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**From:** Ali Mahani <ali.mahani@mahangeo.com>  
**Sent:** 2019, January 15 2:10 PM  
**To:** Oswell, Terry  
**Subject:** Re: CNRL ground motion data

Hi Terry,

My number is (22) [REDACTED] I just talked to Kofi by the way.

Cheers,

Ali

On Tue, Jan 15, 2019 at 8:57 AM Oswell, Terry <[Terry.Oswell@bchydro.com](mailto:Terry.Oswell@bchydro.com)> wrote:

Hi Ali,

Could you tell me what your phone number is? I'll give it to Kofi Addo so that he can talk to you directly.

Thanks very much,

Terry

**From:** Ali Mahani [mailto:[ali.mahani@mahangeo.com](mailto:ali.mahani@mahangeo.com)]  
**Sent:** 2018, December 22 5:58 PM  
**To:** Oswell, Terry  
**Cc:** Stefik, Ron; Johnson, Jeff  
**Subject:** CNRL ground motion data

Hi Terry,

Attached, please find the raw waveforms that CNRL shared with us for the recent seismic events. I will send the McGill waveforms next.

Regards,

Ali

--

Ali Mahani, Ph.D., P.Geol.

Director, Mahan Geophysical Consulting Inc.

([mahangeo.com](http://mahangeo.com))

Project Seismologist, Induced Seismicity Monitoring Project

BCOGC: 300-398 Harbour Road, Victoria BC V9A 3S1

PGC: 9860 W Saanich Road, Sidney BC V8L 4B2

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--

Ali Mahani, Ph.D., P.Geol.

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PGC: 9860 W Saanich Road, Sidney BC V8L 4B2

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**From:** Addo, Kofi  
**Sent:** 2019, February 14 4:19 PM  
**To:** (19), (22)  
**Cc:** (19), (22); Oswell, Terry; Watson, Andrew  
**Subject:** RE: Ground motions from OGC

I assume you are referring to the November 29 FSJ earthquake.  
Per my last e-mail, I did contact Gail and we agreed that the data wasn't in great shape to process without lots of additional effort.

However, I was able to convert it to ASCII and need poles/zeros/gain + other station information to further process the records.

What specifically do you want out of these records?

Kofi

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**From:** (19), (22)  
**Sent:** 2019, February 08 1:20 PM  
**To:** Addo, Kofi  
**Cc:** (19), (22); Oswell, Terry; Watson, Andrew  
**Subject:** RE: Ground motions from OGC

Good afternoon Kofi,

Have you had a chance to process the data from the most recent induced earthquake?

Thanks,

(19),  
(22)

---

(19), (22)  
Owner's Design Representative, GSS Civil Works Contract  
Site C Clean Energy Project

P (19), (22)  
N  
E

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**From:** Addo, Kofi  
**Sent:** 2019, January 16 6:27 PM  
**To:** Watson, Andrew  
**Cc:** Stevenson, Garry; Oswell, Terry (19), (22)  
**Subject:** RE: Ground motions from OGC

Andrew,

I was able to reach the OGC yesterday. Based on the clarification received, I converted the raw waveform data to ASCII. I still have to go back to the OGC for metadata needed for additional processing. I will touch base with Gail before doing so.

Regards,  
Kofi

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**From:** Watson, Andrew  
**Sent:** Wednesday, January 16, 2019 5:14 PM  
**To:** Addo, Kofi  
**Cc:** Stevenson, Garry; Oswell, Terry; (19), (22)  
**Subject:** Ground motions from OGC

Kofi,

The data provided by OGC is also not something gail can work with or at least not without additional work. Can you call her and combine request to OGC? We should get OGC to provide the data in suitable form so we can quickly review the ground motions. Sounds like Gail is also looking to extrapolate to expected bedrock motions but I want to ensure we have the best data and minimize uncertainty. I assume with all the monitoring in place there must be some recordings in rock. Listening to crew they periodically have downhole movements. Others must as well so there must be some nearby recordings in rock.

Can you follow-up with Gail and let me us know if you need assistance getting anything from OGC?

You point on increased monitoring at the site is increasingly important. JF will get back to you on that one.

Thx  
ANdrew

**Andrew Watson, P.Eng., M.Eng.**  
Director, Design Engineering  
Site C Clean Energy Project  
BC Hydro  
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**From:** Stefik, Ron <Ron.Stefik@bcogc.ca>  
**Sent:** 2018, December 21 12:09 PM  
**To:** Oswell, Terry  
**Subject:** RE: Nov 29 Event - Ground Motions

Hi Terry, I have messaged to the geophysicist working on contract with the Commission to respond to you directly.



---

**Ron Stefik** EngL  
Supervisor, Reservoir Engineering  
[Ron.Stefik@bcogc.ca](mailto:Ron.Stefik@bcogc.ca)

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**From:** Oswell, Terry <Terry.Oswell@bchydro.com>  
**Sent:** Friday, December 21, 2018 11:09 AM  
**To:** Stefik, Ron <Ron.Stefik@bcogc.ca>  
**Subject:** RE: Nov 29 Event - Ground Motions

Thanks Ron. I haven't received the information yet – who is Ali sending it to?

---

**From:** Stefik, Ron [<mailto:Ron.Stefik@bcogc.ca>]  
**Sent:** 2018, December 20 4:46 PM  
**To:** Oswell, Terry; Koosmann, Nicole  
**Cc:** Slocomb, Richard  
**Subject:** RE: Nov 29 Event - Ground Motions

Ali Mahani has confirmed that he is preparing to send now.



---

**Ron Stefik** EngL  
Supervisor, Reservoir Engineering  
[Ron.Stefik@bcogc.ca](mailto:Ron.Stefik@bcogc.ca)

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**From:** Oswell, Terry <[Terry.Oswell@bchydro.com](mailto:Terry.Oswell@bchydro.com)>  
**Sent:** Thursday, December 20, 2018 2:25 PM  
**To:** Koosmann, Nicole <[Nicole.Koosmann@BCOGC.ca](mailto:Nicole.Koosmann@BCOGC.ca)>  
**Cc:** Stefik, Ron <[Ron.Stefik@bcogc.ca](mailto:Ron.Stefik@bcogc.ca)>; Slocomb, Richard <[Richard.Slocomb@bcogc.ca](mailto:Richard.Slocomb@bcogc.ca)>  
**Subject:** Re: Nov 29 Event - Ground Motions

Thanks Nicole.

Ron - when do you think we could get the information?

Cheers,  
Terry

Sent from my iPhone

On Dec 20, 2018, at 10:26 AM, Koosmann, Nicole <[Nicole.Koosmann@BCOGC.ca](mailto:Nicole.Koosmann@BCOGC.ca)> wrote:

Hi Ron,  
Can you please follow up on the request noted below from Terry Oswell with BC Hydro?

Thanks,

<image001.png>

**Nicole Koosmann** P.Eng., P.M.P.  
Vice President, Energy Infrastructure & Integrity  
[Nicole.Koosmann@BCOGC.ca](mailto:Nicole.Koosmann@BCOGC.ca)

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<image002.jpg> <image003.jpg>

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**From:** Oswell, Terry <[Terry.Oswell@bchydro.com](mailto:Terry.Oswell@bchydro.com)>  
**Sent:** Thursday, December 20, 2018 11:18 AM  
**To:** Koosmann, Nicole <[Nicole.Koosmann@BCOGC.ca](mailto:Nicole.Koosmann@BCOGC.ca)>  
**Subject:** Nov 29 Event - Ground Motions

Hi Nicole,

We would like to get the records of ground motions that were measured in the vicinity of the Nov 29<sup>th</sup> event in Fort St. John. Who should I talk to in order to get this information?

Thanks,  
Terry

---

**Terry Oswell** | Dam Safety Program Engineer, Dam Safety

**BC Hydro**  
6911 Southpoint Dr, 10th floor  
Burnaby, BC V3N 4X8

P 604 528 2187  
M (22)

E [terry.oswell@bchydro.com](mailto:terry.oswell@bchydro.com)

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**From:** Oswell, Terry  
**Sent:** 2018, December 11 3:52 PM  
**To:** (19), (22) Schubak, Bob; Watson, Andrew  
**Cc:** (19), (22)  
**Subject:** RE: Site C activities & Crew Fracking

(19), (22) and I had our phone call with eight people from the OGC (listed below). The objective of the call was for the OGC to get an update on any mitigation or response that BC Hydro has to Crew Energy starting their fracking activities in January. By response, I took it to mean post-event response.

(19), (22) described how we responded to the event on November 29<sup>th</sup> with evacuating the cofferdam and tunnel work areas, inspection and review of instrumentation. They wanted to know how long it took before work resumed (about 24 hours because the shaking occurred late in the day). He also gave them an update on the upcoming construction activities.

I think the OGC said they have a shake map of the November 29<sup>th</sup> event and that they would share it. The OGC received data from CNRL within an hour of the event occurring.

The OGC has asked operators in the area to provide information on the type and length of faults in their areas. They said that the event on Nov 29<sup>th</sup> was in the graben area which may be conducive to larger events but that the where Crew is working may also have the same type of faulting. Crew is going to start drilling on January 5<sup>th</sup> and in early February.

Some of the questions the OGC asked:

- Have we considered shutting down construction activity because of the work Crew is doing in the area? I think we clarified that they were talking about after they trigger a shake in which case we would follow the response plans and only if it was unsafe to resume work, would we not continue until it was made safe. And that we are not expecting the cofferdams to fail because of a fracking event but that it's prudent to evacuate people until they are inspected.
- How many people are working below the water level? Several hundred
- What would we do if Crew caused a shake? Same response as per the Nov 29<sup>th</sup> event and we would be asking the OGC for the information about the event.
- How was the Nov 29<sup>th</sup> event felt on site? Initial jolt felt strongly and widely followed by several smaller shakes and then a final larger jolt felt widely.
- Is there anything the OGC can do for BC Hydro? We couldn't come up with anything other than provide the data after an event so that we could use it in our analyses. I started to talk about the SMA but then back-tracked because I don't know enough.

I suggested that we have a follow-up meeting in January if they have more questions or if you want any information from the OGC (19), (22) suggested we get a list of questions ahead of time and I concur.

The list of attendees from the OGC was:

- Nicole Nurkowski
- John Nurkowski
- Jordan van Besouw
- Jeff Johnson
- Ron Stefik
- Mark Hayes
- Michelle Gaucher
- Richard Slocomb



Cheers,  
Terry

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**From:** Oswell, Terry  
**Sent:** 2018, December 10 2:45 PM  
**To:** (19), (22)  
**Cc:** Schubak, Bob; Watson, Andrew  
**Subject:** RE: Site C activities & Crew Fracking

Hi (19),  
(22)

Just FYI, Nicole has forwarded the meeting invite along and so far the following OGC people have accepted the meeting request:

- John Nurkowski
- Jordan van Besouw
- Ken Paulson
- Jeff Johnson
- Ron Stefik

Cheers,  
Terry

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**From:** Oswell, Terry  
**Sent:** 2018, December 07 12:18 PM  
**To:** Schubak, Bob; Watson, Andrew (19), (22)  
**Subject:** FW: Site C activities & Crew Fracking

The OGC would like to understand what construction activities will be taking place while Crew is working in the close proximity and what protocols are in place in event of a shake.

I suspect that (19), (22) is the person with that information but is there anyone else who should attend?

---

**From:** Koosmann, Nicole [mailto:Nicole.Koosmann@BCOGC.ca]  
**Sent:** 2018, December 07 12:01 PM  
**To:** Oswell, Terry  
**Subject:** RE: Site C activities & Crew Fracking

Hi Terry,  
Yes, my team would like to understand what activities may be stopped, continued, and what protocols are in place during the fracking.

Thanks,



Nicole Koosmann P.Eng., P.M.P.  
Vice President, Energy Infrastructure & Integrity  
[Nicole.Koosmann@BCOGC.ca](mailto:Nicole.Koosmann@BCOGC.ca)

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**From:** Oswell, Terry <Terry.Oswell@bchydro.com>  
**Sent:** Friday, December 7, 2018 11:59 AM  
**To:** Koosmann, Nicole <Nicole.Koosmann@BCOGC.ca>  
**Subject:** RE: Site C activities & Crew Fracking

Hi Nicole,

Are you looking to understand what our response would be in the event of a fracking-induced shake or for an understanding of what construction activities will be taking place during the period that Crew is working within proximity of the Site C dam? Or both? That will give me an idea of who should attend a meeting.

Thanks,  
Terry

---

**From:** Watson, Andrew  
**Sent:** 2018, December 07 11:46 AM  
**To:** Koosmann, Nicole  
**Cc:** Kahl, Darren; Oswell, Terry  
**Subject:** Re: Site C activities & Crew Fracking

Terry Oswell from our dam safety group is leading this consultation and discussions with crew.

Terry can you follow up with Nicole  
Thx  
Sent from my iPhone

On Dec 7, 2018, at 11:43 AM, Koosmann, Nicole <[Nicole.Koosmann@BCOGC.ca](mailto:Nicole.Koosmann@BCOGC.ca)> wrote:

Hi Andrew, Darren,  
BCOGC would like to set up a meeting to understand the activities BC Hydro is planning to do during/for the crew fracking activity planned for early 2019 located within the proximity of the site C dam. Are you the right people to invite, and what is your availability next week?

Thanks,

<image001.png>

**Nicole Koosmann** P.Eng., P.M.P.  
Vice President, Energy Infrastructure & Integrity  
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<image002.jpg> <image004.jpg>

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**From:** Watson, Andrew  
**Sent:** 2019, January 01 9:10 PM  
**To:** Oswell, Terry  
**Cc:** (19), (22)  
**Subject:** Re: CNRL ground motion data

Thx terry

Can you forward this to those I have cc'ed. I sent the second email already but this one bounced as internet is not very fast at my location.

Andrew

Sent from my iPhone

On Dec 31, 2018, at 1:30 PM, Oswell, Terry <[Terry.Oswell@bchydro.com](mailto:Terry.Oswell@bchydro.com)> wrote:

**From:** Ali Mahani [<mailto:ali.mahani@mahangeo.com>]  
**Sent:** 2018, December 22 5:58 PM  
**To:** Oswell, Terry  
**Cc:** Stefik, Ron; Johnson, Jeff  
**Subject:** CNRL ground motion data

Hi Terry,

Attached, please find the raw waveforms that CNRL shared with us for the recent seismic events. I will send the McGill waveforms next.

Regards,

Ali

--

Ali Mahani, Ph.D., P.Geo.

Director, Mahan Geophysical Consulting Inc.  
([mahangeo.com](http://mahangeo.com))

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<CNRL\_data.zip>