

Induced Seismicity Consortium (ISC)

Executive Summary

Fred Aminzadeh, ISC Managing Director and PI (Petroleum Engineering Program)
Donald Paul, CO-PI (Executive Director, USC Energy Institute)
Iraj Ershaghi (Director, Petroleum Engineering Program)

USC Faculty Team members:

Behnam Jafarpour CO-PI (Petroleum Engineering Program)
Charles Sammis, and Meghan Miller, CO-PI (Southern California Earthquake Center and Department of Earth Sciences)
Lucio Soibelman, and Roger Ghanem, CO-PI (Department of Civil and Environmental Engineering)
Julie Albright, CO-PI (USC Energy Institute and Information Sciences Institute)
Don Clarke, (CO-PI, Member of the NRC Committee on Induced Seismicity)

Consortium proposal, objectives, and structure

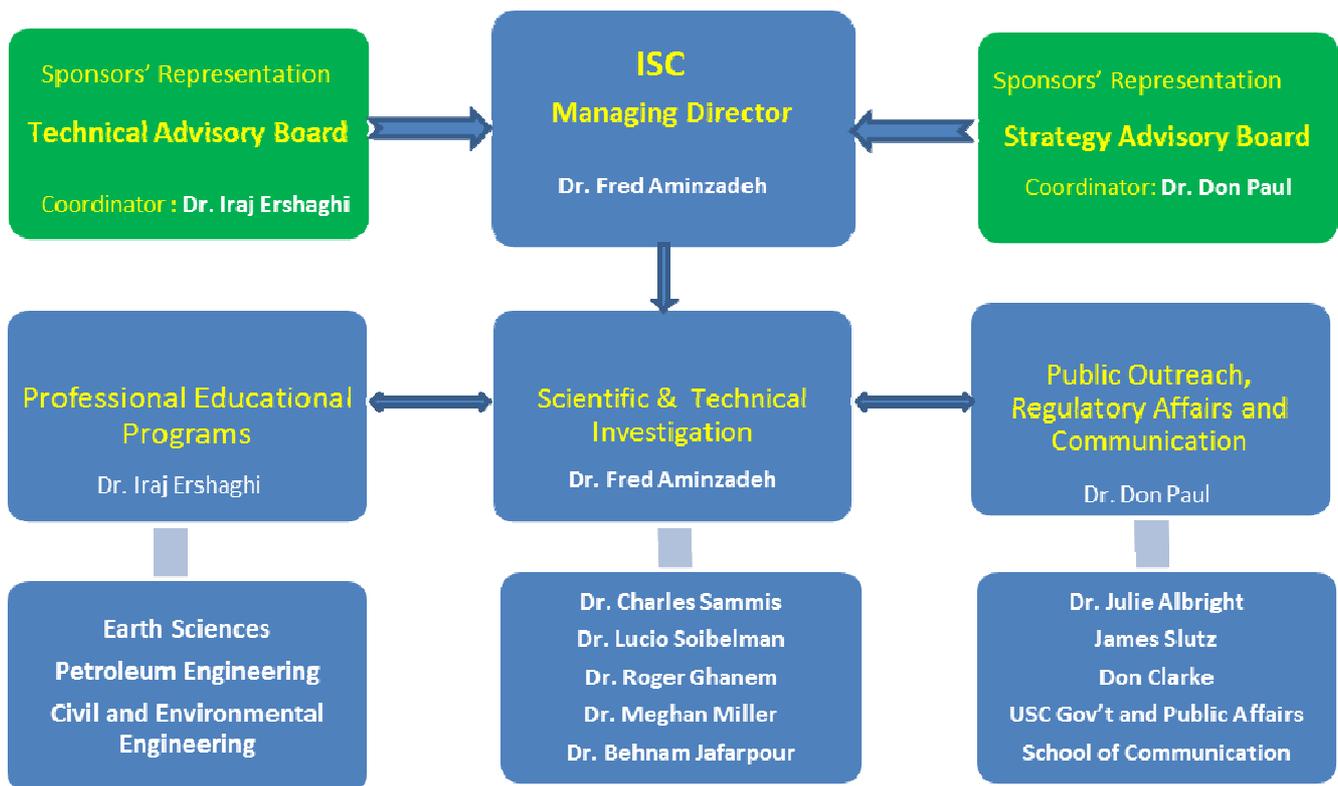
This Induced Seismicity Consortium (ISC) addresses a very critical and under-developed aspect of environmental safety associated with hydraulic fracturing operations, waste water injection, fluid production and disposal wells, enhanced geothermal resource development, and EOR/CO₂ sequestration. The proposed collaborative effort will uniquely integrate efforts of scientists from the Southern California Earthquake Center (SCEC), the Department of Civil and Environmental Engineering (CEE), and the Petroleum Engineering Program at the University of Southern California with industry and concerned regulatory agency partners. The consortium will support two key integrated programs; 1) advancing geoscience and engineering technologies required to predict geologic and surface impacts of *subsurface fluid injection (including hydraulic fracturing) and production processes (SFIP)* and 2) effectively communicating, informing, and advising regulatory, educational, and public entities regarding SFIP operations and impacts.

The governance of the consortium's program and processes will be the responsibility of two Advisory Boards. They will provide the guidance and input to the ISC Managing Director and PI. The Strategic Advisory Board (SAB) will oversee the overall program directions, objectives, and



deliverables. It will provide advice on integrating the results of the technical program into an effective external communication process for government and regulatory agencies, consortium members, and a broad array of public and external organizations. The Technical Advisory Board (TAB) will have the primary responsibility for providing advice on the scientific and engineering investigations of the program, including recommending research priorities and resources, monitoring technical progress, and assessing deliverables. The SAB is designed to have a representative from each funding member of the consortium, augmented with additional selected members representing government and regulatory agencies and non-governmental organizations. The TAB is also designed to have a representative from each funding member. As shown in management structure below, members from USC will provide coordination for SAB and TAB.

ISC Management Structure



Integrating the capabilities of petroleum engineering, earthquake seismology, as well as civil and environmental engineering faculty will produce modeling and data analysis capabilities for predicting seismic impacts associated with SFIP operations. Specific tasks include:

- 1. Characterizing Fracture Network using microseismic data**
- 2. Establishing correlations between induced seismic events and microseismic attributes**
- 3. Developing a hierarchical probabilistic model for understanding the relationship between operational parameters, subsurface stress and observed seismicity**
- 4. Designing a system to mitigate the seismic hazards associated with SFIP**
- 5. Providing a regional geologic framework for interpreting observed seismicity and predictive modeling**
- 6. Creating a science-based framework for input to regulatory and government entities**
- 7. Introducing educational and communication programs for the professional community and the general public**

The proposed technical work (Tasks 1-5) will be based upon a combination of tectonic modeling, scientific analysis, and the interpretation of seismic, geology, production, petrophysical and other usable data. Such a comprehensive study is necessary to quantify the risks associated with SFIP operations which may cause induced seismicity and the conditions under which they can trigger detectable earthquakes. The sponsored studies in this consortium are intended to provide a scientific base for the interrelationship of observed data and to help in alleviating public concerns for the likelihood of triggered seismicity and will pave the way to new workflow design processes for improved fluid injection schemes and their proper monitoring. The ultimate goal is to enhance operational safety and efficiency, as well as elevating awareness among the scientific community

The educational and the public information component of the ISC, (Tasks 6 -7) will enable sound regulatory policies and expand the knowledge of the general public addressing the concerns associated with SFIP and induced seismicity. The Consortium will also bring together considerable experience and expertise in the development and communication of research results to the educational programs, government organizations, media, and the public.

We invite your company or organization to join this Consortium and be among the pioneering sponsors for making this collaborative work a foundation for intelligent management of fluid injection projects including hydraulic fracturing. For more details on the problem statement, the proposed program directions, and USC team capabilities, please visit: <http://gen.usc.edu/usc-induced-seismicity-consortium>.) For additional information please contact Prof. Fred Aminzadeh: faminzad@usc.edu 213-821-4268.