Oil and Gas Research Program

North Dakota

Industrial Commission

Application

Project Title: UND's Department of Petroleum Eng Oil and gas research

Applicant: Vamegh Rasouli

Principal Investigator: Vamegh Rasouli

Date of Application: 10/23/2021

Amount of Request: $2,980,000

Total Amount of Proposed Project: $6,613,930

Duration of Project: 2 Years

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ABSTRACT

The department of Petroleum Engineering (DPE) at University of North Dakota (UND) received a total of $600,000 funding in support of his research activities in Sept 2018, which was continued (contract # G-051-100) in March 2020 with a total of $2,788,000 for a 3- year period. The latter contract was with the expectation to support 15 Ph.D. students from the NDIC funding, plus 10 additional students supported by the DPE to work on 22 project topics proposed by the NDIC. Also, the fund supported the initial set up of the drilling and completion lab (DRACOLA). The grand opening of the lab was on October 21, 2021 with presence of many industry and officials from ND.

The DPE commenced its graduate program in Fall 2016, however, now serves as the largest graduate program at the College of Engineering and Mines (CEM) and placed in top 3 in nation with currently 73 Ph.D. students from 18 nationalities and 21 Master students as of fall 2021. The department do not provide any type of financial support to the Master students but only to Ph.D. students who conduct research work and provide tutoring and teaching assistance support to the undergraduate students. The department has published so far over 300 papers and allowed over 100 conference and workshop travels for the students within the USA, which is a significant model to promote the program, University and the State of ND. This rapid growth and success could not happen without the strong support of the NDIC.

The DPE has over 25 representatives serving at the Industry Advisory Council (IAC) of the department and meet twice per year in fall and spring to discuss the state of the program and provide advice on how to expand and make the program stronger.

With the unfortunate decline of the undergraduate students' enrolment in Petroleum Engineering worldwide, the growth of the graduate program is critical to maintain the existence of the department with the hope to see more undergrad students in the near future. The department, with the support of the IAC is doing all its efforts to do effective outreach activities to encourage more high school students to join DPE. While most of the Ph.D. students who are financially supported are international students, they intend to stay in the USA and work for the oil industry in ND. Out of 22 Ph.D. students graduating by end of 2021, to date, there are 8 of them joined the EERC as full-time employee after they completed their program. Also, including past and current students we have 18 students who are working as graduate assistance on a part time basis at the EERC. This is a significant workforce support to the oil and gas sector in the State.

With the successful operation of the above funding model, this proposal is to request new funding to start from March 2023. The new request is for 2 years of funding for 30 Ph.D. students' support. In addition, funding is requested for support of DRACOLA to upgrade it to fully automated status and add the data acquisition and monitoring capabilities to collect multiple data. We are aiming to make this lab one of the unique data hub in drilling worldwide.

FUNDING PROPOSAL

This funding request is for a period of 2 years period of March 1, 2023- March 1, 2025. The fund is the request to support the followings:

- Tuition and graduate teaching and research assistance (GTA/GRA) for a total of 30 Ph.D. students.
- One month of faculty summer salary for a total of 7 faculty in DPE.
- Support of DRACOLA with the idea to make it fully automated and add the data acquisition and collection capabilities. We are expecting to start various operations in 2022 including drilling, fracking and completion design and several other oil and gas related operations at real field scales in this lab and collect some initial and necessary data. However, we believe it is important to make the rig fully automated to the current industry standard and add full capabilities for collecting as many data as possible in order to learn and improve the design and operations. We are determined to make this lab a big data hub in drilling and fracking worldwide. We expect to receive a great industry in-kind and manpower support to leverage the budget we request from the NDIC. The budget that we ask for is for the supplies, maintenance, material and programming supports towards this upgrade. We anticipate to complete the main part of the work in 2023 and complete it during the following 2 years.

JUSTIFICATION

The justifications for the new funding request include:

- The progress review of the current contract demonstrates how effectively the department managed the use of the current funding to support many Ph.D. students much more than it was committed, produce several publications and promote the Petroleum Engineering program at UND by attendance of Ph.D. students and faculty in different conferences and workshops.
- DPE has grown significantly in its teaching and research capabilities and has strong lab resources as well as industry contacts, so it is in a position to grow to its next level. Our vision is that by end of 2026, *the DPE at UND will be the place of choice for highest quality education, training, research and industry support in the oil and gas related topics.*
- Through my personal contact with the oil and gas companies internationally, I have been able, and will continue, to admit high quality individuals with several years of industry experiences to join our Ph.D. program. This is a significant advantage of our program over many others in the country.
- The job placement statistics of our Ph.D. students demonstrates that over 90% of them have been able to join the industry workforce in North Dakota. The passion and interest of these international students to remain in the US after completion of their studies and the need of the oil and gas industry to hire them is a significant support to the Bakke development and its future growth.

- Now that, with the support of the NDIC, in less than one year, through the hard work of several people, the drilling and completion lab (DRACOLA) has completed its initial set up, we want to bring it to the next Phase, which is fully automated with capabilities to collect and analyze various operational data. We envisage that we can complete the main part of this work in 2023 by which we expect to be able to support the industry in ND by providing any operational services and also offer practical courses and research topics to students.

STANDARDS OF SUCCESS

The standard of success for this funding will be measurable through a number of different criteria including:

- The number of published journal and conference papers,
- The number of travels of Ph.D. students and faculty members to different oil and gas related conferences and workshops,
- For the new faculty hire, the number of Ph.D. students being advised by him/her, review of the quality of his/her teaching, research and industry interaction and communication with the OGRC and other companies in ND,
- Oral and poster presentations of the projects at different events,
- Industry feedback regarding the applicability and quality of the projects, an example of this is the feedback by the Industry Advisory Council (IAC) members of the department,
- Presentation of the results to the OGRC members,
- High job placement rate for the graduated students mainly in ND,
- Bringing DRACOLA to full operational status and promoting it as one of a kind data hub worldwide.

BACKGROUND/QUALIFICIATIONS

Dr. Vamegh Rasouli, the PI of this project has been involved in many research and industry projects related to lab and field scale data collection and analysis. His over 18 years of industry experiences in the oil and gas industry with focus on geomechanics projects will be an essential support to the projects related to the hydraulic fracturing, and refracturing, which is one of the main topics of study in this proposal. Dr. Rasouli will also advise Ph.D. students.

Dr. Minou Rabiei, the Co-PI of this project has the required education background and work experience in advanced data processing, AI technologies and big data analytics. She has collaborated in many research and practical projects involving technical and economic feasibility studies for improved HSE requirements. Minou began her employment with UND as an assistant professor in the Petroleum Engineering Department in March 2015. Since then, she has established her research group in advanced data mining, machine learning and big data analytics applied in petroleum industry. She has been actively participating in various research opportunities and has successfully secured several internal and external research grants acting as

PI or Co-PI. Her contribution to this proposal will be on projects related to data mining, AI, UAS and data analytics.

Dr. Kegang Ling, the Co-PI of the project, who is an associate professor of DPE with expertise in reservoir and production Engineering. He will be working on projects related to the pipeline leakage detection and EOR and advise Ph.D. students.

Dr. Hui Pu, the Co-PI of the project, an assistant professor of DPE. He is conducting a separate NDIC project currently which is close to end and will work on projects related to reservoir Engineering, well logging and in particular on the new project "Economic Viability of Horizontal Open Hole Completions, Madison Group, ND" with a number of Ph.D. students who he will advise.

Dr. Hadi Jabbari, is an associate professor at the department of Petroleum Engineering with his expertise in the areas of reservoir simulations. He will be advising Ph.D. students in projects related to the CO2-EOR and communicates with relevant industries to bring their practical experiences into the projects.

Dr. Thomas Jo, is an assistant professor at the department of Petroleum Engineering with his expertise in the areas of completion and geomechanics. He has background of working with different industry and is the join hire by the DPE and EERC. He will be advising Ph.D. students and teaching related courses.

Dr. Foued Badrouchi, is an assistant professor at the department of Petroleum Engineering with his expertise in the areas of drilling, flow analysis and reservoir Eng. He received his Ph.D. from DPE last year and will be teaching and advising students.

MANAGEMENT

The PI will present the progress reports as requested by the OGRC with the details of how each project has moved on, a summary of the work done during each period, and the number of publications, travels to conferences and workshops and industry interactions.

The PI also proposes to have 6 or 12- months period face to face or remotely facilitated meeting with the OGRC members and other industry partners to have the Ph.D. students presenting the progress of their project. This presentation can be done during the department's semester-based IAC meetings, when several industry representatives are attending the meeting. In Fall 2021, this was done as one-minute project presentations by PhD students which was well received by all.

The PI will identify an industry interaction and communication plan for the NDIC endowed faculty member to ensure a strong link with the industry is in place to benefit from practicality of the projects and continuous feedback of industry people to the projects, in addition to promote the undergrad program in Petroleum Engineering in order to attract more students to the program, which if of the priority of the department.

The PI, as it has been the case for the current grant, will establish different research groups in the department, each led by one of the faculty members, to supervise one of the project areas and have frequent meetings with the Ph.D. students. There will also be monthly presentations by

students to present their project progress. Also, as we currently do, for each Ph.D. student we will assign a co-advisor from the EERC and/or industry to provide additional support to the advising and mentoring needs.

The PI will work closely with the director of DRACOLA to ensure that the work for completion of the data acquisition plan is progressing as per the plan.

Comments and feedback by the OGRC will be communicated with faculty and students by the PI on a continuous basis.

In case of any potential changes to the project or unforeseen situations that may affect the progress of projects as anticipated, the PI will inform the OGRC immediately requesting their advice.

TIMETABLE

The project lasts for 2- year period, starting from beginning of March 2023.

BUDGET

1. Tuition and Stipend of Ph.D. Students

Approximate costs of a Ph.D. student per annum are listed in Table below.

Item	Budget
Tuition	$10,000
Stipend	$20,000
PC & Office Supply	$2,000
Travel to Conferences, Workshops	$3,000
Lab Material, Supply, Maintenance etc. for lab-based projects	$5,000
Total per student	**$40,000**
Total for 30 students per year	**$1,200,000**

2. Faculty Summer Salary

Including fringes and benefits varies between $17,000 and $22,000 monthly for Assistant to Full Professor positions. Average of $20,000. We request one month of summer salary per annum for 7 faculty members, a total of **$140,000** per annum.

Table below shows the total fund request for 2- year period:

Item	Total Budget
30 Ph.D. students' tuition, stipend, other supports	2,400,000
7 faculty on- month summer salaries each year @ $20k/month/faculty	280,000
DRACOLA Support (Automation & Data Hub)	300,000
TOTAL	**2,980,000**

5. Industry Cost Share

Company	Total ($)
SimTech: Technical advice and software license provision	1,430,000
Bumpa's Consulting (Technical support for operation of DRACOLA)	90,000
Schmidt Mgm (Electrical Support of DRACOLA)	75,000
ResFrac (Software support)	82,500
Itasca Consulting Group: Technical advice and software license provision	1,827,630
Nabors Drilling (donation of BOP and technical advice)	128,800
TOTAL	**3,633,930**

CONFIDENTIAL INFORMATION

No confidential information is applicable to this proposal.

PATENTS/RIGHTS TO TECHNICAL DATA

Not applicable to this proposal.

APPLICATION CHECKLIST

Use this checklist as a tool to ensure that you have all of the components of the application package. Please note, this checklist is for your use only and does not need to be included in the package.

☒	Application
☒	Transmittal Letter
☒	$100 Application Contribution
☐	Tax Liability Statement
☒	Letters of Support (If Applicable)
☐	Other Appendices (If Applicable)

When the package is completed, send an electronic version to Ms. Karlene Fine at kfine@nd.gov, and 2 hard copies by mail to:

Karlene Fine, Executive Director
North Dakota Industrial Commission
State Capitol – 14th Floor
600 East Boulevard Ave Dept 405
Bismarck, ND 58505-0840

For more information on the application process please visit:
http://www.nd.gov/ndic/ogrp/info/ogrcsubgrant-app.pdf

Questions can be addressed to Ms. Fine at 701-328-3722 or Brent Brannan at 701-425-1237.