Date: October 30, 2017
CLIFF: 102292

MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES

BRIEFING NOTE FOR INFORMATION

I PREPARED FOR: Dave Nikolejsin, Deputy Minister of Energy, Mines and Petroleum Resources (EMPR)

II ISSUE: Background information on the Scientific Hydraulic Fracturing Review for the Canadian Association of Petroleum Producers /Deputy Ministers meeting on November 23, 2017.

III BACKGROUND:

EMPR is currently taking steps to advance the commitment in the 2017 election platform calling for a Scientific Panel Review on Hydraulic Fracturing:

> *"Most of BC's natural gas is produced using hydraulic fracturing, a process that has been used in north eastern BC for decades. With the potential of a significant expansion of gas production in the years ahead, we will appoint a scientific panel to review the practice to ensure that gas is produced safely, and that our environment is protected. This will include assessment of impacts on water and, given recent minor earthquakes in the area, what role gas production has in seismic activity."*

IV DISCUSSION:

The purpose of the Scientific Hydraulic Fracturing Review is to review the practice of hydraulic fracturing in British Columbia (BC) to ensure natural gas is produced safely and the environment is protected. The scope of the review will focus on:

- impacts on water quantity and quality, and
- what role hydraulic fracturing has in induced seismicity in Northeast BC

The outcome of the review will be a publically available report summarizing the panel's findings, with advice to Government.s.13
s.13

At this time, the process for the review is under development and once finalized, a public announcement will be made. The review will be conducted by a three-person panel of recognized experts. Experts under consideration for the panel all have scientific/technical background and knowledge in areas relating to environmental management, water, induced seismicity and hydraulic fracturing. Initial contact with some of the panelists under consideration has been made.

It is anticipated that the three-member panel will review background studies and then hold oral hearings with scientific experts and key stakeholders to hear evidence related to hydraulic fracturing in BC, including traditional indigenous knowledge. The proposed key stakeholder groups to be invited to present to the panel are:

(1) Academic/Scientific Researchers
(2) Industry Associations
(3) First Nations Treaty 8
(4) Communities in Northeast BC
(5) Environmental Non-Government Organizations, and
(6) BC Oil and Gas Commission.

The proposed format provides an opportunity for key stakeholders, including industry, to formally present scientific evidence on the practice of hydraulic fracturing. It also allows industry to share their hands-on experience and knowledge of the practice for inclusion in the review.

The review will collect and analyze BC-based evidence which may lead to the identification of gaps or areas requiring further analysis. The findings may lead to a greater public understanding of hydraulic fracturing, increased BC-based evidence and improved practices.

The proposed timeline for the Scientific Hydraulic Fracturing Review is for the panel to convene by January 2018, conduct the majority of the oral hearings during the spring of 2018, and conclude the review with the submission of the final report in the fall of 2018.

V CONCLUSION:

Government looks forward to getting this review underway and engaging with key stakeholders on this important initiative. The review will ensure gas is produced safely and in a manner that protects our environment, and will help build public knowledge and confidence in the practice of hydraulic fracturing.

DRAFTED BY:	**APPROVED BY:**	
Alisa Holtz, PAR	Michelle Schwabe, PAR,	✓
	Richard Grieve, ED, PAR	✓
	Ines Piccinino, ADM, UDD	✓
	Dave Nikolejsin, DM, EMPR	

Warwick, Alexei ENV:EX

From: Duncan, Laurie ENV:EX
Sent: Tuesday, February 13, 2018 9:43 AM
To: Ireland, Shannon L ENV:EX
Subject: Materials for February 14 mtgs
Attachments: 313816 - IN for MGH - CAPP.pdf

Follow Up Flag: Follow up
Due By: Tuesday, February 13, 2018 1:30 PM
Flag Status: Completed

Categories: PRINT

Good Morning Shannon,

Please find attached the IN for MGH (prepared by EMPR), for tomorrow's meeting with CAPP at 4:30pm. Meeting will take place at MO.

Thank you,

Laurie Duncan

a/Sr. Executive Assistant to Bobbi Plecas
Deputy Minister, Climate Change
Ministry of Environment & Climate Change Strategy

Phone: 250-356-8794
Email: Laurie.1.Duncan@gov.bc.ca

Date: February 2, 2018
CLIFF: 103708

MINISTRY OF ENERGY, MINES AND PETROLEUM RESOURCES

BRIEFING NOTE FOR INFORMATION

I PREPARED FOR: Honourable Michelle Mungall, Minister of Energy, Mines and Petroleum Resources; Honourable Bruce Ralston, Minister of Jobs, Trade and Technology; Honourable George Heyman, Minister of Environment and Climate Change Strategy

II ISSUE: Meeting with the Executive Vice-President and Chief Operating Officer of the Canadian Association of Petroleum Producers (CAPP)

III BACKGROUND:

The Canadian Association of Petroleum Producers (CAPP) represents companies that explore for, develop and produce natural gas and crude oil throughout Canada. The member companies of CAPP produce about 80 per cent of Canada's natural gas and crude oil. CAPP's mission is to advocate for and enable economic competitiveness and safe, environmentally and socially responsible performance.

Terry Abel is the Executive Vice-President and Chief Operating Officer for CAPP. He joined the Association in 2014 as the Director of Oil Sands and has over 30 years of experience as an energy regulator in the Province of Alberta. He holds a Bachelor's degree in Chemical Engineering from the University of Alberta and is a registered professional with the Association of Professional Engineers, Geologists and Geophysicists of Alberta.

IV DISCUSSION:

Liquefied Natural Gas (LNG) Competitiveness Review

The Ministry of Energy, Mines and Petroleum Resources conducted a review of BC's LNG fiscal framework and policies to better understand the Province's competitive position. The review began in the summer of 2017 and involved industry and industry associations (including CAPP), First Nations, and the federal government. Recommendations for actions to improve BC's competitiveness were presented at the end of the year and are under active consideration by government.

Carbon Tax Increases

BC is increasing the carbon tax by $5 per tonne per year until it reaches $50/tonne in 2021. BC's carbon tax currently applies to combustion emissions. BC recognizes increasing the carbon tax could affect industrial emitters. BC is committed to working with business and industry to ensure the Province remains a competitive place to invest

while achieving its climate targets. BC is aware of the latest approaches in the Alberta and Federal Government programs and will take this into account.

Canada and Alberta's Approach to Carbon Pricing

Both the federal carbon pricing backstop, and Alberta's carbon pricing system are made up of a carbon levy applied to fossil fuels and an output based pricing system for industrial facilities from emissions-intensive, trade-exposed (EITE) sectors. EITE sectors will be exempt from the levy. Under the systems, industrial emitters set a production-weighted emission intensity 'benchmark' and receive free emissions allowances up to this benchmark. Facilities over the benchmark can meet the obligations through purchasing excess allowance credits from those under the benchmark, buying eligible offset units or contributing to a tech fund at the rate of the carbon levy.

Both systems cover not only combustion emissions, but also Industrial Process emissions, venting, flaring and fugitive emissions. Canada's system will exempt methane venting and methane fugitive emissions from oil and gas facilities (already covered by upcoming methane regulations).

BC is looking into these regimes and analyzing options going forward to address competitiveness concerns.

Climate Benefits of LNG

Displacing higher carbon fuels, like coal and diesel, with BC LNG can lead to significant global lifecycle emission reductions. A recent study by the University of Calgary and M.I.T. estimated that the export of 18 million tonnes of BC LNG to China could lead to global reductions of 25 to 52 million tonnes of greenhouse gases (GHG). The Province recognizes that LNG production is emissions intensive and could have an effect on achieving BC's targets. As a result, the Province has established measures to reduce emissions in the oil and gas sector including the LNG benchmark, the Environmental Incentive Program, the carbon tax and its upcoming methane policy.

Regulatory Process Reviews

CAPP is concerned that industry may soon experience what it refers to as regulatory fatigue given the various policy initiatives currently under review. These include:

- ***Hydraulic Fracturing Scientific Review***
  As noted in our 2017 Election Platform there is the potential for significant expansion of shale gas production in the years ahead. That is why a commitment was made to appoint a scientific panel to review the practice to ensure that gas is produced safely, and that our environment is protected. This will include assessment of impacts on water and what role gas production has in seismic activity. The Province plans to appoint this Panel in the first half of 2018 and the details of the review process will be made public at that time.
- ***Upstream Methane Emissions Regulation***
  The federal government is moving ahead on creating specific regulations on methane emissions from the oil and gas sector. Western provinces can achieve Canadian federal goals using their own approaches.

A team consisting of representatives of the Ministry of Energy, Mines and Petroleum Resources, BC's Oil and Gas Commission, and Climate Action Secretariat is working on the development, enactment, and implementation of applicable standards and/or other regulatory requirements. BC is advancing a methane emissions reduction strategy using a combination of targets, incentives and regulatory tools.
Target: 45 per cent reduction of fugitive and vented emissions from extraction and processing infrastructure built before January 1, 2015.
Incentives: The Clean Infrastructure Royalty Credit Program to stimulate investments in new technology for GHG reductions and a new offset protocol to further encourage innovative projects that reduce methane emissions.
Regulatory Tools: BC will make leak detection and repair mandatory and develop other requirements aligned with Alberta.

The Ministry of Environment and Climate Change Strategy is leading a number of policy initiatives likely to be of interest to CAPP and is best placed to speak to them. These initiatives include:

- Environmental Assessment Revitalization;
- Marine Spills; and,
- Professional Reliance

V CONCLUSION:

The Province supports the continued development of its natural gas industry including opening new markets by working with proponents to advance their LNG projects in line with our four stated conditions, and in doing so looks forward to continuing to collaborate with the Canadian Association of Petroleum Producers.

DRAFTED BY:	**APPROVED BY:**	
Mark Urwin, Senior Economist	Geoff Turner, A/ED, OGD	✓
	Ines Piccinino, A/DM	✓

From:	Heyman, George ENV:EX
To:	Drew, Ashley ENV:EX
Subject:	FOI MOE 2018-82247
Date:	Thursday, April 5, 2018 8:46:04 PM
Attachments:	Heads up - HF panel announcement.msg

From: Frampton, Caelie ENV:EX []
To: Heyman, George ENV:EX [George.Heyman@gov.bc.ca]
Subject: FW: Heads up - HF panel announcement
Date: Wednesday, March 14, 2018 18:00:03
Attachment 1: QA_Hydraulic Fracturing Review_March 8_ADM.docx
Attachment 2: NR-BG_Hydraulic Fracturing Review Panel_updated March 14 - RGGedits ADM clean 425PM.docx

---

FYI Minister. This is going out tomorrow.

From: Crebo, David GCPE:EX
Sent: Wednesday, March 14, 2018 5:41 PM
To: Frampton, Caelie ENV:EX; Xia, Eveline ENV:EX
Cc: Zacharias, Mark ENV:EX; Morel, David P ENV:EX; McGuire, Jennifer ENV:EX; Plecas, Bobbi ENV:EX
Subject: Fwd: Heads up - HF panel announcement

FYI - Frac review announcement

Dave Crebo
Communications Director
Ministry of Environment and Climate Change Strategy.
(250) 812-5747 (cell)

Begin forwarded message:

From: "Beaupre, Darren GCPE:EX" <Darren.Beaupre@gov.bc.ca>
Date: March 14, 2018 at 4:53:59 PM PDT
To: "Crebo, David GCPE:EX" <David.Crebo@gov.bc.ca>, "Cotton, Brian GCPE:EX" <Brian.Cotton@gov.bc.ca>
Cc: "Haslam, David GCPE:EX" <David.Haslam@gov.bc.ca>
Subject: Heads up - HF panel announcement

Very much looks like 10am tomorrow for the attached. Just confirming final NR and confirming time with calendar.

QUESTION AND ANSWERS
Hydraulic Fracturing Scientific Review Panel
February 2018

Ministry of Energy, Mines and Petroleum Resources

Key Messages

- **The growth and diversification of British Columba's natural gas sector creates good jobs and strengthens economic prospects for people across the province. In northeast B.C. specifically, activities linked to exploration and production supports local businesses and creates opportunities for First Nations communities.**

- **With that said, the protection of British Columbia's environment is a priority for our government. We are following through with our election platform commitment of a scientific review of hydraulic fracturing.**

- **The three panel members are recognized academic experts with knowledge in areas relating to environmental management, water, induced seismicity and hydraulic fracturing.**

- **The appointed panel will evaluate scientific evidence, traditional indigenous knowledge and how our regulatory framework addresses risks of induced seismicity and potential impacts to water.**

Questions and Answers

1. What are you announcing today?

The British Columbia government is following through on their election platform commitment and is announcing the appointment of a scientific panel to conduct a review of the process of Hydraulic Fracturing.

2. Why are you putting this panel together?

We are following through on our election platform commitment to appoint a scientific panel to review the practice to ensure that gas is produced safely, and that our environment is protected.

3. How were the panel members chosen?

The Ministry of Energy, Mines and Petroleum Resources created a list of academics and professionals that have knowledge about the subject in Canada and the Minister made the final decision on the panelists. Candidates were contacted directly and invited to participate. Panel members accepted.

4. Who is on the panel?

The Panel consists of three recognized academic experts with knowledge in areas relating to environmental management, water, induced seismicity and hydraulic fracturing.

5. What is the scope of the scientific review?

The scope is limited to the process of hydraulically fracturing a well, and specifically includes: water use (quality, quantity) and disposition, fugitive methane emissions as part of drilling the well, and induced seismicity.

6. Why aren't you looking at things like cumulative effects from oil and gas development?

The objective of the Panel is to review the scientific evidence on the process of hydraulic fracturing. There are other existing venues in which concerns like cumulative effects are being looked at.

7. Why aren't you looking at things like the economic benefits of oil and gas development?

The objective of the Panel is to review the scientific evidence on the process of hydraulic fracturing. The economic benefits of oil and gas development are well known by the Province.

8. Why are greenhouse gas emissions not being evaluated as part of the review?

We are limiting the scope of the review to the process of hydraulic fracturing – basically what 'comes in' and 'goes out' when a well is hydraulically fractured to produce oil and gas, including the water cycle for these operations.

Although greenhouse gas emissions in general are out of scope, the Panel has agreed to look into fugitive methane emissions that might result from the process of drilling a well. The review will NOT cover all GHG emissions, just those related to the operations of drilling a well using the process of hydraulic fracturing.

BC already has tools in place like the carbon tax. This addresses greenhouse gas emissions, and commitments to reduce methane emissions from oil and gas.

9. Why aren't you reviewing hydraulic fracturing chemicals impacts on human health?

Potential water contamination as part of the process of hydraulic fracturing is part of the scope of this review. A chemicals impact on human health is outside the scope of the review.

To address public concerns related to health and safety in the oil and gas sector, a Human Health Risk Assessment of oil and gas activities in northeastern BC was conducted between 2012 and 2015. The results of this study can be found online at https://www2.gov.bc.ca/gov/content/health/keeping-bc-healthy-safe/oil-and-gas-activities

In B.C. it is mandatory that oil and gas producers report hydraulic fracturing fluid ingredients through the publically accessible FracFocus Canada website. http://fracfocus.ca/

10. Are the panel members receiving compensation?

No, they are not. Panel participation is voluntary. Any travel, hotels, meals and related expenses incurred to participate will be reimbursed.

11. What is the timeline of the review?

- Kick off date: March 2018
- Information Gathering Sessions: April - June 2018
- Additional Information Gathering Sessions: September - October 2018 (if needed)
- Wrap-up: December 2018

12. What is the purpose of this review?

The purpose is to review the process of hydraulic fracturing in BC, building on existing research and evidence, analyze how the existing regulatory framework addresses risks, and provide recommendations.

13. Who can participate in the review? Are meetings open to the public? If not – why?

The Panel will first familiarize themselves with all existing evidence on the process of hydraulic fracturing as per the scope. Based on this prelimary analysis, the Panel will decide on the what they would like to hear at the Information Gathering Sessions. At that point, presenters will be selected and invited.

The meetings will be closed door and the findings of the review will be posted to a webpage for public access once the panel's report is completed and government has an opportunity to review.

14. How will presenters to the Information Gathering Sessions be chosen? Will the panel have a say?

The panel will be presented with a list of potential presenters; ultimately the panel will decide who they will hear presentations from.

15. What if my organization/community has relevant information available to provide to the panel but we are not called to present?

The panel will be supported by a Secretariat with senior staff at the Ministry of Energy, Mines and Petroleum Resources. If an organization or community would like to provide feedback on items pertaining to the scope of the review and they are not called to present at an Information Gathering Session, they can provide the information to the Secretariat. Information on how to do so will be provided a bit later into the process to ensure a smooth first round of Information Gathering Sessions.

16.How will First Nations be consulted? Are First Nations participating?

The panel will seek and incorporate indigenous traditional knowledge into the scientific review from Treaty 8 First Nations. The Secretariat to the Panel has hired an experienced technical contractor who will bring expertise and advice to the panel in integration of western science with traditional indigenous knowledge.

17.Where will the Information Gathering Sessions take place?

They are expected to be conducted in Northeast BC and Vancouver in order to hear from local experts and minimize travel costs.

18.What information will the panel use for consideration?

The panel will review recent studies/reports as well as presentations made by invited experts at the Information Gathering Sessions.

19.When will the panel conclude presentations and compile their report?

Presentations are scheduled to conclude in June 2018 with the possibility of additional sessions running until October 2018. Upon completion of the presentations the panel will compile a report detailing their findings and recommendations for the Minister by December 2018.

20.Is Hydraulic Fracturing necessary in British Columbia?

British Columbia is fortunate to have premier natural gas resources. Natural gas is an affordable and reliable resource which can act as a foundation fuel to a lower-carbon energy future – for B.C. and for other areas of the world.

Hydraulic fracturing is a technique used by industry to extract natural gas out of the ground when in 'tight' formations. The natural gas sector creates jobs, supports local businesses and sustains economic activity in our rural communities.

It should also be noted that the BC Oil and Gas Commission has been regulating the natural gas sector for 20 years, including hydraulic fracturing. We have a very solid safety record as a result.

21. What if the panel concludes Hydraulic Fracturing should not be occurring in British Columbia?

There is enough scientific evidence that the practice of hydraulic fracturing, if properly regulated, is safe. In any case, all of the panel's findings will be included in the final report they deliver to government. The findings and advice of the panel will be reviewed by the government.

22. If the panel finds gaps in how hydraulic fracturing is regulated will new legislation be introduced?

The panel will provide their findings and advice on how BC's regulatory framework addresses risks of induced seismicity and potential impacts to water. The findings and advice of the panel will be reviewed by government.

23. Why is hydraulic fracturing not being banned during the review?

There is enough scientific evidence that the practice of hydraulic fracturing, if properly regulated, is safe. British Columbia has modern, stringent safety procedures for natural gas development. When 'bans' were established in other jurisdictions during reviews, those jurisdictions had limited or no regulatory framework in place.

24. Will this review and findings be made public?

Yes, once the review is complete and the government has a chance to evaluate the findings and recommendations.

25. Where can I find the report?

Once the report is final it will be posted to a dedicated webpage where it will remain available to the public.

26. Is industry participating?

The panel will hear from stakeholders and First Nations presenting evidence on the scope of the review. This will include industry technical presentations.

27.Will there be an opportunity for community input?

The panel will hear from experts in municipalities and regional governments presenting evidence on the scope of the review.

28.Will this review hinder B.C.'s opportunity to build a competitive natural gas sector, including a LNG industry?

This review is taking place to ensure gas is produced safely, and that our environment is protected. If anything, this report intends to close any real or perceived gaps in knowledge or regulations.

29. Does this review create uncertainty for the industry at a time when the natural gas market is struggling?

We have engaged with all industry associations prior to announcing the review panel to explain the need and objectives of the review. They understand the objectives of the process.

30. Why were industry informed of details about the scientific review panel of hydraulic fracturing previous to the announcement?

The Ministry of Energy, Mines and Petroleum Resources has let associations know it's working on putting the Hydraulic Fracturing Scientific Review Panel together based on the scope directed by Cabinet and Minister Mungall, and that we expect the Panel will ask the ministry (as Secretariat) for a list of potential technical experts on multiple topics to complement any literature/regulatory review on the approved scope of the scientific review.

The ministry has suggested the associations start building a list of expert individuals so that it can be tabled for Panel consideration once it is in operation. The same information about the Panel was provided to Northeast municipalities and to the Pembina Institute, and work is currently going on to identify individuals from Treaty 8 First Nations who can contribute traditional indigenous knowledge to the Panel process.

The ministry will provide any information the Panel might require in the fulfillment of their duties – this includes available research, overall support and logistics, and lists of potential experts for consideration. We expect the Panel will make its own decisions on whom it will talk to.

NEWS RELEASE

For Immediate Release
[release number]
[Date]

Ministry of Energy, Mines and Petroleum Resources

Hydraulic Fracturing Scientific review panel announced

VICTORIA – The B.C. government is moving forward with an independent scientific review of hydraulic fracturing to make sure it's meeting the highest safety and environmental standards, Energy, Mines and Petroleum Resources Minister Michelle Mungall announced today.

The review will be carried out by a three-member independent panel consisting of a hydrogeologist, a geological engineering professor and a geological engineer/geophysicist.

"Protecting our air, land and water is central to our government's direction of sustainably developing the province's resources and creating jobs for British Columbians," said Minister Mungall.

"We know British Columbians have questions about hydraulic fracturing. It's our job to make sure that natural gas operations continue to meet world class standards and best practices for environmental protection."

The appointment of the panel follows through on the government's commitment to conduct a science-based review of the hydraulic fracturing process. Specifically, the panel will look at the role of hydraulic fracturing as it relates to induced seismicity and its impacts on water quantity and quality. It will also look into fugitive methane emissions that may occur in the process of hydraulic fracturing.

"The scientific panel will look at the process of hydraulic fracturing used to extract BC's natural gas, review our regulations and provide recommendations to minimize risks to the environment said Mungall.

The scientific review panel is responsible for hearing presentations and collecting scientific evidence from organizations and experts as well as traditional indigenous knowledge from First Nations. Information and evidence will be collected from academics, industry associations, northeast B.C. communities, Treaty 8 First Nations and environmental organizations. Ms. Nalaine Morin will provide advice to the panel on traditional indigenous knowledge.

The panel will compile all information obtained and provide findings and advice to the Minister before the end of the year.

A backgrounder follows.

Suntanu Dalal
Media Relations
Ministry of Energy, Mines and Petroleum Resources

250 952-0628

BACKGROUNDER

Hydraulic Fracturing review panel – member biographies

Dr. Diana M. Allen, P. Geo

Dr. Diana Allen (Ph.D. 1996, Carleton University) is a Professor in the Department of Earth Sciences at Simon Fraser University. Her research focuses broadly on water security, spanning the development of risk assessment methodologies to understanding and projecting the potential impacts of climate change on water resources. As a hydrogeologist, Dr. Allen conducts field- and numerical modeling-based research that aims to link hydrological and hydrogeological processes in diverse geological settings. She has conducted research in different regions of British Columbia, including the Gulf Islands, the Fraser Valley, the Okanagan, south-central BC, and Northeast BC, as well as in other countries. Dr. Allen has led several projects in Northeast BC that encompass the assessment of risk to shallow groundwater, the groundwater potential of buried valley aquifers, the migration of saline wastewater during deep disposal, and the sustainability of surface water under scenarios of increased demand and climate change.

Dr. Allen was the 2013 winner of the C.J. Westerman Award by Engineers and Geoscientists BC, and the 2015 winner of the Robert N. Farvolden Award by the Canadian National Chapter of the International Association of Hydrogeologists. Dr. Allen also served as Co-Editor of the Canadian Water Resources Journal for 6 years, and was a member of the Province of BC Ground Water Advisory Board from 2002 to 2010. She is currently the President of the Canadian National Chapter of the International Association of Hydrogeologists, and the Group Chair for Geosciences for the Natural Sciences and Engineering Research Council of Canada (NSERC).

Dr. Erik Eberhardt, P. Eng

Dr. Erik Eberhardt is a Professor of Rock Mechanics and Rock Engineering, and the Director of the Geological Engineering program at the University of British Columbia. His research focuses on the integration and advancement of field geology, innovative monitoring, experimental rock mechanics, and state-of-the-art numerical modelling applied to geological hazard problems encountered in deep mining, unconventional gas, and rock slope engineering projects. His research is driven by a recognition that the tools frequently used in assessing risk are often descriptive and qualitative, and that there is a need to better understand the underlying mechanisms responsible for complex rock mass responses to engineering activities. Erik is a registered professional engineer in British Columbia and consults on international projects in North and South America, Europe and Asia. He has published over 200 technical papers, and was the 2013 recipient of the John A. Franklin Award for outstanding technical contributions to rock mechanics and rock engineering, and 2017 recipient of the Thomas Roy Award for outstanding contributions to the field of Engineering Geology in Canada.

Dr. Amanda Bustin, PhD
Dr. Amanda Bustin is a research associate at the University of British Columbia and the president of Bustin Earth Science Consultants. Amanda holds degrees in geological engineering (BASc 2001) from the University of British Columbia and a PhD (2006) in geophysics from the University of Victoria. She is currently working as a researcher and professional consultant on a variety of unconventional gas projects with the main focus on induced seismicity and reservoir development. Amanda has broad experience in reservoir fluid evaluation including extraction, injection, storage, and disposal.

Amanda's expertise comprises induced and natural seismicity, unconventional reservoir modelling, geophysical analyses and interpretation, geomechanics, petrophysics, field work and laboratory analysis, reservoir completion and production engineering, and hydro-geomechanical modelling. She has worked on a diverse range of projects including plate tectonics and natural seismicity; reservoir assessment; complex reservoir modelling including detailed parametric analyses, comingled production, impact of hydraulic fracturing, multi-lateral well pads, and field-scale simulations; CO2 capture and storage; nitrogen enhanced coalbed methane production; methane clathrate hydrates; and quantification of slip due to fluid injection from hydro-geomechanical modelling. Her current research at the University of British Columbia is focused on monitoring, risk assessment, management, and mitigation of induced seismicity due to fluid injection related to natural resource activities in western Canada. This research involves the integration of field studies, laboratory analysis, and numerical simulations. She has currently deployed a seismic sensor network in western Canada that monitors hydraulic fracturing, fluid disposal, and storage.

Amanda's professional experience over the last 15 years has included working with a variety of small and large petroleum and environmental companies as a technical advisor providing engineering and geophysics oversight and analysis on fluid extraction, storage and disposal projects. She has experience in most major basins in North American and has worked broadly internationally on diverse projects. Amanda has been responsible for or worked as a team member on all phases of reservoir development including drilling, completion, production, economics, and environmental assessment as well as the optimisation of production and disposal.

Advisor to the Panel: Nalaine Morin
Nalaine Morin is nationally recognized for her work in environmental assessment. She has led and managed the environmental reviews of several large resource development projects on behalf of First Nations. Her deep technical background in both mining and environmental assessment processes combined with being of Tahltan descent has enabled her to understand and to identify methods for the connection and support of both First Nation traditional knowledge and western science in a way that bridges cultural understanding on both sides. Nalaine provides services in technical review, regulatory support, negotiations, community consultation and environmental resource management.

In 2006, Nalaine helped establish the Tahltan Heritage Resources Environmental Assessment Team on behalf of the Tahltan Nation. THREAT is an innovative team that incorporates the expertise of the Tahltan people with Western science. As the lead manager of THREAT, Nalaine has supported the Tahltan Nation to navigate the environmental assessment processes of

several large-scale resource projects including mines, run-of-river hydro projects and transmission lines. Nalaine has gained a national reputation for effectively managing complicated resource project issues in a cross cultural setting. Many of the innovative processes she has helped develop have been subsequently adopted for use at the Provincial level.

Nalaine works with First Nations across Canada on projects as varied as mining, pipelines and highway infrastructure. In 2009, Nalaine's expertise was recognized by the Canadian Environmental Assessment Agency when she was selected as a panel member for the review of a major mining project in BC. Nalaine has been asked to speak at several conferences both provincially and nationally. In 2013, she shared a keynote address discussing impact assessment at the International Association of Impact Assessment conference and was a featured speaker at the Prospectors and Developers Association of Canada conference.

Nalaine holds a Bachelor of Applied Science degree from the University of British Columbia and a Mechanical Engineering Technology Diploma from the British Columbia Institute of Technology. Nalaine also holds certification as an Environmental Professional, certified by the Canadian Environmental Certification Approvals Board.

Contact:
Suntanu Dalal
Media Relations
Ministry of Energy, Mines and Petroleum Resources
250 952-0628