



PEER Assessment 2018

Virginia Department of Mines, Minerals & Energy
Division of Oil & Gas





States First is a state-led initiative aimed at facilitating multi-state collaboration and innovative regulatory solutions for oil and natural gas producing states. Governors, regulators, and policy leaders from oil and gas producing states across the country have partnered with the Interstate Oil and Gas Compact Commission (IOGCC) and Ground Water Protection Council (GWPC) in this endeavor. This joint initiative allows a unique mix of regulatory experts, state policy and technical staff from across the country to come together and to share the way they do business, review internal operations and opens opportunities for extrapolating effective practices from one state to another.

Looking forward, the states remain committed to excellence and to providing the regulatory leadership necessary for a sound energy future. As leaders, the states recognize the need to continuously improve and to develop innovative solutions to emerging regulatory challenges. Through States First programs, state regulatory agencies are collaborating and communicating with one another in an ongoing effort to keep current with rapidly changing technology, as well as to share the very best and innovative regulatory procedures from state to state.

State Oil and Gas Regulatory Exchange (SOGRE) is an outreach program created under the States First Initiative. The mission of the SOGRE is to assist states to continually improve state oil and gas regulatory programs by providing member states consultation and program assessment services targeted to their specific needs.

Ground Water Protection Council | www.gwpc.org

The GWPC is a nonprofit 501(c)6 organization whose members consist of state ground water regulatory agencies which come together within the GWPC organization to mutually work toward the protection of the nation's ground water supplies.

The purpose of the GWPC is to promote and ensure the use of best management practices and fair but effective laws regarding comprehensive ground water protection. The mission of GWPC is to promote the protection and conservation of ground water resources for all beneficial uses, recognizing ground water as a critical component of the ecosystem. The organization provides an important forum for stakeholder communication and research in order to improve governments' role in the protection and conservation of groundwater.

Interstate Oil & Gas Compact Commission | iogcc.ok.gov

The IOGCC, comprised of 38 oil and gas producing states, is a multi-state government entity that promotes the conservation and efficient recovery of domestic oil and natural gas resources while protecting health, safety and the environment.

The Commission, acting through member-state governors, assists states to maximize oil and natural gas resources through sound regulatory practices. As the collective voice of member governors on oil and gas issues, the IOGCC advocates for states' rights to govern oil and natural gas resources within their borders.

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Virginia's Department of Mines, Minerals and Energy

SOGRE Virginia Assessment Team

Joe Lee, Ground Water Protection Council

Assessment Team Lead

Joe Lee received his Bachelor of Science degree in Geosciences and completed course work for a Masters of Environmental Pollution Control from The Pennsylvania State University. He has had over 35 years of experience in state government applying geologic, and hydrogeological principles, and techniques in assessing environmental, and public safety impacts of mineral resource development and protection of groundwater, and water supplies. He has developed and managed environmental protection programs for safe drinking water, groundwater and mineral resource development, including oil and gas. Mr. Lee served on the Board of Directors of the GWPC for over 10 years. Mr. Lee is a licensed professional geologist in the Commonwealth of Pennsylvania; and, he is the principle of Lee Geologic.

Dr. Berry H. (Nick) Tew, Jr., State Geologist and Oil and Gas Supervisor, Geological Survey for Alabama, Alabama Oil and Gas Board, Chairman, Alabama State Water Agencies Working Group

Dr. Berry H. (Nick) Tew, Jr. is Alabama's state geologist and oil and gas supervisor. In these capacities, he directs the Geological Survey of Alabama and the staff of the State Oil and Gas Board (OGB) of Alabama. In February of this year, he was appointed research professor and director of the Center for Sedimentary Basin Studies in the Department of Geological Sciences at the University of Alabama, in addition to his other duties. Nick holds bachelor's, master's, and Ph.D. degrees in geology and has been with Geological Society of America (GSA) and OGB for more than 30 years, serving in his present capacity since 2002.

Dr. Tew has extensive knowledge of Alabama's surface and subsurface geology and the state's rich endowment of geologically related natural resources. He is an expert in Gulf Coastal Plain stratigraphy, petroleum geology and public policy applications of the geosciences, as well as the regulation of oil and natural gas operations. Dr. Tew is chairman of the AWAAG, a group of state agencies directed by Governor Robert Bentley to recommend an action plan and timeline for implementing a statewide water management plan. He is a member of the National Petroleum Council and the National Academies of Science, Engineering and Medicine Roundtable on Hydrocarbon Resources, in addition to numerous other committee, board and service activities. He is a past president of the American Geosciences Institute (AGI) and Association of American State Geologists and served as vice-chairman of the IOGCC and chairman of the U.S. Department of the Interior Outer Continental Shelf Policy Committee. Dr. Tew is a fellow in the GSA. He is the 2013 recipient of the E.W. Marland Award for outstanding state regulator and the 2016 recipient of the AGI Medal in Memory of Ian Campbell for Superlative Service to the Geosciences, the highest award of the American Geosciences Institute.

SOGRE Virginia Assessment Team (continued)

Hollis French, Chair & Commissioner, Alaska Oil and Gas Conservation Commission

Hollis French moved to Alaska in 1978 and then worked thirteen years in the oil industry, both in Cook Inlet and on the North Slope. In 1992 he enrolled at Cornell Law School, and upon graduation he clerked for a superior court judge in Anchorage. He joined the Anchorage District Attorney's office in 1996 and worked as a state prosecutor dealing with a variety of criminal cases in Anchorage, Dillingham, Bethel and St. Paul. In 2002 Mr. French was elected to the Alaska State Senate where he served for twelve years. In 2016 Governor Bill Walker appointed him to the Alaska Oil and Gas Conservation Commission. In addition to his public service, he is also an avid mountaineer and has successfully climbed Denali twice.

Donald Drazan, Consultant

Don Drazan is the President / Geologist of Drazan Energy, LLC. Drazan Energy, LLC's primary goal is to assist regulatory agencies in tracking and overseeing oil and gas activities in their jurisdictions. He has a Bachelor's in Geology from the University of Buffalo and is a Certified Petroleum Geologist. Mr. Drazan has over forty years' experience with oil and gas operations with thirty years in the New York oil and gas regulatory program responsible for many areas of the program. In addition to other clients Mr. Drazan serves as a Project Coordinator with the GWPC, Risk Based Data Management System (RBDMS.) He works with multiple states on their implementation of RBDMS as well as several national topics including well bore visualization, and Geographic Information System Enhancements.

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Introduction

Virginia's Department of Mines, Minerals and Energy (DMME): Division of Gas and Oil (Division) regulates the exploration and production of natural gas and oil in the Commonwealth through the Virginia Gas and Oil Act (the Act) and its attendant regulations. The Act sets out several goals for DMME; notably to foster, encourage and promote the safe and efficient production of oil and natural gas while also protecting the citizens and environment of the Commonwealth. Production started in the early 1900's and has historically been centered in the southwestern portion of the state. Production is a mixture of conventional gas and oil wells and coal bed methane wells. There has been roughly 7,000 wells drilled in Virginia.

The Virginia regulatory program has been reviewed twice as part of the State Review of Oil and Natural Gas Environmental Regulations (STRONGER). STRONGER reviews were issued in April 2004¹ and a follow up review was issued in 2017.² These reviews found that generally Virginia's regulatory programs provided adequate protections relative to the STRONGER requirements during both efforts.

In April 2016 SOGRE was contacted via phone by the Division and asked to participate in the STRONGER review as an observer. As a follow up to the 2017 STRONGER Review, Deputy Director, Bradley Lambert approached SOGRE in writing requesting additional analysis. Mr. Lambert said, "DMME appreciated STRONGER's largely positive feedback and has incorporated many of its recommendations. However, DMME believes there are a couple of aspects of its regulatory program that could benefit from a more in depth, granular review. Therefore, DMME respectfully requests SOGRE examine the following areas:

- The existing laws and regulations that govern exploration and production of oil and gas resources in the eastern half of the Commonwealth (Commonly referred to as the Tidewater region)
- Whether DMME should adopt regulations governing Naturally Occurring Radioactive Material (NORM) and whether those regulations should apply statewide or only in specific regions."

A questionnaire was developed and distributed to DMME as a first step in collecting information to perform this assessment. (See Appendix 1-3)

Background Materials Evaluated

Each member of the SOGRE Team read the following materials related to the Division's regulatory regime based on the responses to the supplied questionnaire:

1 <http://www.strongerinc.org/wp-content/uploads/2015/04/Virginia-Initial-Review-4-2004.pdf>

2 <https://www.strongerinc.org/wp-content/uploads/2017/05/2016-VA-Follow-Up-Final-Report-with-2017-DMME-response-050117.pdf>

1. Virginia Administrative Code; Title 9. Environment; Agency 15. Department of Environmental Quality (DEQ); Chapter 20. Guidelines for the Preparation of Environmental Impact Assessments (EIA) for Oil or Gas Well Drilling Operations in Tidewater Virginia (9VAC15-20.pdf);
2. Code of Virginia; Title 62.1. Waters of the State, Ports and Harbors; Chapter 20. Miscellaneous Offenses; 62.1-195.1. Chesapeake Bay; drilling for oil or gas prohibited (62.1-195.pdf);
3. DMME; Division of Gas and Oil (DGO); Gas and Oil Complaint Investigations: Policy and Procedures;
4. Guidance Memorandum: Bonding and Additional Financial Security Requirements Applicable to Wells Drilled in Tidewater Virginia;
5. Memorandum of Agreement (MOA) between DMME and DEQ for Air Quality;
6. MOA between DMME and DEQ for Review of Environmental Impacts from Oil and Gas Development in Tidewater Virginia;
7. Analysis of NORM in Shale Gas Source Rocks from Virginia; August 2017 (NORM Report 08-25-2017, Revised);
8. Pennsylvania DEP, Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) Study Report; Section 9.0; pages 1-13; 01-15-2015, Revised;
9. The DMME's responses to SOGRE's "Virginia SOGRE Questionnaire." (Appendix 3)

As requested Mr. Joe Lee participated as an observer during the STRONGER review. Mr. Lee reviewed the report and had several calls with the Division staff regarding their concern. Additional calls were held by Mr. Drazan in discussion with Division staff on the requested assessments.

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SOGRE Assessment Team Findings

A. Statutory Authority and Implementing Regulations

The following presents the identified portions of the Act that were implemented to regulate the industry in Virginia:

1. Chapter 22.1 of the Code of Virginia is The Virginia Gas and Oil Act.
2. Chapter 150 of the Code of Virginia are the Virginia Gas and Oil Regulations
3. Chapter 20 of the of the Code of Virginia are the Guidelines for Preparation of EIA for Oil or Gas Well Drilling Operations in Tidewater Virginia
4. The IOGCC provides an overview of the above requirements:³

B. SOGRE Assessment Team Response to Specific Issues Raised by the Department

The Assessment Team in cooperation with Division staff assessed two primary areas of concerns. Based on these two issues SOGRE recommends the Division develop a proposal to implement the following recommendations:

1. **Bonding Requirements:** If development begins in the Tidewater region, the Division should evaluate whether additional bond requirements should be implemented for that area above and beyond what is required in the southwest region of the state.
2. **NORM Assessment:** The Assessment Team recommends that the Division verify that there is no need for an oil and gas NORM program. The Division should collaborate with other State/ Federal agencies and industry to develop an initial field monitoring data collection program and scientific study to facilitate the determination of need.

C. Issues for Department Consideration Identified by SOGRE Team

1. Bonding Requirements

STRONGER Recommendations and DMME Responses relevant to Bonding:

3 http://iogcc.publishpath.com/Websites/iogcc/images/State_Statute_Summaries_2015/2015%20SOS/Virginia%202015.pdf

Recommendation 4.2.4.a: The review team recommends that the DGO should reevaluate the adequacy of its bond requirements if oil and gas activity increases significantly over current levels.	DMME is currently reevaluating its bond requirements, but notes legislation may be necessary to increase them. DMME also notes that current market conditions make it unlikely that activity will increase significantly in the near future.
Recommendation 4.2.4.b: If development begins in the Tidewater region, DGO should evaluate whether additional bond requirements should be implemented for that area above and beyond what is required in the southwest region of the state.	DMME issued a guidance document in December 2016 that addresses additional bonding requirements for Tidewater.

DMME specifically requested issues related to bonding and financial security requirements be limited to the Tidewater region.

Current statewide bonding and financial security requirements are found under ([§ 45.1-361.31](#).) While some discretion is provided to the Board or Director in setting the amount, there is also statutory maximum bond of \$100,000.

It was recognized that drilling in the Tidewater region could pose risks to water resources for a large portion of the state population. DMME after the STRONGER review, through discussions with a Gas and Oil Regulatory Advisory Panel Meeting implemented, Bonding and Additional Financial Security Requirements Applicable to Wells Drilled in Tidewater Virginia. The [Guidance Memorandum](#) was issued under the authority of [§ 45.1-361.27 E-5](#) which reads:

“The Director shall also have the authority to prescribe the nature of and form for the presentation of any information and documentation required by any provision of this article or regulation adopted thereunder.”

This guidance significantly increased the surety and insurance requirements for drilling in Tidewater Virginia. These changes are summarized below:

- A. Effective immediately, blanket bonds will not be accepted with any permit applications for any well drilled in Tidewater Virginia. Surety acceptable to the Director pursuant to [§ 45.1-361.31\(A\)](#) shall be in the amount of \$20 per foot, including vertical and horizontal lengths, of each well.
- B. In addition to the bonding requirements of [§ 45.1-361.31](#) of the Code, applicants for a permit to drill any gas or oil well in the Coastal Plain shall be required to submit proof of adequate additional financial security as described below.
- C. Permitted operators shall maintain third party liability coverage for sudden, accidental releases stemming from operations at the permitted site.
- D. The operator shall carry a valid policy or policies of insurance issued by an insurance company or companies authorized to do business in the Commonwealth of Virginia. In the event such insurance policy or policies are cancelled, the permit shall be suspended on such date of cancellation and the operator’s right to operate under the permit shall immediately cease until the operator files additional insurance as provided herein.
- E. Commercial General Liability Policy
 - a. This coverage must include premises, operations, blowout or explosion, products,

completed operations, sudden and accidental pollution (with discovery and reporting periods of not less than fifteen (15) days and thirty (30) days respectively), blanket contractual liability, underground resources damage, broad form property damage, independent contractors protective liability and personal injury. This coverage shall be a minimum of five million (\$5,000,000) dollars per occurrence.

- b. Excess or Umbrella Liability
- c. Insurance limits in a minimum of ten million dollars (\$10,000,000). Coverage is to be at least as broad as, applies of and follows form of the primary liability coverage required for commercial general liability, auto liability and employer's liability. Coverage must include an endorsement for sudden or accidental pollution

F. Environmental Pollution Liability Coverage

- a. Operator shall purchase and maintain for the duration of the permit, insurance for environmental pollution liability applicable to bodily injury, property damage, including loss of use of damaged property or of property that has not been physically injured or destroyed; cleanup costs; and defense, including costs and expenses incurred in the investigation, defense or settlement of claims; all in connection with any loss arising from the insured site. Coverage shall be maintained in an amount of at least ten million (\$10,000,000) dollars per loss.

SOGRE Response:

Financial security to adequately ensure that an operator will properly plug and abandon its wells and to provide protection for surface disturbance and pollution issues remains a critical topic for all oil and gas producing states. In 2016, the IOGCC completed a review of State Financial Assurance Requirements.⁴ and found that multiple states have expanded bonding amounts beyond conventional and blanket bonds. Virginia should consider a process that would be based on relative plugging costs and not a strict high level per foot cost. For wells over 6,000', New York requires financial security amounts based on anticipated plugging costs⁵. In addition, many states require only plugging the vertical section of hole above the production interval. Drilling in the Tidewater will require the completion of an EIA as part of the permitting process. While the EIA is a requirement of the DEQ, as part of the MOA between DMME and DEQ the submission of and justification for financial security, in particular plugging costs should be addressed by the applicant as part of their submission. Once a sufficient numbers of wells are drilled in the area a statutory revision should be considered.

Groundwater resources are of concern in the Tidewater area. There are multiple reservoirs underlain in the Tidewater and the Potomac Aquifer supplies water for approximately half of Virginia's population. Ensuring adequate financial assurance through bonding and insurance is critical to protect these resources.

The topic of additional protections including; Commercial General Liability Policy, Excess or Umbrella Liability and Environmental Pollution Liability Coverage are covered in the guidance document. While the enabling statute provides options for the Director to require additional financial security, at this point the

⁴ http://iogcc.ok.gov/Websites/iogcc/images/Financial_Assurances_FINAL_web.pdf

⁵ [https://govt.westlaw.com/nycrr/Document/I4ebe291bcd171dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=\(sc.Default\)&bhcp=1](https://govt.westlaw.com/nycrr/Document/I4ebe291bcd171dda432a117e6e0f345?viewType=FullText&originationContext=documenttoc&transitionType=CategoryPageItem&contextData=(sc.Default)&bhcp=1)

guidance provides recommendations, but these changes are not contained in rule or statute. The State of Ohio in 2018, passed new legislation relating to liability insurance coverage⁶, these changes are applicable to the majority of wells statewide. Virginia is encouraged to review this statute to determine if similar legislation should be introduced. In 2018, the IOGCC completed a review of the “Transfer of Infrastructure and Liabilities Assessment Criteria and Considerations Toolbox for State and Provincial Regulators”⁷ this document looks at how states handle transfers and provides possible avenues in how to limit state liabilities during the transfer process. While this could be considered beyond the scope of what DMME has requested of the SOGRE process it provides strong guidance on limiting unfunded liabilities transferring to the state.

2. **NORM Assessment**

STRONGER Recommendations and DMME Responses relevant to NORM:

<p>Recommendation 7.2.a</p> <p>The Review Team recommends that the DGO verify that there is no need for an oil and gas NORM program. The DGO should collaborate with other State/Federal agencies and industry to develop an initial field monitoring data collection program and scientific study to facilitate the determination of need.</p>	<p>DMME agrees with the recommendation and is currently working to analyze samples from wells statewide to determine if there is a need for a NORM program. DMME anticipates receiving the analysis before the end of 2017. Once sample data is received, DMME will consult with DEQ and Virginia Department of Health as appropriate.</p>
<p>Recommendation 7.2.b</p> <p>The Review Team recommends that the DGO verify the need for an oil and gas NORM program in the Tidewater Region by partnering with DEQ to require a NORM investigation as a core element of the EIA study currently required by regulation.</p>	<p>See recommendation above. DMME does not have the authority to establish the requirements of the EIA. However, DMME will continue to collaborate with DEQ to determine if modification of the EIA is appropriate for the Tidewater Region.</p>
<p>Recommendation 7.2.c</p> <p>The Review Team recommends that the DGO consider utilizing section 7 of the guidelines along with the State NORM program (if implemented) as the basis for developing the elements of an oil and gas NORM Program in the event preliminary investigations warrant future implementation.</p>	<p>As stated above, DMME will review the data generated from the samples to determine if a NORM program is necessary. If so, DMME will review Section 7 of the guidelines and collaborate with DEQ as appropriate.</p>

As noted above by DMME, the legislature does not provide authority to establish the requirements for a NORM survey. As is in many states, Virginia has a multifaceted regulatory program where certain responsibilities are assigned to a specific Department. DMME coordinates with its sister agency; the DEQ and has several MOA's with DEQ.

⁶ <http://codes.ohio.gov/orc/1509.07v2>

⁷ <http://iogcc.ok.gov/Websites/iogcc/images/2018Idaho/International%20-%20Legal%20Tool%20Box%20-%20Final%2007102018.pdf>

As noted as part of the STRONGER Review, DMME recognized the lack of a NORM study in Virginia has created uncertainty regarding if there was an issue in the state. To address the issue of NORM in Virginia a study was undertaken by the DMME's Division of Geology and Mineral Resources. This study was structured in a similar manner to other nearby oil and gas producing states. The study was based primarily on cuttings on file in the Well Cuttings Repository. The study focused on those cuttings samples and covered a variety of formation located across the state including the Tidewater Region.

The analysis were conducted by two professional labs and the tested samples all had very low NORM levels. While the testing prepared by the Geological Survey appears complete, it would be useful to have the wells and zones tested better characterized with a regional stratigraphic table developed showing formations analyzed for easy correlation for future drilling

This testing protocol was similar to those conducted in Pennsylvania, West Virginia and New York.

SOGRE Response:

At this time unless new formations are drilled for potential production zones this study should be sufficient to rule out the need for NORM regulations excepting the issue of TENORM.

This study specifically did not address TENORM levels that may be found associated with oil and gas production and processing. The issue of scaling and filter cake concentration is an area that DMME should investigate. This testing could be done in association with existing oil and gas facilities and would need to be brought forward should production occur in a new formation or basin area.

D. Summaries/Conclusions

The SOGRE Team identified several issues for the Division's consideration as its rules and procedures continue to evolve to meet the changing environment for oil and gas exploration and production in Virginia.

1. Financial security to insure adequate funds exists to properly plug remains as a concern to most oil and gas producing states. While Virginia explicitly requested that the Tidewater area be reviewed the team recommends that DMME investigates revising its current statewide financial security for plugging and abandonment activities.
2. NORM activities are central to the discussion of national oil and gas issues. Based on work by the Geological Survey it appears that the current productive zones and those targeted as potential zones in the Tidewater area contain levels of radioactivity that are significantly below the Federal trigger levels for action. A follow-up study to the cutting sample study should be conducted to identify potential production processing or waste handling activities TENORM.

Disclaimer:

The SOGRE Team has not performed a legal analysis or interpretation of the Department's Rules or Chapter 22.1 of the Code of Virginia, The Virginia Gas and Oil Act, and nothing contained in this Report should be construed to be a legal analysis or interpretation.

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Appendix 1

Statutory Authority and Implementing Regulations

1. Chapter 22.1 of the Code of Virginia is The Virginia Gas and Oil Act. <https://law.lis.virginia.gov/vacode/title45.1/chapter22.1/>
2. Chapter 150 of the Code of Virginia are the Virginia Gas and Oil Regulations <https://law.lis.virginia.gov/admincode/title4/agency25/chapter150/>
3. Chapter 20 of the Code of Virginia are the Guidelines for Preparation of EIA for Oil or Gas Well Drilling Operations in Tidewater Virginia. <https://law.lis.virginia.gov/vacode/title62.1/chapter20/section62.1-195.1/>
4. IOGCC Summary of State Statutes, http://iogcc.publishpath.com/Websites/iogcc/images/State_Statute_Summaries_2015/2015%20SOS/Virginia%202015.pdf

Appendix 2

References

1. Virginia State Review, State Review of Oil and Natural Gas Environmental Regulations, Inc., STRONGER April, 2004 <http://www.strongerinc.org/wp-content/uploads/2015/04/Virginia-Initial-Review-4-2004.pdf>
2. Virginia, 2016 Follow-Up State Review Report, STRONGER, May, 2017 <https://www.strongerinc.org/wp-content/uploads/2017/05/2016-VA-Follow-Up-Final-Report-with-2017-DMME-response-050117.pdf>
3. Commonwealth of Virginia, SOGRE Assessment Request, Brad Lambert, Deputy Director, VA Department of Mines, Minerals and Energy. May 4, 2017. https://iogcc.publishpath.com/Websites/iogcc/images/Idaho/3%20VArequest_Bengal-2017-05-04.pdf
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5. Virginia Administrative Code; Title 9. Environment; Agency 15. Department of Environmental Quality (DEQ); Chapter 20. Guidelines for the Preparation of Environmental Impact Assessments (EIA) for Oil or Gas Well Drilling Operations in Tidewater Virginia. <https://law.lis.virginia.gov/admincode/title9/agency15/chapter20/>

6. Code of Virginia; Title 62.1. Waters of the State, Ports and Harbors; Chapter 20. Miscellaneous Offenses; 62.1-195.1. Chesapeake Bay; drilling for oil or gas prohibited <https://law.lis.virginia.gov/vacode/title62.1/chapter20/section62.1-195.1/>
7. DMME; Division of Gas and Oil (DGO); Gas and Oil Complaint Investigations: Policy and Procedures; <https://iogcc.publishpath.com/Websites/iogcc/images/Idaho/7%20Complaint%20Investigations.pdf>
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9. Memorandum of Agreement (MOA) between VA DMME and VA DEQ for Air Quality; <https://iogcc.publishpath.com/Websites/iogcc/images/Idaho/9%20MOA%20DEQ%20air%20quality.pdf>
10. MOA between DMME and DEQ for Review of Environmental Impacts from Oil and Gas Development in Tidewater Virginia; [/Websites/iogcc/images/Idaho/10 MOA DEQ Tidewater.pdf](https://iogcc.publishpath.com/Websites/iogcc/images/Idaho/10%20MOA%20DEQ%20Tidewater.pdf)
11. Analysis of Naturally Occurring Radioactive Materials (NORM) in Shale Gas Source Rocks from Virginia, William L. Lassetter, Geology Manager, VA Department of Mines, Minerals and Energy, August, 2017 https://iogcc.publishpath.com/Websites/iogcc/images/Idaho/11%20NORM_REPORT_08252017_REV.pdf
12. Pennsylvania DEP, Technologically Enhanced Naturally Occurring Radioactive Material (TENORM) Study Report; Section 9.0; pages 1-13; 01-15-2015, Revised; https://iogcc.publishpath.com/Websites/iogcc/images/Idaho/12%20Pages-from-PA-DEP-TENORM-Study_Report_Rev_0_01-15-2015.pdf
13. Commonwealth of Virginia, Guidance Memorandum, Rick Cooper, Director, VA Department of Mines, Minerals and Energy, December 28, 2016 https://townhall.virginia.gov/L/GetFile.cfm?File=GuidanceDocs%5C409%5CGDoc_DMME_6129_v2.pdf
14. State Financial Assurance Requirements, IOGCC Legal & Regulatory Committee, 2016, http://iogcc.ok.gov/Websites/iogcc/images/Financial_Assurances_FINAL_web.pdf
15. Official Compilation Of Codes, Rules And Regulations Of The State Of New York, TITLE 6. Department Of Environment Conservation, Chapter V. Resource Management Services, Subchapter B. Mineral Resources, Part 551. Reports And Financial Security, <https://govt.westlaw.com/nycrr/Document/>
16. The State of Ohio in 2018, passed new legislation relating to liability insurance coverage, <http://codes.ohio.gov/orc/1509.07v2>
17. Transfer of Infrastructure and Liabilities Assessment Criteria and Considerations Toolbox for State and Provincial Regulators, IOGCC International and Legal & Regulatory Committees, May 2018 <http://iogcc.ok.gov/Websites/iogcc/images/2018Idaho/International%20-%20Legal%20Tool%20Box%20-%20Final%2007102018.pdf>
18. STUDY/Well Cutting Repository – See reference document #11

Appendix 3

Statutory Authority and Implementing Regulations

§ 45.1-361.31. Bonding and financial security required.

<https://law.lis.virginia.gov/vacode/title45.1/chapter22.1/section45.1-361.31/>

§ 45.1-361.27. (E)(5) Duties, responsibilities and authority of the Director

<https://law.lis.virginia.gov/vacode/title45.1/chapter22.1/section45.1-361.27/>

§ 45.1-361.31(A) Bonding and financial security required.

<https://law.lis.virginia.gov/vacode/title45.1/chapter22.1/section45.1-361.31/>

Appendix 4

Acronyms

SOGRE – State Oil and Gas Regulatory Exchange

IOGCC – Interstate Oil and Gas Compact Commission

GWPC – Ground Water Protection Council

AWAWG - Alabama Water Agencies Working Group

RBDMS – Risk Based Data Management System

DMME – Virginia’s Department of Mines, Minerals and Energy

STRONGER – State Review of Oil and Natural Gas Environmental Regulations

NORM – Natural Occurring Radioactive Materials

DEQ – Department of Environmental Quality

EIA – Environmental Impact Assessments

DGO – Division of Gas and Oil

MOA – Memorandum of Agreement

DEP – Department of Environmental Protection

TENORM – Technologically Enhanced Naturally Occurring Radioactive Material