

Additional Information

Mack Energy Glacier SWD-2617

Miscellaneous E-mails

- Follow-up on permit status
- E-mail and Map showing AOR deficiencies from original C-108 submission
- Lack of data for FSP analysis & Waiver Response
- Water Sample for Devonian

From: [Jerry Sherrell](#)
To: [Gebremichael, Million, EMNRD](#); [Harris, Anthony, EMNRD](#); [Goetze, Phillip, EMNRD](#)
Cc: [Deana Weaver](#); [Delilah Flores](#)
Subject: [EXTERNAL] RE: Pending SWD Permits
Date: Thursday, August 15, 2024 6:57:36 AM

CAUTION: This email originated outside of our organization. Exercise caution prior to clicking on links or opening attachments.

Following up.

From: Jerry Sherrell
Sent: Tuesday, July 30, 2024 6:36 AM
To: Gebremichael, Million, EMNRD <Million.Gebremichael@emnrd.nm.gov>; Harris, Anthony, EMNRD <Anthony.Harris@emnrd.nm.gov>; Goetze, Phillip, EMNRD <phillip.goetze@emnrd.nm.gov>
Cc: Deana Weaver <dweaver@mec.com>; Delilah Flores <delilah@mec.com>
Subject: Pending SWD Permits

Good afternoon,

I just wanted to check on the status of two permits that Mack Energy has pending.

Glacier SWD #1 (action id 173002)

Manitoba SWD #1 (action id 320815) This well was submitted due to bad casing on our approved Labrador SWD #1 SWD-2488. At your request we staked the Manitoba 300'+ away. Our hope was to get this approval quickly since the Labrador had already been reviewed.

Jerry W. Sherrell
Regulatory Supervisor
Mack Energy Corporation
Bulldog Operating Company
PO Box 960
Artesia, NM 88210
Office 575-748-1288
Cell 575-703-7382
jerrys@mec.com

From: [Deana Weaver](#)
To: [Harris, Anthony, EMNRD](#); [Jerry Sherrell](#)
Cc: [Goetze, Phillip, EMNRD](#); [Gebremichael, Million, EMNRD](#); [Sandoval, Stacy, EMNRD](#); [Chavez, Carl, EMNRD](#)
Subject: [EXTERNAL] RE: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.
Date: Tuesday, September 17, 2024 9:42:24 AM
Attachments: [additional Information.pdf](#)

Some people who received this message don't often get email from dweaver@mec.com. [Learn why this is important](#)

CAUTION: This email originated outside of our organization. Exercise caution prior to clicking on links or opening attachments.

Anthony- Attached is the additional information requested below. A deep injection seismicity report will be forwarded once completed.

Thank you

Deana Weaver
Regulatory Technician II
Mack Energy Corporation
575-748-1288

From: Harris, Anthony, EMNRD <Anthony.Harris@emnrd.nm.gov>
Sent: Friday, August 30, 2024 1:26 PM
To: Jerry Sherrell <jerrys@mec.com>
Cc: Deana Weaver <dweaver@mec.com>; Goetze, Phillip, EMNRD <phillip.goetze@emnrd.nm.gov>; Gebremichael, Million, EMNRD <Million.Gebremichael@emnrd.nm.gov>; Sandoval, Stacy, EMNRD <Stacy.Sandoval@emnrd.nm.gov>; Chavez, Carl, EMNRD <Carlj.Chavez@emnrd.nm.gov>
Subject: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.
Importance: High

EXTERNAL EMAIL - Verify the sender and use caution before opening attachments or clicking links

Good Day, Jerry

Below are the list of deficiencies and or items requiring clarification before the application can be reviewed. If possible, I would like to take 30 mins to review some of these items with you before I send this to Mack.

1. Page 3/61 – C-108 Section VII
 - a. Please provide chemical analysis for the disposal zone formation water (Item VII.5)
2. Page 3/61 – C-108 Section VIII

- a. Provide the geologic name, and depth to bottom of all USDW overlying the proposed injection zone as per C-108 Section VIII
 - b. Provide the geologic name, and depth to bottom of all USDW underlying the proposed injection zone as per C-108 Section VIII
3. Page 7/61 Section VII.4
 - a. Please specify the Source of the Produced Water – San Andres? Other?
4. Page 18/61- “Before” Wellbore diagram for proposed Glacier SWD#1 well
 - a. No plugging details included on wellbore diagram. Please provide plugging details if available.
5. Page 22/61 – No Label / Titles included on the Map. AOR is less than 1 mile
 - a. 1-Mile AOR not shown on this map.
 - i. Refer to attached map labelled “**Page 22.. AOR deficiencies**” illustrating the unit letters (denoted by X’s) that need to be included to encompass the 1-mile AOR
 1. Please update the map on Page 22 to include a circle clearly showing the 1-mile AOR.
 2. Please update “proof of notice” requirement to verify that the surface owner and lease operators (ie. including the 30 Unit letters denoted by an “X” in the attached map) have been notified (**Refer to item 5b below**)
 3. Please provide a separate map (**with label / Title**) that clearly identifies the Surface Owner upon which the proposed well is located
 4. Please provide a separate map (**with label / Title**) that clearly identifies the Leasehold Operators within 1 mile radius of the proposed well.
 - b. Refer to Eastern portion of map that identifies Grizzly Operating as an owner
 - i. Ownership of well 30-015-30667 was transferred from Grizzly to Contango effective 1-29-2021 (ie. prior to Mack Energy Glacier Application being submitted)
 1. Please submit “proof of notice” requirements to verify that Contango has been notified.
6. Refer to Page 52/61 – Water Analysis Report
 - a. No Label / Title include on this Water Sample
 - i. Is this a Fresh Water Sample ?
 - b. Report lists the sample point as “*Glacier SWD#1- Wellhead Sample*”

- i. If the sample was collected from the Glacier well, please clarify how the sample was collected along with details of the zone that was sampled.
- ii. If this is a fresh water sample, please clarify (with appropriate Label / Title) the location of the well and date the sample was collected (Refer to C-108 Item XI)

7. General notes:

- a. Proposed cement volume for Production casing (885 sks) is not sufficient to reach surface
 - i. If there is a DV tool(s) planned for cement job, please clarify and update the wellbore diagram?
- b. CBL will be required for the Surface casing (set and cemented in 2001)
 - i. Note that well is in high Karst area, and surface casing cement quality has to be confirmed by CBL.
- c. Please provide a brief description of the planned workover operations to convert this well
- d. Provide a technical narrative and geologic assessment to demonstrate how the injected fluids will be contained within the Devonian

Induced Seismicity Potential (Minimum requirements)

The well is proposed for disposal into the Devonian and is located near, and along the trend line of, the Dagger Draw SRA (refer to attached image). Considering the ongoing seismic activity in the southern region of New Mexico, OCD requests an assessment of the Induced Seismicity potential. Below is an outline of the minimum requirements to assess the risks of Induced Seismicity for wells in close proximity to a known Seismic Response Area.

Minimum Requirements (for shallow injection wells)

- 1. General Information / overview:
 - a. Operator to provide a brief narrative on the location of the proposed SWD well (Section, township, range, County etc)
 - b. Geologic description (ie. Interbedded carbonate, limestones, siltstones, sandstones etc) of the proposed injection interval
 - c. Proposed formation and the depth of the injection interval
 - d. Statement on potential for communication with the Precambrian via faulting or other geologic features
 - e. Statement on potential for communication with USDW.
- 2. Seismic Risk assessment based on USGS data
 - a. Statement on the Historical seismicity in the area of the proposed SWD
 - i. Number of earthquakes above 2.5 magnitude within 10 miles of the proposed well
 - ii. Location and depth of nearest earthquake and the distance to the

proposed well.

- b. Subsurface Conditions / Faulting
 - i. Distance and depth to the nearest basement-penetrating fault(s)
 - ii. Narrative on the maximum stress direction, the stress regime and potential for communication with basement-penetrating faults.

Deep Injection – Minimum requirements Provide all items listed for Shallow injection, in addition to the following:

1. 1-mile AOR required for all Devonian-Silurian injection wells
2. Include a structural contour map of the Precambrian basement
 - a. Highlight basement-penetrating faults on the map as applicable
 - b. Include a 2 Mile radius around the proposed well showing proximity to basement-penetrating faults if applicable
3. If basement penetrating faults are identified, include an analysis of Fault Slip Potential utilizing Stanford-Zoback model which should include the following:
 - a. Construction of a hydrologic model to simulate the impact of injection from the proposed well (and nearby injection wells) over a 30 year period to estimate the Fault-slip potential associated with injection.
 - i. Simulate injection scenarios based on maximum proposed injection rate for the well, and offset wells if applicable
 - ii. An example of parameters to be utilized in the model are included in Table 8,9 & 10 below
 - b. Identification of subsurface faults and a description of the faults (strike direction, type of fault – normal, extensional, etc)
 - c. Include a record of all USGS documented seismic events of magnitude 2.5 or greater within a 10 mile radius, including details on the depth (focus) and epicenter
 - d. A narrative on whether injection in the vicinity the faults will result in an elevated risk for injection-induced fault slip

Table 8. Input parameters and source material for FSP simulations

Modeled Parameter	Input Value	Variability (+/-)	UOM	Source
<i>Stress</i>				
Vertical Stress Gradient	1.05	0.105	psi ft ⁻¹	Nearby well estimate
Max Horizontal Stress Direction	N75E	5	Deg.	Lund Snee & Zoback, 2018
Reference Depth	7,000	100	ft	Nearby well evaluation
Initial Res. Pressure Gradient	0.43	0.043	psi ft ⁻¹	Lund Snee & Zoback, 2018
A _s Parameter	0.6	0.06	-	Lund Snee & Zoback, 2018
Reference Friction Coefficient (μ)	0.6	0.06	-	Standard Value
<i>Hydrologic</i>				
Aquifer Thickness	1170	100	ft	Nearby well evaluation
Porosity	4	0.5	%	Nearby well evaluation
Permeability	25	2.5	mD	Nearby well evaluation
<i>Material properties</i>				
Density (Water)	1040	20	kg m ⁻³	Standard Value
Dynamic Viscosity (Water)	0.0008	0.0001	Pa.s	Standard Value
Fluid Compressibility (water)	3.6 x 10 ⁻¹⁰	0	Pa ⁻¹	Standard Value
Rock Compressibility	1.08 x 10 ⁻⁹	0	Pa ⁻¹	Standard Value

Table 9. Location and characteristics of injection wells simulated in FSP assessment

Well #	API	Well Name	Lat. (NAD83)	Long. (NAD83)	Vol. (bbls/day)	Start	End
1	30-025- XXXX	XXXX SWD #012	XXXX	-103. XXXX	7,000	2022	2052
2	30-025- XXXX	XXXX SWD #026	XXXX	-103. XXXX	5,000	2022	2052
3	30-025- XXXX	XXXX SWD #002	XXXX	-103. XXXX	20,000	2022	2052
4	N/A	XXXX SWD #1	XXXX	-103. XXXX	15,000	2022	2052

Table 10. Summary of model simulation results showing the required pore pressure change to induced fault slip, actual change in pressure (as predicted by the FSP model), and probability of fault slip at the end of the simulated injection scenario.

Fault Segment #	ΔPressure Necessary to Induce Fault Slip	Actual ΔPressure at fault midpoint in 2052	Fault Slip Potential in 2052
1	2842	156	0.00
2	1956	157	0.00
3	2859	156	0.00
4	1764	151	0.00
5	531	166	0.02
6	832	152	0.00
7	496	137	0.03
8	446	116	0.03
9	1840	141	0.00
10	2515	152	0.00
11	894	166	0.00
12	1769	180	0.00

Conclusion – Induced Seismicity potential:

Operator representative(s), with skills and competencies suitable to assess the risk of induced seismicity, to provide an affirmative statement / summary on the potential for Induced seismicity based upon the parameter listed above. Example wording included below

1. “After examination of publicly available / Operator’s geologic and engineering data, there (is / is not) evidence of open faults or other hydrologic connections between the proposed

disposal zone and any USDW.

2. "After examination of publicly available / Operator data, it is concluded that there is (low/high) risk for induced seismicity based upon the following parameters":

- i. Vertical separation between the proposed injection zone and the pre-cambrian
- ii. Narrative on the existence of basement-penetrating faults in the area of the proposed SWD
- iii. Distance from proposed well to the nearest known basement-penetrating fault(s)
- iv. Distance from the closest historic earthquake
- v. Summary of Fault Slip potential based on Stanford-Zoback model.
- vi. Other items as applicable..

Regards

Tony Harris

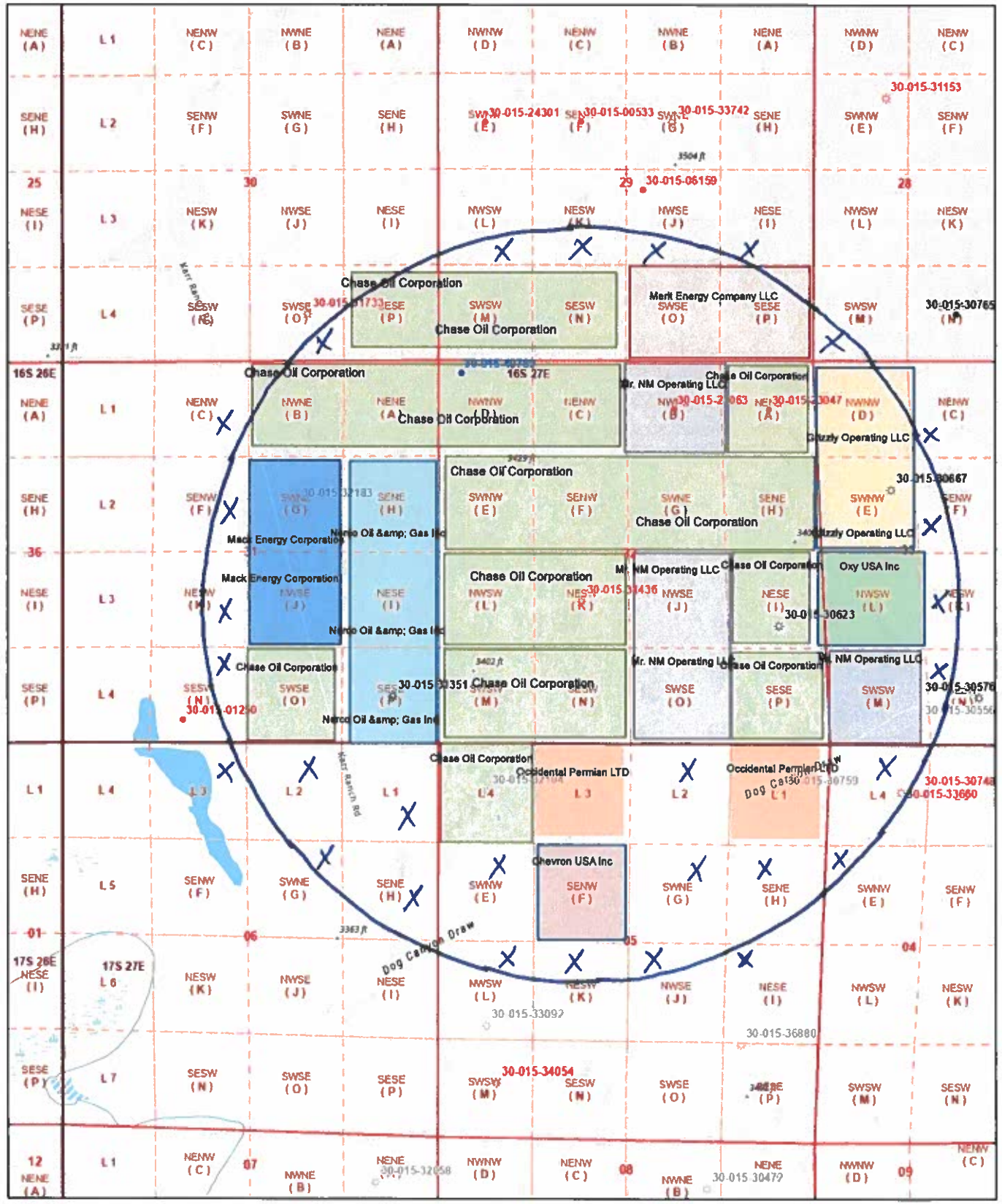
Petroleum Specialist

Anthony.harris@emnrd.nm.gov

505 549 8131.

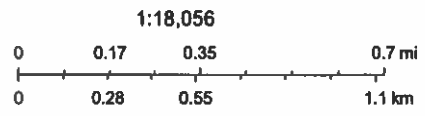


OCD Well Locations



11/9/2022, 10:20:59 AM

- Areas**
- Override 1
 - Override 2
 - Override 3
 - Override 4
 - Override 5
 - Override 6
 - Override 7
 - Override 8
 - Override 9
 - Override 10
- Wells - Large Scale**
- Gas, Active
 - Gas, Cancelled
 - Gas, Plugged
 - Oil, Active
 - Oil, New
 - Oil, Plugged
- PLSS**
- PLSS Second Division
 - PLSS First Division
 - PLSS Townships



Earl Community Maps Contributors, New Mexico State University, Texas Parks & Wildlife, Earl, HERE, Garmin, SafeGraph, GeoTechnologies, Inc, METI/NASA, USGS, EPA, NPS, US Census Bureau, USDA, Earl, NASA, NGA.

From: [Harris, Anthony, EMNRD](#)
To: [Reed Davis](#)
Cc: [Oliver Seekins](#); [Tom Tomastik](#); [Goetze, Phillip, EMNRD](#); [Gebremichael, Million, EMNRD](#); [Sandoval, Stacy, EMNRD](#)
Subject: RE: [EXTERNAL] FW: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.
Date: Tuesday, September 24, 2024 2:58:00 PM
Attachments: [image005.png](#)

Good Afternoon Reed

Please see my response below in RED

Regards

Tony Harris

Petroleum Specialist

Anthony.harris@emnrd.nm.gov

505 549 8131.



From: Reed Davis <rdavis@all-llc.com>
Sent: Wednesday, September 18, 2024 10:36 AM
To: Harris, Anthony, EMNRD <Anthony.Harris@emnrd.nm.gov>
Cc: Oliver Seekins <oseekins@all-llc.com>; Tom Tomastik <ttomastik@all-llc.com>; Goetze, Phillip, EMNRD <phillip.goetze@emnrd.nm.gov>; Gebremichael, Million, EMNRD <Million.Gebremichael@emnrd.nm.gov>
Subject: Re: [EXTERNAL] FW: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.

Some people who received this message don't often get email from rdavis@all-llc.com. [Learn why this is important](#)

Anthony,

ALL Consulting assisted Mack Energy in completing the seismic analysis letters required as part of their Glacier & Manitoba SWDs C-108 applications. They recently received additional information requests (as outlined below) for both applications.

It is our understanding that an FSP model has been requested for these deep injection applications; subsequently, we have a couple of questions regarding these FSP requests:

1. The email chain indicates that a Precambrian Basement structural contour map is to be included. However, we do not believe there are sufficient well data/basement penetrations in the vicinity of the proposed wells to construct such a map in a quality manner. Can you please advise on how NMOCD would like us to handle this situation? **Based upon the lack of data / basement penetrations to construct a map, the requirement is waived.**

2. Within the email chain, it is stated that "If basement penetrating faults **are** identified, include an analysis of Fault Slip Potential..." however, no basement penetrating faults were identified within 2-miles (or 100 square miles) of the proposed SWDs (according to the BEG public data set at the time of submission). Given the lack of publicly known basement faults, is it intended for us to run the FSP model with simulated faulting, or is there possibly additional fault data in the area that ALL is unaware of? If there are additional data sources, please let us know and we will gladly acquire that public data for our analysis. **Based upon the lack of available data the requirement is waived.**

Thanks for your time, please feel free to call if that is an easier way to discuss!

Reed Davis
ALL Consulting LLC
1718 S Cheyenne Ave
Tulsa, OK 74119

Office: 918-382-7581

Cell: 918-361-8375

From: Jerry Sherrell <jerrys@mec.com>

Sent: Friday, September 6, 2024 10:38 AM

To: Oliver Seekins <oseekins@all-llc.com>; Reed Davis <rdavis@all-llc.com>; Mark Kidder <mkidder@all-llc.com>; Tom Tomastik <ttomastik@all-llc.com>; Ben Bockelmann <bbockelmann@all-llc.com>

Cc: Deana Weaver <dweaver@mec.com>

Subject: FW: [EXTERNAL] FW: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.

Just forwarding this email.

From: Jerry Sherrell

Sent: Wednesday, September 04, 2024 11:21 AM

To: 'Oliver Seekins' <oseekins@all-llc.com>

Cc: Deana Weaver <dweaver@mec.com>

Subject: FW: [EXTERNAL] FW: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.

Oliver,

Please the email below from NMOCD. They are requiring a Fault Slip Potential for the Glacier SWD #1 as part of their Deep Injection guidance. Can you please provide the necessary information?

Jerry W. Sherrell

Regulatory Supervisor

Mack Energy Corporation

Bulldog Operating Company

PO Box 960

Artesia, NM 88210

Office 575-748-1288

Cell 575-703-7382

jerrys@mec.com

From: Harris, Anthony, EMNRD <Anthony.Harris@emnrd.nm.gov>

Sent: Wednesday, September 04, 2024 11:08 AM

To: Jerry Sherrell <jerrys@mec.com>

Cc: Deana Weaver <dweaver@mec.com>

Subject: RE: [EXTERNAL] FW: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.

EXTERNAL EMAIL - Verify the sender and use caution before opening attachments or clicking links

Good Morning, Jerry

I can confirm that a FSP analysis will be required. Please follow the guidance for “Deep Injection” as outlined in the e-mail below.

Regards

Tony

From: Harris, Anthony, EMNRD

Sent: Wednesday, September 4, 2024 10:17 AM

To: Jerry Sherrell <jerrys@mec.com>

Cc: Deana Weaver <dweaver@mec.com>

Subject: RE: [EXTERNAL] FW: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.

Good Morning

I did review it, and it does satisfy the minimum (shallow injection) requirements. Considering the injection will be deep (Devonian) and the proximity to an active Seismic Response Area, I will need to review with management to confirm if a FSP analysis is required. I will advise ASAP

Thanks

Tony

From: Jerry Sherrell <jerrys@mec.com>
Sent: Wednesday, September 4, 2024 10:12 AM
To: Harris, Anthony, EMNRD <Anthony.Harris@emnrd.nm.gov>
Cc: Deana Weaver <dweaver@mec.com>
Subject: [EXTERNAL] FW: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.

CAUTION: This email originated outside of our organization. Exercise caution prior to clicking on links or opening attachments.

Anthony,

Did you have a chance to look at this report? It appears to meet the guidelines, but wanted to make sure.

From: Jerry Sherrell
Sent: Tuesday, September 03, 2024 11:25 AM
To: 'Harris, Anthony, EMNRD' <Anthony.Harris@emnrd.nm.gov>
Cc: Deana Weaver <dweaver@mec.com>
Subject: RE: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.

Anthony,

The section about induced seismicity minimum requirements. This was sent in March. Just wanted to make sure you received it.

From: Harris, Anthony, EMNRD <Anthony.Harris@emnrd.nm.gov>
Sent: Friday, August 30, 2024 1:26 PM

To: Jerry Sherrell <jerrys@mec.com>

Cc: Deana Weaver <dweaver@mec.com>; Goetze, Phillip, EMNRD <phillip.goetze@emnrd.nm.gov>; Gebremichael, Million, EMNRD <Million.Gebremichael@emnrd.nm.gov>; Sandoval, Stacy, EMNRD <Stacy.Sandoval@emnrd.nm.gov>; Chavez, Carl, EMNRD <Carlj.Chavez@emnrd.nm.gov>

Subject: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.

Importance: High

EXTERNAL EMAIL - Verify the sender and use caution before opening attachments or clicking links

Good Day, Jerry

Below are the list of deficiencies and or items requiring clarification before the application can be reviewed. If possible, I would like to take 30 mins to review some of these items with you before I send this to Mack.

1. Page 3/61 – C-108 Section VII

1. Please provide chemical analysis for the disposal zone formation water (Item VII.5)

2. Page 3/61 – C-108 Section VIII

1. Provide the geologic name, and depth to bottom of all USDW overlying the proposed injection zone as per C-108 Section VIII
2. Provide the geologic name, and depth to bottom of all USDW underlying the proposed injection zone as per C-108 Section VIII

3. Page 7/61 Section VII.4

1. Please specify the Source of the Produced Water – San Andres? Other?

4. Page 18/61- “Before” Wellbore diagram for proposed Glacier SWD#1 well

1. No plugging details included on wellbore diagram. Please provide plugging details if available.

5. Page 22/61 – No Label / Titles included on the Map. AOR is less than 1 mile

1. 1-Mile AOR not shown on this map.

i. Refer to attached map labelled “**Page 22.. AOR deficiencies**” illustrating the unit letters (denoted by X’s) that need to be included to encompass the 1-mile AOR

1. Please update the map on Page 22 to include a circle clearly showing the 1-mile AOR.
2. Please update “proof of notice” requirement to verify that the surface owner and lease operators (ie. including the 30 Unit letters denoted by an “X” in the attached map) have been notified (**Refer to item 5b below**)
3. Please provide a separate map (**with label / Title**) that clearly identifies the Surface Owner upon which the proposed well is located
4. Please provide a separate map (**with label / Title**) that clearly identifies the Leasehold Operators within 1 mile radius of the proposed well.

1. Refer to Eastern portion of map that identifies Grizzly Operating as an owner

i. Ownership of well 30-015-30667 was transferred from Grizzly to Contango effective 1-29-2021 (ie. prior to Mack Energy Glacier Application being submitted)

1. Please submit “proof of notice” requirements to verify that Contango has been notified.

6. Refer to Page 52/61 – Water Analysis Report

1. No Label / Title include on this Water Sample

i. Is this a Fresh Water Sample ?

1. Report lists the sample point as “*Glacier SWD#1- Wellhead Sample*”

i. If the sample was collected from the Glacier well, please clarify how the sample was collected along with details of the zone that was sampled.

- ii. If this is a fresh water sample, please clarify (with appropriate Label / Title) the location of the well and date the sample was collected (Refer to C-108 Item XI)

7. General notes:

1. Proposed cement volume for Production casing (885 sks) is not sufficient to reach surface
 - i. If there is a DV tool(s) planned for cement job, please clarify and update the wellbore diagram?
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1. Please provide a brief description of the planned workover operations to convert this well
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Induced Seismicity Potential (Minimum requirements)

The well is proposed for disposal into the Devonian and is located near, and along the trend line of, the Dagger Draw SRA (refer to attached image). Considering the ongoing seismic activity in the southern region of New Mexico, OCD requests an assessment of the Induced Seismicity potential. Below is an outline of the minimum requirements to assess the risks of Induced Seismicity for wells in close proximity to a known Seismic Response Area.

Minimum Requirements (for shallow injection wells)

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5. Statement on potential for communication with USDW.
2. Seismic Risk assessment based on USGS data
 1. Statement on the Historical seismicity in the area of the proposed SWD
 - i. Number of earthquakes above 2.5 magnitude within 10 miles of the proposed well
 - ii. Location and depth of nearest earthquake and the distance to the proposed well.
 1. Subsurface Conditions / Faulting
 - i. Distance and depth to the nearest basement-penetrating fault(s)
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Deep Injection – Minimum requirements Provide all items listed for Shallow injection, in addition to the following:

1. 1-mile AOR required for all Devonian-Silurian injection wells
2. Include a structural contour map of the Precambrian basement
 1. Highlight basement-penetrating faults on the map as applicable
 2. Include a 2 Mile radius around the proposed well showing proximity to basement-penetrating faults if applicable
3. If basement penetrating faults are identified, include an analysis of Fault Slip Potential utilizing Stanford-Zoback model which should include the following:
 1. Construction of a hydrologic model to simulate the impact of injection from the proposed well (and nearby injection wells) over a 30 year period to estimate the Fault-slip potential associated with injection.
 - i. Simulate injection scenarios based on maximum proposed injection rate for the well, and offset wells if applicable
 - ii. An example of parameters to be utilized in the model are included in Table 8,9 & 10 below
 1. Identification of subsurface faults and a description of the faults (strike direction, type of fault – normal, extensional, etc)
 2. Include a record of all USGS documented seismic events of magnitude 2.5 or greater within a 10 mile radius, including details on the depth (focus) and epicenter
 3. A narrative on whether injection in the vicinity the faults will result in an elevated risk for injection-induced fault slip

Table 8. Input parameters and source material for FSP simulations

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Max Horizontal Stress Direction	N75E	5	Deg.	Lund Snee & Zoback, 2018
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A ₄ Parameter	0.6	0.06	-	Lund Snee & Zoback, 2018
Reference Friction Coefficient (μ)	0.6	0.06	-	Standard Value
<i>Hydrologic</i>				
Aquifer Thickness	1170	100	ft	Nearby well evaluation
Porosity	4	0.5	%	Nearby well evaluation
Permeability	25	2.5	mD	Nearby well evaluation
<i>Material properties</i>				
Density (Water)	1040	20	kg m ⁻³	Standard Value
Dynamic Viscosity (Water)	0.0008	0.0001	Pa.s	Standard Value
Fluid Compressibility (water)	3.6 x 10 ⁻¹⁰	0	Pa ⁻¹	Standard Value
Rock Compressibility	1.08 x 10 ⁻⁹	0	Pa ⁻¹	Standard Value

Table 9. Location and characteristics of injection wells simulated in FSP assessment
















Well #	API	Well Name	Lat. (NAD83)	Long. (NAD83)	Vol. (bbls/day)	Start	End
1	30-025- 	 SWD #012		-103. 	7,000	2022	2052
2	30-025- 	 SWD #026		-103. 	5,000	2022	2052
3	30-025- 	 SWD #002		-103. 	20,000	2022	2052
4	N/A	 SWD #1		-103. 	15,000	2022	2052

Table 10. Summary of model simulation results showing the required pore pressure change to induced fault slip, actual change in pressure (as predicted by the FSP model), and probability of fault slip at the end of the simulated injection scenario.

Fault Segment #	ΔPressure Necessary to Induce Fault Slip	Actual ΔPressure at fault midpoint in 2052	Fault Slip Potential in 2052
1	2842	156	0.00
2	1956	157	0.00
3	2859	156	0.00
4	1764	151	0.00
5	531	166	0.02
6	832	152	0.00
7	496	137	0.03
8	446	116	0.03
9	1840	141	0.00
10	2515	152	0.00
11	894	166	0.00
12	1769	180	0.00

Conclusion – Induced Seismicity potential:

Operator representative(s), with skills and competencies suitable to assess the risk of induced seismicity, to provide an affirmative statement / summary on the potential for Induced seismicity based upon the parameter listed above. Example wording included below

1. "After examination of publicly available / Operator's geologic and engineering data, there is / is not evidence of open faults or other hydrologic connections between the proposed disposal zone and any USDW.
2. "After examination of publicly available / Operator data, it is concluded that there is (low/high) risk for induced seismicity based upon the following parameters":
 - i. Vertical separation between the proposed injection zone and the pre-cambrian
 - ii. Narrative on the existence of basement-penetrating faults in the area of the proposed SWD
 - iii. Distance from proposed well to the nearest known basement-penetrating fault(s)
 - iv. Distance from the closest historic earthquake
 - v. Summary of Fault Slip potential based on Stanford-Zoback model.
 - vi. Other items as applicable..

Regards

Tony Harris

Petroleum Specialist

Anthony.harris@emnrd.nm.gov

505 549 8131.



From: [Harris, Anthony, EMNRD](#)
To: [Jerry Sherrell](#)
Cc: [Deana Weaver](#); [Goetze, Phillip, EMNRD](#); [Gebremichael, Million, EMNRD](#); [Sandoval, Stacy, EMNRD](#); [Chavez, Carl, EMNRD](#)
Subject: RE: [EXTERNAL] RE: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.
Date: Monday, September 16, 2024 2:57:00 PM
Attachments: [jimage005.png](#)

Hi Jerry

Please see my response below highlighted in blue

Hope this helps

Tony

From: Jerry Sherrell <jerrys@mec.com>
Sent: Tuesday, September 10, 2024 9:14 AM
To: Harris, Anthony, EMNRD <Anthony.Harris@emnrd.nm.gov>
Cc: Deana Weaver <dweaver@mec.com>; Goetze, Phillip, EMNRD <phillip.goetze@emnrd.nm.gov>; Gebremichael, Million, EMNRD <Million.Gebremichael@emnrd.nm.gov>; Sandoval, Stacy, EMNRD <Stacy.Sandoval@emnrd.nm.gov>; Chavez, Carl, EMNRD <Carlj.Chavez@emnrd.nm.gov>
Subject: [EXTERNAL] RE: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.

CAUTION: This email originated outside of our organization. Exercise caution prior to clicking on links or opening attachments.

Good Morning,

Mack Energy is close to having all the concerns addressed and submitted. I have a couple questions(below) could you please advise.

1. Page 3/61 – C-108 Section VII
 - a. Please provide chemical analysis for the disposal zone formation water (Item VII.5) **There is not a Devonian well in the area to get a sample. Can we provide the sample during completion. YES We can perf and swab the well to provide a sample. Just curious why this is necessary? It is necessary as per Section VII.5 of the C-108 (see snapshot below). Your application simply states “N/A” which does not provide much insight for a person reviewing the application. Alternatively, and for future reference, it would be helpful if your application included a statement similar to what you included above highlighting that no sample is available from offset wells, together with a commitment to collect the data via swab test during the drilling/completion operations.**

VII. Attach data on the proposed operation, including:

1. Proposed average and maximum daily rate and volume of fluids to be injected;
2. Whether the system is open or closed;
3. Proposed average and maximum injection pressure;
4. Sources and an appropriate analysis of injection fluid and compatibility with the receiving formation if other than reinjected produced water; and,
5. If injection is for disposal purposes into a zone not productive of oil or gas at or within one mile of the proposed well, attach a chemical analysis of the disposal zone formation water (may be measured or inferred from existing literature, studies, nearby wells, etc.).

4. Page 18/61- “Before” Wellbore diagram for proposed Glacier SWD#1 well
 - a. No plugging details included on wellbore diagram. Please provide plugging details if available. **The Well file in the OCD online system is incomplete. Apparently it never got entered into the system. We are aware of incomplete online dataset, and hence the reason for stating “if available”. If you are unable to locate any information as part of your pre-intervention due-diligence then this requirement will be waived. Should this re-entry be unsuccessful Mack Energy will P&A per OCD regulations. Thank you for the clarification.**

From: Harris, Anthony, EMNRD <Anthony.Harris@emnrd.nm.gov>

Sent: Friday, August 30, 2024 1:26 PM

To: Jerry Sherrell <jerrys@mec.com>

Cc: Deana Weaver <dweaver@mec.com>; Goetze, Phillip, EMNRD <phillip.goetze@emnrd.nm.gov>; Gebremichael, Million, EMNRD <Million.Gebremichael@emnrd.nm.gov>; Sandoval, Stacy, EMNRD <Stacy.Sandoval@emnrd.nm.gov>; Chavez, Carl, EMNRD <Carlj.Chavez@emnrd.nm.gov>

Subject: Mack Energy Glacier SWD#1 - List of deficiencies and clarification required.

Importance: High

EXTERNAL EMAIL - Verify the sender and use caution before opening attachments or clicking links

Good Day, Jerry

Below are the list of deficiencies and or items requiring clarification before the application can be reviewed. If possible, I would like to take 30 mins to review some of these items with you before I send this to Mack.

1. Page 3/61 – C-108 Section VII
 - a. Please provide chemical analysis for the disposal zone formation water (Item VII.5)
 2. Page 3/61 – C-108 Section VIII
 - a. Provide the geologic name, and depth to bottom of all USDW overlying the proposed injection zone as per C-108 Section VIII
 - b. Provide the geologic name, and depth to bottom of all USDW underlying the proposed injection zone as per C-108 Section VIII
 3. Page 7/61 Section VII.4
 - a. Please specify the Source of the Produced Water – San Andres? Other?
 4. Page 18/61- “Before” Wellbore diagram for proposed Glacier SWD#1 well
 - a. No plugging details included on wellbore diagram. Please provide plugging details if available.
 5. Page 22/61 – No Label / Titles included on the Map. AOR is less than 1 mile
 - a. 1-Mile AOR not shown on this map.
 - i. Refer to attached map labelled “**Page 22.. AOR deficiencies**” illustrating the unit letters (denoted by X’s) that need to be included to encompass the 1-mile AOR
 1. Please update the map on Page 22 to include a circle clearly showing the 1-mile AOR.
 2. Please update “proof of notice” requirement to verify that the surface owner and lease operators (ie. including the 30 Unit letters denoted by an “X” in the attached map) have been notified (**Refer to item 5b below**)
 3. Please provide a separate map (**with label / Title**) that clearly identifies the Surface Owner upon which the proposed well is located
 4. Please provide a separate map (**with label / Title**) that clearly identifies the Leasehold Operators within 1 mile radius of the proposed well.
 - b. Refer to Eastern portion of map that identifies Grizzly Operating as an owner
 - i. Ownership of well 30-015-30667 was transferred from Grizzly to Contango effective 1-29-2021 (ie. prior to Mack Energy Glacier Application being submitted)
 1. Please submit “proof of notice” requirements to verify that Contango has been notified.
6. Refer to Page 52/61 – Water Analysis Report
 - a. No Label / Title include on this Water Sample

- i. Is this a Fresh Water Sample ?
- b. Report lists the sample point as “Glacier SWD#1- Wellhead Sample”
 - i. If the sample was collected from the Glacier well, please clarify how the sample was collected along with details of the zone that was sampled.
 - ii. If this is a fresh water sample, please clarify (with appropriate Label / Title) the location of the well and date the sample was collected (Refer to C-108 Item XI)

7. General notes:

- a. Proposed cement volume for Production casing (885 sks) is not sufficient to reach surface
 - i. If there is a DV tool(s) planned for cement job, please clarify and update the wellbore diagram?
- b. CBL will be required for the Surface casing (set and cemented in 2001)
 - i. Note that well is in high Karst area, and surface casing cement quality has to be confirmed by CBL.
- c. Please provide a brief description of the planned workover operations to convert this well
- d. Provide a technical narrative and geologic assessment to demonstrate how the injected fluids will be contained within the Devonian

Induced Seismicity Potential (Minimum requirements)

The well is proposed for disposal into the Devonian and is located near, and along the trend line of, the Dagger Draw SRA (refer to attached image). Considering the ongoing seismic activity in the southern region of New Mexico, OCD requests an assessment of the Induced Seismicity potential. Below is an outline of the minimum requirements to assess the risks of Induced Seismicity for wells in close proximity to a known Seismic Response Area.

Minimum Requirements (for shallow injection wells)

- 1. General Information / overview:
 - a. Operator to provide a brief narrative on the location of the proposed SWD well (Section, township, range, County etc)
 - b. Geologic description (ie. Interbedded carbonate, limestones, siltstones, sandstones etc) of the proposed injection interval
 - c. Proposed formation and the depth of the injection interval
 - d. Statement on potential for communication with the Precambrian via faulting or other geologic features
 - e. Statement on potential for communication with USDW.
- 2. Seismic Risk assessment based on USGS data
 - a. Statement on the Historical seismicity in the area of the proposed SWD
 - i. Number of earthquakes above 2.5 magnitude within 10 miles of the proposed well
 - ii. Location and depth of nearest earthquake and the distance to the proposed well.
 - b. Subsurface Conditions / Faulting
 - i. Distance and depth to the nearest basement-penetrating fault(s)
 - ii. Narrative on the maximum stress direction, the stress regime and potential for communication with basement-penetrating faults.

Deep Injection – Minimum requirements Provide all items listed for Shallow injection, in addition to the following:

- 1. 1-mile AOR required for all Devonian-Silurian injection wells
- 2. Include a structural contour map of the Precambrian basement
 - a. Highlight basement-penetrating faults on the map as applicable
 - b. Include a 2 Mile radius around the proposed well showing proximity to basement-penetrating faults if applicable
- 3. If basement penetrating faults are identified, include an analysis of Fault Slip Potential utilizing Stanford-Zoback model which should include the following:
 - a. Construction of a hydrologic model to simulate the impact of injection from the proposed well (and nearby injection wells) over a 30 year period to estimate the Fault-slip potential associated with

- injection.
- i. Simulate injection scenarios based on maximum proposed injection rate for the well, and offset wells if applicable
 - ii. An example of parameters to be utilized in the model are included in Table 8,9 & 10 below
 - b. Identification of subsurface faults and a description of the faults (strike direction, type of fault – normal, extensional, etc)
 - c. Include a record of all USGS documented seismic events of magnitude 2.5 or greater within a 10 mile radius, including details on the depth (focus) and epicenter
 - d. A narrative on whether injection in the vicinity the faults will result in an elevated risk for injection-induced fault slip

Table 8. Input parameters and source material for FSP simulations

Modeled Parameter	Input Value	Variability (+/-)	UOM	Source
<i>Stress</i>				
Vertical Stress Gradient	1.05	0.105	psi ft ⁻¹	Nearby well estimate
Max Horizontal Stress Direction	N75E	5	Deg.	Lund Sneek & Zoback, 2018
Reference Depth	7,000	100	ft	Nearby well evaluation
Initial Res. Pressure Gradient	0.43	0.043	psi ft ⁻¹	Lund Sneek & Zoback, 2018
A* Parameter	0.6	0.06	-	Lund Sneek & Zoback, 2018
Reference Friction Coefficient (μ)	0.6	0.06	-	Standard Value
<i>Hydrologic</i>				
Aquifer Thickness	1170	100	ft	Nearby well evaluation
Porosity	4	0.5	%	Nearby well evaluation
Permeability	25	2.5	mD	Nearby well evaluation
<i>Material properties</i>				
Density (Water)	1040	20	kg m ⁻³	Standard Value
Dynamic Viscosity (Water)	0.0008	0.0001	Pa.s	Standard Value
Fluid Compressibility (water)	3.6 x 10 ⁻¹⁰	0	Pa ⁻¹	Standard Value
Rock Compressibility	1.08 x 10 ⁻⁹	0	Pa ⁻¹	Standard Value

Table 9. Location and characteristics of injection wells simulated in FSP assessment

Well #	API	Well Name	Lat. (NAD83)	Long. (NAD83)	Vol. (bbls/day)	Start	End
1	30-025- XXXX	XXXX SWD #012	XXXX	-103.1 XXXX	7,000	2022	2052
2	30-025- XXXX	XXXX SWD #026	XXXX	-103.1 XXXX	5,000	2022	2052
3	30-025- XXXX	XXXX SWD #002	XXXX	-103.1 XXXX	20,000	2022	2052
4	N/A	XXXX SWD #1	XXXX	-103.1 XXXX	15,000	2022	2052

Table 10. Summary of model simulation results showing the required pore pressure change to induced fault slip, actual change in pressure (as predicted by the FSP model), and probability of fault slip at the end of the simulated injection scenario.

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7	496	137	0.03
8	446	116	0.03
9	1840	141	0.00
10	2515	152	0.00
11	894	166	0.00
12	1769	180	0.00

Conclusion – Induced Seismicity potential:

Operator representative(s), with skills and competencies suitable to assess the risk of induced seismicity, to provide an affirmative statement / summary on the potential for Induced seismicity based upon the parameter listed above. Example wording included below

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evidence of open faults or other hydrologic connections between the proposed disposal zone and any USDW.

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Regards

Tony Harris

Petroleum Specialist

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State of New Mexico
Energy, Minerals and Natural Resources
Oil Conservation Division
1220 S. St Francis Dr.
Santa Fe, NM 87505

CONDITIONS

Action 395182

CONDITIONS

Operator: MACK ENERGY CORP P.O. Box 960 Artesia, NM 882110960	OGRID: 13837
	Action Number: 395182
	Action Type: [IM-SD] Admin Order Support Doc (ENG) (IM-AAO)

CONDITIONS

Created By	Condition	Condition Date
anthony.harris	None	10/23/2024