

TECHNICAL WORKSHOP # 3

PROJECT IDENTIFICATION AND TRANSMISSION RESULTS

Summary and Feedback Report

December 17, 2015



INTRODUCTION

This report summarizes what was said at Yukon Development Corporation's (YDC) Next Generation Hydro Workshop called Workshop #3: Project Identification and Transmission Results. Held on November 26 and 27, 2015, this is the third of three engagement workshops scheduled in Phase 1: Project Identification of the Next Generation Hydro Project. Each workshop was designed to provide technical information to representatives from Yukon and First Nation Governments, agencies, and stakeholder groups. Two speaker events were also held (November 26 and 27, 2015) to share the technical information with the public both through a live event and as an on-line video.

This event continues the conversation initiated at the second workshop where two Next Generation Hydro technical papers Midgard's remaining Yukon Next Generation Hydro and Transmission Viability Study technical papers as follows:

- ◆ Jurisdictional Transmission Line Technical Logistics Analysis
- ◆ Transmission Market Benefits Assessment
- ◆ Watson Lake to Faro Transmission Study
- ◆ Scalability Assessment Report
- ◆ Positive and Negative Environmental and Socio-economic Effects
- ◆ Project Cost Per Hydro Development Phase
- ◆ Providing a Context for Next Generation Hydro

The purpose of the workshop #3 was to discuss the information presented, review key technical concepts and provide an opportunity to share concerns, perspectives and questions. Participants in breakout sessions explored the technical topics and report information.

All feedback and input received during the workshop was recorded and compiled as a record of discussion and summarized in this document. This record of discussion will also be used in the draft "what we heard document" called the Next Generation Hydro Discussion Paper. This document, in conjunction with the Next Generation Hydro and Transmission Viability Study will be presented to the Yukon Development Corporation (YDC) Board in the early 2016.

All reports, a video of the speaker events and other materials are available on the website at nextgenerationhydro.ca.

TECHNICAL WORKSHOP OBJECTIVES

The overarching objective of the workshop was to inform audiences of the Directive, the technical process to date, and the timelines. Additional goals included:

- To provide the audiences with balanced, objective information and to assist them with understanding the problem, alternatives, tradeoffs and opportunities regarding Yukon’s future long-term energy needs.
- To show how the Next Generation Hydro solution compares with other non-renewable and renewable portfolio options.
- To introduce and review concepts related to energy literacy.
- To providing an opportunity for discussion and feedback related to the technical information shared.

ATTENDANCE

Workshop Representation:

There were 53 attending the workshop from:

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| • ATELP | • SLR Consulting |
| • ATCO Electric Yukon | • Ta'an Kwäch'än Council |
| • Canadian Parks and Wilderness Society | • Teslin Tlingit Council |
| • Canadian Wildlife Service | • YG - Economic Development |
| • Carcross Tagish First Nation | • YG - Energy Mines & Resources |
| • City of Whitehorse | • YG - Energy Solutions Centre |
| • Ducks Unlimited | • YG - Water Resources Branch |
| • Dawson District Renewable Resource Council | • Yukon Chamber of Mines |
| • Department of Fisheries and Ocean | • Yukon Conservation Society |
| | • Yukon Climate Change Secretariat |
| | • Yukoners' Concerned with Oil |

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| <ul style="list-style-type: none"> • Environment Canada • Experiential Science 11 Students (Day 2 only) • Laberge Renewable Resource Council • Mayo District Renewable Resource Council • Northern Climate Exchange • Selkirk First Nation • Selkirk Renewable Resource Council | <ul style="list-style-type: none"> and Gas Development • Yukon Development Corporation • Yukon Energy Corporation • Yukon Heritage Resources Board • Yukon NDP • Yukon Research Centre |
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Attendance Per Event:

- Day Workshop (approximately 53)
- Day 1 Speaker Event (approximately 25)
- Day 2 Workshop (approximately 60)
- Day 2 Speaker Event (approximately 8)

First Nations Representation

Overall the following was the representatives of First Nation Government at the workshop:

Governments: Ta’an Kwäch’än (2), Selkirk (1), Teslin Tlingit (3), and Carcross Tagish (1).

Renewable Resource Councils: Laberge (1), Selkirk (4), Dawson (1) and Mayo District (1)

WORKSHOP AND EVENING SPEAKER EVENT FORMAT

The workshop was designed to promote participant engagement and opportunities for dialogue and feedback with technical representatives working on Next Generation Hydro. Workshop #3 began with introductory remarks by Minister Cathers. YDC provided an overview of the Next Generation Hydro Phase 1 project elements, timelines, and next steps. A panel presentation allowed some of the key energy partners in the Yukon to explain their role and activities. The workshop sessions focused on the results of the remaining seven technical papers. Breakout sessions ended each day so participants could converse about the presented technical work, key concepts, and their perspectives.

Two evening speaker events were held on November 26th and 27th as an opportunity for broader public engagement. These events were video recorded and are posted on the Next Generation Hydro website. The public was invited to review the work completed by the workshop participants and to ask questions and provide feedback. This report summarizes what was heard at Workshop #3 and will contribute to the final Phase 1 engagement report called Next Generation Hydro Discussion Paper.

WORKSHOP PRESENTATIONS

Day 1

Welcome and Introductions

- ◆ **Gerry Kruse Selkirk First Nation:** Opening Prayer
- ◆ **Minister Brad Cathers:** Welcome and opening remarks
- ◆ **Darielle Talarico, Tipping Point Strategies:** Workshop facilitator.
- ◆ **Presentation #1 – Project Management Update Lisa Badenhorst, Project Director, YDC:** Provided an overview of project to date, next steps and a review of engagement feedback from Workshop #2 and First Nation Energy Forum
- ◆ **Presentation #2 – Yukon’s Energy Partners Panel**
 - **Goran Sreckovic, Manager, Yukon Energy Corporation**
 - **Jay Massie, Manager, ATCO Electric Yukon**

- **Shane Andrea, Director, YG – Energy Branch**
- **Lisa Badenhorst, Next Generation Hydro Project Director, YDC**
- The panelists each briefly described their role in the energy picture and how they are working to meet future needs
- ◆ **Presentation #3 – Putting Next Generation Hydro into Context – Other Solutions to Meet Yukon’s Long Term Energy Future**

Peter Helland, Midgard and Darielle Talarico, Tipping Point Strategies: Provided an overview of the technical paper: Putting Next Generation Hydro in Context

Breakout Group Session 1:

After the presentations, participants were divided into smaller groups and led through a series of questions. The intent of the exercise was to explore the trade-offs of each scenario from the perspective of the following criteria: technical, economic, socio-economic and environmental.

At the end of the breakout group session, each facilitator presented the themes of the conversations and outcomes of the breakout exercise.

Evening Speaker Event Day 1

- ◆ **Darielle Talarico, Tipping Point Strategies - Opening Remarks**
- ◆ **Joanne Fairlie, YDC - Opening Remarks**
- ◆ **Justin Ferbey, YDC - YDC Working to Meet Future Energy Needs**
- ◆ **Peter Helland, Midgard Consulting - Putting Next Generation Hydro Into Context – Other Solutions to Meet Yukon’s Long Term Energy Future**

Day 2

- ◆ **Opening Remarks –Joanne Fairlie, Chair of YDC**
- ◆ **Presentation #4 – Summary of the remaining Next Generation Hydro and Transmission Technical Papers**
- ◆ **Peter Helland, Midgard:** Provided an overview of results of Scalability Assessment Report.

- ◆ **Mike Walsh, Midgard:** Jurisdictional Transmission Line Technical Logistics Analysis Report and Yukon Transmission Market Benefits Assessment
- ◆ **Steve Morrison and Tomasz Wlodarczyk, SLR Consulting:** Positive and Negative Environmental and Socio-economic Effects
- ◆ **Peter Helland, Midgard:** Project Cost per Hydro Phase.

Breakout Group #2: The Benefits and Trade-offs of the Remaining Potential Next Generation Hydro Sites

Participants went to breakout groups to discuss a matrix of the comparable features of each of the remaining potential Next Generation Hydro sites. At the end facilitators, reported back to the broader group on their discussions. They also relayed the content of discussion regarding the tradeoffs and pros and cons of the sites and the Next Generation Hydro project in general.

Evening Speaker Event Day 2

The public was invited to the evening speaker event. The event was recorded and is available on the website nextgenerationhydro.ca.

- ◆ **Justin Ferbey, YDC:** Overview of project to date and next steps.
- ◆ **Peter Helland, Midgard:** Provided an overview of results of Scalability Assessment and Project Cost reports.
- ◆ **Mike Walsh, Midgard:** Jurisdictional Transmission Line Technical Logistics Analysis Report and Yukon Transmission Market Benefits Assessment
- ◆ **Steve Morrison and Tomasz Wlodarczyk, SLR Consulting:** Positive and Negative Environmental and Socio-economic Effects

RESULTS

Comments and input from participants at the workshop and speaker event were documented from the question and answer sessions, and breakout groups (see Appendices). The comments from the workshop breakout groups were analyzed to derive the following themes of participant feedback and concerns.

Day 1 - Putting Next Generation Hydro in Context Discussion

Scenario 1 – Natural Gas

There was little support for this scenario amongst the workshop attendees.

Scenario 2 - Next Generation Hydro Option

During this discussion a number of topics were raised. The following are the key themes that emerged:

First, there was general acknowledgement and concern for the size and related impacts a Next Generation Hydro reservoir would have.

Second, many participants felt a one project solution would have a significant impact for the First Nation affected and those people who live in nearby communities.

Third, there was a concern that the affected First Nation and nearby community might not be able to fully take advantage of the jobs and businesses opportunities associated with the project (it was assumed a larger firm would get the construction job). A related concern went the other way and some thought it wasn't right that only one First Nation would benefit.

Fourth, there was discussion regarding the use of surplus power a Next Generation Hydro facility would produce and whether this was good or bad, depending on how much it would cost, if it could be sold as secondary (fuel switching) power or at times to industrial customers.

Scenario 3 and 4 – Small Renewable Portfolios

During this discussion a number of topics were raised the following are the key themes that emerged:

First, there was general interest in these options, especially the fourth version that included pump storage because these portfolios included a variety of renewables (wind, solar, small hydro storage) with a very limited amount of fossil fuel use.

Second, these options would distribute the footprint created by electrical production to various areas of the Yukon and affect various First Nations and communities. A variety of small hydro projects with smaller reservoirs were assumed to be more beneficial than one Next Generation Hydro and larger reservoir. There could be further advantage to small hydro reservoir projects, if the affected rivers were not salmon bearing. It was noted however that the cumulative foot print impact of the small hydro with storage projects would be slightly greater than one Next Generation Hydro project. This scenario 3 and 4 style, impact was still viewed better as the impact would come as the projects were staged out over time, as they were needed.

Third, a variety of project options, as opposed to one Next Generation Hydro project, were seen depending on the point of view, as being both more risky and less risky. It was acknowledged that scenario 3 and 4 would require finding a number of viable projects, that affect a number of rivers and this would require seven or more assessment (YESAB) and regulatory processes. Some felt, scenario 3 and 4 were less risky as a variety of energy types (wind, solar and hydro) were spread or distributed to different locations making for a more complex and diverse system. A Next Generation Hydro project was seen as a less diverse option and its one transmission line could be at risk of interruptions.

Fourth, a number of participants preferred scenario 3 and 4 as they valued a more community-based approach, which could mean there would be more local economic benefits like ongoing jobs.

Fifth, scenario 4 was generally more favorable to scenario 3 because it includes pump storage. The advantage of pump storage is its ability to provide winter energy when it's needed and second it changes the number of small hydro with storage projects needed in scenario 3 from eleven to six.

Sixth, in general there was discussion about other possible scenario combinations and how they might be able to meet the future need. For instance, what if renewables like biomass/gas, geothermal, hydrokinetic were used. Also, some people asked about small nuclear and its ability to meet the need.

Seventh, there was a desire to see how a life cycle cost analysis might affect the outcomes of the various scenarios and their associated environmental effects.

Day 2 - Next Generation Hydro Technical Discussion

On day 2 Midgard Consulting released another seven technical papers. The questions raised during these presentations are listed in the appendices. A breakout session held after the release of the papers allowed for a discussion on the findings of the papers as presented in a summary matrix. The following are some of the key points that came out of the break out discussions.

Theme – Transmission

During this discussion a number of topics were raised as follow:

First, there were questions regarding importing and exporting power and the potential to do either on a transmission grid to either Alaska (Fairbanks) or British Columbia (Northwest). Transmission line congestion was explained as one limiting factor on the Northwest grid, along with market prices and cost to build the lines. There were questions on the ability to buy power from other jurisdictions and whether green power could be stipulated.

Second, there was a discussion as to the benefits and costs of connection Watson Lake to the Yukon grid.

Third, there was a discussion on the possible benefits and risks of building a connecting transmission line versus building a Next Generation Hydro site. It was pointed out that buying power from another jurisdiction might be difficult and even if it were possible, Yukon would still need to have equivalent back up capacity.

Given Midgard’s analysis and its conclusions, general discussion rested on the fact at this time transmission connection wasn’t economically viable.

Theme – Next Generation Hydro Matrix Cost

A number of topics were discussed in relation to the cost of a Next Generation Hydro project (see Appendix 2).

First, there were questions as to why lifecycle costing wasn’t used.

Second, there was a discussion on the LCOE estimates and whether they included such things as jobs, First Nation benefits and compensation. As well, there were questions regarding the LCOE’s meaning in terms of future electrical rates and rate class especially industrial rates.

Third, there was discussion about GDP and how to include things like the value of intact wilderness and ecological services.

Fourth, a few participants raised questions around broader economic assessment. For instance, what would the impact be on the economy if a Next Generation Hydro project is built. Others wanted to know if a north south transmission line would provide more “broader” economic benefits than a Next Generation Hydro project.

Theme – Next Generation Hydro Matrix Socio-economic

A number of topics were discussed in relation to the socio-economic effects of a Next Generation Hydro project (see appendices).

First, there was discussion regarding the need for First Nation involvement, as announced by the Minister this is seen as a required next step.

Second, there was a discussion about economic benefits of a project like this, especially jobs with regards to building and maintaining a future hydro plant. This discussion linked back to day 1's discussion on the value of having one project in one place or a portfolio of projects in different areas of the Yukon. It also linked to the idea of building out or scaling out projects so as to avoid one big project with a number of construction jobs for a short period of time.

And third, it was noted at this stage recreation and tourism impacts were not assessed in the socio-economic and environment report.

Theme – Next Generation Hydro Matrix Technical

A number of topics were discussed in relation to the technical aspects of a potential Next Generation Hydro project (see appendices). The site matrix was reviewed and the various attributes of the six remaining sites were discussed. Often the conversations went back to the topics discussed in day 1 around scenario 3 and 4. With regards to the technical aspects of the six remaining potential Next Generation Hydro sites here are some common themes.

First, some participants asked about the exclusion of sites on the Yukon River.

Second, a number of participants wanted to know if more can be done to make existing hydro infrastructure more efficient, including the use of a smart grid system and upgrades to transmission lines.

Third, there were some questions about over build or having extra capacity for certain years until demand caught up.

Theme – Next Generation Hydro Matrix Environment

A number of topics were discussed in relation to the environmental aspects of a potential Next Generation Hydro project (see appendices).

First, the main concern included placing a barrier on a river and how this might impact fish migration and spawning, especially for salmon.

Secondarily, there were concerns regarding the size of reservoirs and the types of impacts this would have on affected ecosystems. It was noted that there might be different impacts from reservoirs on canyons versus lakes.

Thirdly, many participants emphasized the need to look closely at climate change and how it should be incorporated into the planning work and analysis.

Speaker Event Comments

Two public speaking events were held one on November 25 and one on November 26. Participants asked a number of questions concerning the technical papers being presented (these have been consolidated into Appendix 1).

SUMMARY

The participants of Workshop #3 and speaker events proved to be very committed and interested in the topic of meeting Yukon's future energy needs. They participated fully, asking questions and providing opinions on the topics presented. Speakers and participants worked to bridge the array of complex topics into meaningful conversations. It was acknowledged that this conversation will continue and more time is required to read and understand the technical papers. As Phase 1 of the Next Generation Hydro project moves to conclusion, it leaves a legacy of knowledge that can be drawn on for these future energy planning conversations, including Yukon Energy's 20 years out Integrated Resource Plan.

Generally, the participants of Workshop #3 and speaker events conversed about the advantages and disadvantages of two different hydro based approaches for meeting Yukon's long-term 20 to 50 year forecasted electrical need. The Next Generation Hydro approach is a one-project renewable solution with a two stages build out (cascading projects being slightly different than the non-cascading projects). An alternative approach discussed, was a multi-staged build out of 6 hydro storage projects and one pump storage project that integrates the use of wind, solar and a small amount of fossil fuel for peaking events. There are advantages and disadvantages to each approach in the categories of environment, socio-economic, and cost. Through the discussions at the workshop, the underlying values of each participant began to find alignment with a corresponding approach or version of an approach.

Other topics were also discussed at the workshop including transmission connections within the Yukon and the market and cost of trade and transmission with neighbouring

jurisdictions. As well, there were questions raised about other forms of energy like nuclear, biomass, geothermal and kinetic hydro and how they might potentially play a role in Yukon's energy future.

Next Steps

A Next Generation Hydro Discussion Paper will be written to consolidate the engagement process associated with the technical work done as part of Phase 1 – Project Identification. In 2016, this report will be available online and a summary of it will be made available as a “what we heard document”. Two more technical papers will be release as well. One summarizing the details of the remaining potential Next Generation Hydro sites and the Next Generation Hydro and Transmission Viability Study which takes all the key elements of the technical papers and consolidates them into a final report.

APPENDIX I: GENERAL QUESTIONS RAISED

Workshop Comments and Questions:

- ◆ Will YDC Board contemplating recommending Scenario 3 and 4 or just NGH?
- ◆ Can we have longer than mid-December 2015 to provide feedback to the reports?
- ◆ Explain again why run of river projects couldn't meet winter need?
- ◆ Why are there so many outages?
- ◆ With wind energy you didn't look at anything beyond batteries, like thermal storage.
- ◆ Where did you get your wind data?
- ◆ Can you store the energy from existing hydro energy that isn't being used without draining rivers?
- ◆ Explain how energy conservation and demand-side management might play a future role in the scenarios?
- ◆ Provide more details on how climate change will impact energy planning and how you're addressing it?
- ◆ How are you going to address carbon policy and pricing with regards to energy planning?
- ◆ Can we see the recommendations made by YDC?
- ◆ How does NGH affect potential future IPP projects?

- ◆ How might new technologies impact future energy planning?
- ◆ Provide an assessment of how other renewables [biomass, biogas (wood or garbage), geothermal and kinetic] and Nuclear might meet the long-term need or be part of renewable energy portfolios.
- ◆ Who and how will Yukon finance a potential Next Generation Hydro, transmission line or renewable portfolio option when they cost so much?
- ◆ How does the LCOE costs translate into rates or the rate structure?
- ◆ What is the fit between YEC Integrated Resource Plan and the Next Generation Hydro process? Won't each process affect the other?
- ◆ How will you learn from past hydro projects to ensure future projects are successful?
- ◆ Why was life cycle costing not included in the analysis of the scenarios from the Technical Paper - Putting Next Generation Hydro in Context?
- ◆ What is the plan for communities off grid?
- ◆ Who can we trust moving forward with planning and decisions?
- ◆ Is Yukon's potential to export power limited to the line size and congestion or Yukon's ability to develop hydro capacity?
- ◆ Could there be a referendum so Yukoners can make the future energy option choice?
- ◆ Why wasn't the Skagway transmission line assessed?
- ◆ What are the economic advantages of building a transmission line to another jurisdiction versus building a Next Generation Hydro facility? Can they be compared using LCOE?

- ◆ There are advantages to having an islanded grid and it shouldn't be assumed it is better to have a transmission line to another jurisdiction.
- ◆ What would the benefits and costs of connecting Watson Lake with transmission?

Speaking Event Comments and Questions:

- ◆ What are the population forecasts and related mineral development assumptions?
- ◆ Explain why run of river didn't make it into the scenario 3 mix?
- ◆ Where would the hydro projects in scenario 3 projects be located?
- ◆ Pump storage is very special, is it realistic to expect to find a pump storage site?
- ◆ What are YDC and YEC's roles in this process?
- ◆ How did you choose which types of energy types to study?
- ◆ Can we see lifecycle costing?
- ◆ Can you balance out wind and solar with thermal mass storage?
- ◆ How will NGH and YEC's 20 Year Integrated Resource Plan affect each other?
- ◆ What factors did you use to do the scalability?
- ◆ If a transmission line were built to BC could you plug into it at any point?
- ◆ What and who would get the benefits from Next Generation Hydro?
- ◆ When will you do a Traditional Knowledge study?

APPENDIX 2: BREAK OUT GROUPS

Session 1: Putting Next Generation Hydro in Context

Groups of 7-12 participants were asked to engage in a discussion of the Technical Paper – Putting Next Generation Hydro in Context that explored 4 scenarios for meeting future needs (fossil fuels, hydro storage, a portfolio of small hydro and other renewables, a portfolio of small hydro, pump storage and other renewables). The following are the summary of key points made in the groups.

- ◆ Scenario 3 and 4 seen as more flexible, adaptable to climate change, community driven, potential IPPs and they leave room for future innovation
- ◆ Scenario 3 and 4 involve a lot more assessment and regulatory processes
- ◆ Scenario 3 and 4 risk of finding rivers for small hydro with storage options
- ◆ Scenario 2 is the most cost effective renewable project and least foot print
- ◆ Scenario 2 provides capacity options post 2065
- ◆ Scenario 2 involves over building for need after build and after second stage out
- ◆ More technology options need to be considered: nuclear, biomass, biogas (garbage or wood), kinetic hydro and geothermal
- ◆ Can there be a 2 pump storage options? And can there be one on the Yukon River?
- ◆ Environmental effects for all scenarios (foot print and greenhouse gases) are too simple and need a discussion about the impacts to fish but salmon in particular
- ◆ How big is the reservoir for the pump storage project in the scenario 4?
- ◆ Can scenario 4 be without natural gas?
- ◆ Lifecycle costs should be factored into analysis may affect results
- ◆ Need more explanation of the load forecast being used for 2035 – 2050
- ◆ Fossil fuel use is not favored and will be affected by future carbon policy
- ◆ What can be done to make the existing hydro infrastructure more efficient?
- ◆ How might a smart grid system fit?
- ◆ Why can't wind meet future need?
- ◆ Will transmission lines need to be upgraded?

- ◆ Intermittent sources not as reliable as hydro
- ◆ Economic spinoffs assessment missing (road improvements, economy)
- ◆ Industrial role and responsibility needs clarity
- ◆ How do scenarios affect and maintain affordable rates
- ◆ Would smaller or certain projects allow Yukon businesses to benefit more (jobs, type of jobs, First Nation benefits, additional improvements and scaled out expansions)
- ◆ GDP discussion on value of intact natural environmental systems
- ◆ What options are more fundable by investors?
- ◆ How do we monetize ecological services?
- ◆ Various questions about the LCOE calculations (operation cost, compensation, labour)

Session 2 – Next Generation Hydro Matrix

Comments related to NGH only. There were many topics raised in the day 2 breakout session that were similar to the ones mentioned above so they are not repeated here:

- ◆ Granite is the most cost effective of the short list sites but cost alone should not be a determining factor
- ◆ Two Mile Canyon might have the least environmental impacts
- ◆ Need more information on the effects of hydro on salmon and how it will affect users both in Yukon and Alaska
- ◆ How has climate change been factored into planning?
- ◆ Discussion of impacts to fish migrating past or through turbines and role of hatcheries
- ◆ Discussion on flooding impacts as they related to different types of habitats (canyons versus riparian areas)
- ◆ More discussion is needed on the impacts and mitigation of hydro reservoir impacts like stripping a reservoir
- ◆ There is an over build for a certain period of time as the project stages out
- ◆ Transmission lines advantages and disadvantages were discussed including costs, length, line loss and purpose

- Many different questions about the LCOE calculations (jobs, compensation, maintenance, etc.) and more interest in topics like capital cost per job created and different ways of looking at GDP

