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9/30/13

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MTSU Clean Energy Initiative Project Funding Request

There are five (5) sections of the request to complete before submitting. See <http://www.mtsu.edu/sga/cleanenergy.shtml> for funding guidelines. Save completed form and email to cee@mtsu.edu or mail to MTSU Box 57.

1. General Information	
Name of Person Submitting Request <u>Ngee Sing Chong</u>	
Department/Office <u>Chemistry/DSB231</u>	Phone # (Office) <u>898-5487</u>
MTSU Box # <u>Box 68, MTSU</u>	Phone # (Cell) <u>615-968-5167</u>
E-mail <u>nchong@mtsu.edu</u>	Submittal Date <u>9/30/2013</u>

2. Project Categories (Select One)	
Select the category that best describes the project.	
<input type="checkbox"/> Energy Conservation/Efficiency	<input checked="" type="checkbox"/> Sustainable Design
<input type="checkbox"/> Alternative Fuels	<input type="checkbox"/> Other
<input type="checkbox"/> Renewable Energy	

3. Project Information
<p>a. Please provide a brief descriptive title for the project.</p> <p>b. The project cost estimate is the expected cost of the project to be considered by the committee for approval, which may differ from the total project cost in the case of matching funding opportunities. Any funding request is a 'not-to-exceed' amount. Any proposed expenditure above the requested amount will require a resubmission.</p> <p>c. List the source of project cost estimates.</p> <p>d. Provide a brief explanation in response to question regarding previous funding.</p>
3a. Project Title <u>Replacing the Use of Helium in Davis Science Building with Hydrogen Generated via Electrolysis</u>
3b. Project Cost Estimate <u>Total Amount Requested \$14,159.50</u>
<p>1. Parker Hannifin Hydrogen Generator Model 60H-MD; Flowrate: 500mL/min \$13,810.00</p> <p>2. Dessicant Cartridge for Hydrogen Gas Generator \$ 349.50</p>
3c. Source of Estimate
<u>ThermoFisher catalog in MTSU Chemistry Department and website list price (http://www.fishersci.com/)</u>

3d. If previous funding from this source was awarded, explain how this request differs?

The current request is under the category of "Sustainable Design" for using a hydrogen gas generator to replace the non-renewable helium and to improve cost efficiency. Previous funding was obtained for the the MTSU and the production of biodiesel from biomass-derived oils.

4. Project Description

(Completed in as much detail as possible.)

- a. The scope of the work to be accomplished is a detailed description of project activities.
- b. The benefit statement describes the advantages of the project as relates to the selected project category.
- c. The location of the project includes the name of the building, department, and/or specific location of where the project will be conducted on campus.
- d. List any departments you anticipate to be involved. Were any departments consulted in preparation of this request? Who? A listing may be attached to this form when submitted.
- e. Provide specific information on anticipated student involvement or benefit.
- f. Provide information for anticipated future operating and/or maintenance requirements occurring as a result of the proposed project.
- g. Provide any additional comments or information that may be pertinent to approval of the project funding request.

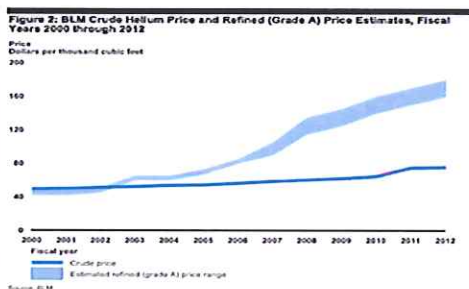
4a. Scope: Work to be accomplished

MTSU Chemistry currently uses helium gas to operate gas chromatography (GC) instrumentation in the laboratory in Davis Science Building. The annual usage of helium is projected to be about \$18,000 in the 2013-14 academic year. Due to the rapidly rising cost of helium, a non-renewable resource, many laboratories in industries and universities have switched to the use of hydrogen gas for operating their GC instrumentation. In order to both eliminate the cost of helium and achieve the sustainable design of using the electrolysis for generating hydrogen that can be used for GC instrumentation, this

proposal aims to purchase a hydrogen gas generator to meet all our GC needs at MTSU. The use of hydrogen gas for GC has been well documented for its technical soundness, operational safety, and is considered environmental friendly because it avoids the use of the dwindling supply of helium which also require energy for processing it into a high purity gas stored in high pressure cylinders.

4b. Scope: Benefit Statement

The primary benefit of this project is to reduce operating expenses for GC used in MTSU Chemistry Department. Additional benefits include environmental sustainability (i.e. helium is a non-renewable chemical resource), operational simplicity since it is no longer necessary to order, move, and change helium cylinders every 1-2 weeks, improved safety by eliminating the need to store and transport pressurized helium cylinders. The benefit of reduction in GC gas expense is obvious because the price of high purity helium has increased 450% since the year 2000 as shown in the following figure. It is estimated that for a hydrogen gas generator with a capacity of 500 mL/min, the savings at the end of the 5th year is about \$29,226 (Reference 1). Most generators have a useful lifetime of 7-10 years and can be expected to yield greater cost savings.



4. Project Description (continued)

4c. Location of Project (Building, etc.)

MTSU Department of Chemistry (Davis Science Building Room 236 or Instrumentation Laboratory)

4d. Participants and Roles

Ngee Sing Chong – Estimating the usage requirement of each GC in Instrumentation Laboratory and deciding the model of hydrogen gas generator to buy as well as the time for the replacement of the dessicant cartridge needed; evaluating cost efficiency by switching from helium to hydrogen.

Jessie Weatherly – Installation and maintenance of the new hydrogen gas generator.

Other Chemistry Faculty and Students – Use the generators and report usage duration to track the volume of hydrogen gas used and thus the amount of savings by eliminating helium use.

4e. Student participation and/or student benefit

The continuous supply of hydrogen by the generator would allow uninterrupted use of the GC, thereby facilitating instructional and research use of the GC instrumentation. It also reduce the need to have students move heavy pressurized helium cylinders to the GC and to improve safety by eliminating the need to strap down the helium cylinders. Over the long run, this may also help keep the student lab fees at a constant level.

4f. Future Operating and/or Maintenance Requirements

Jessie Weatherly in the Department of Chemistry is in charge of maintenance for all lab equipment including the GC and the proposed hydrogen generator. The replacement of the dessicant cartridge is typically once every 0.5-1 year and the cartridge cost of \$349.50 is minimal and can be paid through the savings in gas expenditure. The generator can also be moved to the new science building without the need to hire the vendor engineers.

4g. Additional Comments or Information Pertinent to the Proposed Project

1. Gas Supply for Gas Chromatography: How to Compare the Costs of Cylinders and Generator

<http://www.sigmaaldrich.com/etc/medialib/docs/Supelco/Bulletin/4545.Par.0001.File.tmp/4545.pdf>

2. Hydrogen: A Carrier Gas Alternative to Helium

<http://www.sigmaaldrich.com/technical-documents/articles/reporter-us/hydrogen-a-carrier.html>

5. Project Performance Information

Provide information if applicable.

- Provide information on estimated annual energy savings stated in units such as kW, kWh, Btu, gallons, etc.
- Provide information on estimated annual energy cost savings in monetary terms.
- Provide information on any annual operating or other cost savings in monetary terms. Be specific.
- Provide information about any matching or supplementary funding opportunities that are available. Identify all sources and explain.

5a. Estimated Annual Energy Savings (Estimated in kW, kWh, Btu, etc.)

Not Applicable. This proposal is about the sustainable design of replacing helium with hydrogen generated by electrolysis.

5b. Annual Energy COST Savings (\$)

It is not possible to determine energy cost savings due to the various methods of extracting and purifying helium.

5c. Annual Operating or Other Cost Savings. Specify. (\$)

Detailed operating cost savings has been calculated for a different brand of hydrogen gas generators using helium cost information from several years ago. The price then was \$171 per helium cylinder and MTSU Chemistry Department is paying \$360.22 per cylinder now.

0.5 liters/minute (x 1/1000m³/liter x 60 min/hr x 24 hr/day x 365 days/year = 262.8m³/year or 9,280.6ft³/year)

Packard Model 9400 Hydrogen Generator, 500cc/minute				Cylinders ^a			
Time	Item	Cost (\$)	Cumulative Total (\$)	Item	Hydrogen Cost (\$)	Helium Cost (\$)	Your Cost
1st year	generator	7,595		Cylinders/year (N)	(47)	(43)	
	desiccant cartridge	150	7,745	Price/cylinder	\$ 70	\$ 171	
2nd year	desiccant cartridge	150		Cost of gas/year	3,315	7,280	
	deionizer pk.	66	7,961	Cylinder rental/year (\$4.87 x N)	231	207	
3rd year	desiccant cartridge	150		Regulator (1st year only)	350	350	
	deionizer pk.	66	8,177	Cylinder fasteners (1st year only)	50	50	
4th year	desiccant cartridge	150		1st year costs	3,945	7,887	
	deionizer pk.	66	8,393	2 year costs (cumulative)	7,490	15,374	
5th year	desiccant cartridge	150		3 year costs (cumulative)	11,035	22,861	
	deionizer pk.	66	8,609	4 year costs (cumulative)	14,580	30,348	
				5 year costs (cumulative)	18,126	37,835	
Hydrogen generator versus hydrogen cylinders:				Hydrogen generator versus helium cylinders:			
savings after 5 years: \$9,517				savings after 5 years: \$29,226			

5d. Matching or Supplementary Funding (Identify and Explain)

Department of Chemistry will pay for the consumable cost of the dessicant cartridges needed for the hydrogen generator. The recovered funds (~\$1500) from the indirect cost charged to an EPA project may be used to offset the cost of purchasing or maintaining the hydrogen gas generator.

Linda Hardymon

From: Ngee Chong
Sent: Monday, September 30, 2013 9:10 PM
To: Center for Energy Efficiency
Subject: Clean Energy Project Funding Request 2013-Hydrogen Generator to Replace Helium Usage
Attachments: Clean Energy Project Funding Request 2013-Hydrogen Generator to Replace Helium Usage.docx

Attached is the funding request from the Chemistry Department. Please let me know if there are any questions regarding this request.

Ngee-Sing Chong, Professor Department of Chemistry P. O. Box X067 Middle Tennessee State University Murfreesboro, TN 37132	Director of MTSU Microscopy Center Office: (615) 898-5487 Fax: (615) 898-5182 Email: nchong@mtsu.edu Pre-dental Coordinator Delta Delta Sigma Advisor
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