi, NTU, Singapore

Collaborators:

Dr Chang Wei-Chung, Victor, NTU, Singapore
Mr Goh Thian Hoe, Tuas Power Generation Pte Ltd, Singapore
Ms Kavita Gandhi, Sustainable Energy Association of Singapore

6. Developing A Fibre Optic Sensing Solution For Gas Pipeline Monitoring

Host Institution: SP PowerGrid Ltd

Project Background:

SP PowerGrid Ltd (SPPG) manages gas transmission and distribution pipeline networks in Singapore and transports both natural gas and town gas to consumers. Damage of underground pipelines caused by unauthorised work activities is SPPG's key concern as it may result in disruption of gas supply. The leakage of gas will also pose safety risks to the public. Unauthorised excavation works by third parties, if undetected, pose a risk of causing accidental damage to underground pipelines. A cost-effective system to provide early warning of excavation activities near the gas pipelines would help provide SPPG with adequate lead-time to respond and prevent such damages.

Outcomes and Benefits:

The objective of the project is to develop an intelligent Fibre Optic Sensing System (FOSS), which can monitor, detect and pin-point, in real-time, any suspicious third party work activities that occur near gas pipelines. This allows early intervention by SPPG to protect the safety and integrity of the gas network. The FOSS will monitor the pressure and/or vibration signals along the gas pipelines with enhanced intelligence that minimises rate of false detections of unauthorised excavation works. Information of unauthorised work activities will also be transmitted to the SPPG's operation centre or to designated mobile devices for swift and timely response by SPPG.

Principal Investigator:

Er Ong Min Sing is a Director (Gas Transmission Management) at SP PowerGrid Limited. His experience in gas industry started from town gas production plant as a maintenance engineer and over the years, has moved to operation and maintenance of high pressure gas pipelines and facilities. He is currently focusing on implementing advanced technologies to enhance the condition monitoring for gas pipelines and facility integrity management.

Co-Principal Investigators:

Mr Yeow Teck Sing, SP PowerGrid Ltd, Singapore
Mr Cen Jinfeng Royce, SP PowerGrid Ltd, Singapore

Collaborators:

Dr Chen Wen, ST Electronics (Satcom & Sensor Systems) Pte Ltd, Singapore
Dr Emily Hao Jianzhong, Institute for Infocomm Research, Singapore