STATE OF NEW MEXICO
NEW MEXICO OIL CONSERVATION DIVISION

APPLICATION OF OIL CONSERVATION DIVISION
TO ADOPT 19.15.41, 19.15.42, AND 19.15.43 NMAC **No. 25875**

DIRECT TECHNICAL TESTIMONY OF DR. HASSAN KHANIANI ON BEHALF OF THE OIL CONSERVATION DIVISION

JUNE 29, 2026

INTRODUCTION

Q. PLEASE STATE YOUR NAME AND BUSINESS ADDRESS.

A. Dr. Hassan Khaniani, 801 Leroy Place, Socorro, NM 87801.

Q. ON WHOSE BEHALF ARE YOU SUBMITTING DIRECT TESTIMONY?

A. The New Mexico Oil Conservation Division.

Q. BY WHOM ARE YOU EMPLOYED AND WHAT IS YOUR POSITION?

A. The Petroleum Recovery Research Center (PRRC) at the New Mexico Institute of Mining and Technology. I am currently an Assistant Professor and Research Scientist.

Q. PLEASE SUMMARIZE YOUR EDUCATION EXPERIENCE.

A. I received my Ph.D. in Geophysics from the University of Calgary, my M.S. in Petroleum Engineering from the University of Calgary, and my B.S. in Petroleum Engineering from the Petroleum University of Technology-Iran.

PURPOSE OF TESTIMONY

Q. WHAT ARE THE AREAS THAT YOU ARE GOING TO BE ADDRESSING?

A. I will be addressing faults and injection zone characteristics, generally found at proposed rule sections 19.15.41.7, 19.15.42.11, 19.15.43.7, and 19.15.43.9.

FAULTS AND INJECTION ZONE CHARACTERISTICS

Q. CAN YOU BRIEFLY DESCRIBE AND DEFINE WHAT A FAULT IS? CAN YOU BRIEFLY DESCRIBE AND DEFINESAME FOR INJECTION ZONE?

A. A fault is a fracture, or a zone of fractures, in subsurface where blocks of rock have broken and moved relative to one another.[1] **Context for Class VI:** In CO2 storage, faults are heavily scrutinized based on 3D seismic data because they can be weak points in the geology. A permeable fault can act as a natural pipeline, allowing the injected CO2 or displaced formation fluids to escape the storage area and potentially contaminate Underground Sources of Drinking Water (USDWs). As part of the permitting process, faults within the project area are evaluated to determine whether they could act as fluid-migration pathways or become reactivated under injection-related pressure increases. This includes fault characterization, pressure modeling, and fault slip potential analysis to assess whether the mapped faults are expected to remain stable and non-transmissive during injection.

An injection zone is a specific geologic formation, a group of formations, or a designated part of a formation that is meant to receive the fluids pumped down an injection well.[2] **Context for Class VI:** For carbon sequestration, the injection zone is the target rock layer where the CO2 will be stored. It must have sufficient *porosity* (empty microscopic space in the rock to hold the CO2) and *permeability* (interconnected spaces so the CO2 can flow into the rock). Critically, this zone must be situated deep underground and strictly located beneath a "confining zone" (a solid, impermeable layer of rock, like shale) that permanently traps the CO2 and prevents it from migrating upward.

Q. HOW DO THE PROPOSED RULES REQUIRE EVALUATION OF FAULTS OR FRACTURES WITHIN THE INJECTION SYSTEM?

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[1] *See* OCD Exhibit 1 at 19.15.41.7.C and OCD Exhibit 3 at 19.15.43.7.K
[2] *Id.*

A. Before a Class VI permit is granted, the applicant must characterize the geologic structure of the proposed storage site and the Area of Review (AoR), including the presence, location, orientation, and properties of known or suspected faults and fractures that may affect containment.[3] This evaluation is commonly based on available geologic data, well logs, regional structure maps, and 2D or 3D seismic data where available. Fault interpretation from seismic data is used to define the location, geometry, and continuity of mapped faults, especially where faults may intersect or approach the injection zone or confining zone.

The applicant must also evaluate whether identified faults or fractures could act as fluid-migration pathways or become mechanically unstable under injection-related pressure increases.[4] This includes evaluating geomechanical conditions such as in-situ stress, pore pressure, fracture pressure, rock strength, and fault orientation. Fault slip potential analysis can be used to estimate the pressure increase required to reactivate mapped faults and to compare that threshold with the pressure increase predicted by reservoir simulation.

Computational modeling is then used to predict the future CO_2 plume and pressure front during injection and post-injection monitoring. The model should demonstrate that the predicted pressure increase remains below levels that would compromise containment, induce fault slip, open existing fractures, or create migration pathways through the confining system. Therefore, the Class VI evaluation combines structural interpretation, geomechanical analysis, pressure/fracture evaluation, and reservoir simulation to show that faults and fractures are not expected to interfere with long-term containment.

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[3] OCD Exhibit 1 at 19.15.41.7.D; OCD Exhibit 2 at 19.15.42.7.C and 19.15.42.11.A.5.h; OCD Exhibit 3 at 19.15.43.9.E

[4] *Id.*

Q. WHY IS IT IMPORTANT TO IDENTIFY TRANSMISSIVE FAULTS OR FRACTURES?

A. It is important to identify transmissive faults or fractures because they may provide preferential pathways for fluid migration. A transmissive fault or fracture is sufficiently connected and permeable to allow CO_2 or displaced formation fluids to move away from the intended injection zone, rather than acting as a geologic barrier. Under injection-related pressure increases, these features could allow fluids to migrate into overlying permeable zones, toward the confining zone, or potentially toward Underground Sources of Drinking Water (USDWs). Therefore, evaluating fault and fracture transmissivity is essential for demonstrating containment, defining the Area of Review, assessing leakage risk, and designing appropriate monitoring and pressure-management strategies.

Q. HOW DO THE PROPOSED RULES REQUIRE AN EVALUATION OF THE CHARACTERISTICS OF THE INJECTION ZONE, INCLUDING POROSITY, PERMEABILITY, THICKNESS, AND AREAL EXTENT?

A. *Porosity and Permeability:* [5]

Core Data & Laboratory Testing: Direct evaluation is performed by extracting physical core samples from the injection zone during the drilling of stratigraphic test wells. These cores undergo laboratory analysis (Routine Core Analysis) to measure interconnected porosity and absolute permeability.

Well Log Analysis: Indirect measurements are obtained using logging tools (such as Neutron, Density, and Sonic logs) to generate a continuous porosity profile across the

[5] *See generally* OCD Exhibit 3 at 19.15.43.7 and 19.15.43.9.B-D and H

formation. Permeability is often empirically correlated with this log-derived porosity, calibrated against the physical core data.

Thickness of the Injection and Confining Zones:[6]

Geophysical Well Logging: The vertical thickness (top and base) of the injection zone and the overlying sealing formations (confining zones) is defined using lithology logs. Specifically, Gamma Ray and Resistivity logs are used to distinguish the porous, permeable storage sandstones/carbonates from the impermeable caprocks.

Areal Extent (Lateral Continuity):[7]

Seismic Surveys: 2D and 3D seismic data are used to map the structural framework of the subsurface, proving that the injection and confining zones extend laterally across the entire Area of Review (AoR) without being interrupted by sealing faults or pinch-outs.

Regional Well Correlation: Well logs from multiple existing or newly drilled wells in the region are correlated to create structural cross-sections, verifying the continuous horizontal distribution and total volume capacity of the injection zone.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

/s/ Hassan Khaniani
Hassan Khaniani

[6] *Id.*
[7] *Id.*