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5.1 GENERAL HISTORY OF EXPANSION PROJECT CONCEPT

The Expansion Project has evolved from a concept to provide sustainable hydro power to some of the main industrial customers of the NWT, all of whom are currently supplying their electrical power from large diesel generation stations. Past consideration has been given to developing sites on the Snare River and La Martre River to supply the Ekati Mine with hydro power. More recently, initial studies in the Taltson Basin examined the potential to use the existing surplus power from Twin Gorges in combination with a small additional plant at the site to supply the proposed Snap Lake Mine. In late 2003, the concept of supplying all of the existing and proposed diamond mines within viable reach of the generation facility (Ekati, Diavik, Snap Lake, and Gahcho Kué) emerged as a feasible alternative.

As a result of positive feedback from preliminary discussions with each of the diamond mine owners, the proposed Snap Lake Power Supply study areas of 2003 were expanded to consider the much larger Project. Field studies were undertaken in 2004 to develop concepts, prepare preliminary economic evaluations for the larger hydro generation plant, and establish baseline environmental conditions. These evaluations led to a conclusion in late 2004 that the Taltson Hydroelectric Expansion Project concept was not economically feasible for the delivery of electrical power to the mines, based on mine site diesel prices of approximately $25/barrel. While some aspects of environmental studies and consultation programs continued through 2005, further Project evaluation and planning activities were deferred.

Since 2005, the price of diesel has risen significantly, and the year-to-year certainty of the annual winter road access to replenish the mines with supplies, including diesel, has diminished. Consequently, potential diamond mine customers have expressed renewed interest in the Expansion Project. In 2006/07, all phases of Project development work were progressed, including consultation, environmental assessment, and financial modelling, as well as engineering design, construction methodologies, and line routing options.

The Expansion Project formally entered the regulatory phase with the submission of the Project Description, filed in May 2007.

5.2 PROJECT PURPOSE

The Project purpose is to develop a low-impact commercial venture that builds on a private sector opportunity to generate and sell clean and renewable electrical energy to industrial customers in the North. The Project has the potential to benefit many stakeholders, including the diamond industry in the North, Aboriginal businesses and individuals, and the general populous of the NWT, while requiring a very limited incremental environmental footprint.

The Project would displace regular use of large-scale diesel generation at three operating and one proposed diamond mines in the NWT. The three operating mines are the Ekati Mine, owned principally by BHP Billiton; Diavik Mine, owned principally by Rio Tinto; and the Snap Lake Mine, owned by De Beers Canada. De

Beers Canada also owns the proposed Gahcho Kué Mine in partnership with Mountain Province Diamonds Inc.

The operating mines are major consumers of electrical power for their operations, which continue on a 24-hour, 7-day-a-week basis. The Expansion Project goal is to supply the portion of total electrical demand at each mine for which heat recovery is not necessary. As heat exchange is a key requirement in the winter, some diesel generation for both heat recovery and for emergency backup would continue at each of the mines. As the possibility of an electrical outage would exist even from the new system, the existing diesel generation facilities at each mine would remain a key component of the overall power system, but would be operated at a greatly reduced duration each year.

The energy sale opportunity for diesel displacement at the mines exists only as long as the marginal cost of diesel generation, which includes a risk premium, is at some level above that for which the Project can reliably deliver hydroelectric energy. Dezé is confident that present market conditions would allow the partnership to deliver reliable hydroelectric power at a cost competitive with the marginal cost of production at the mines, and with a highly stable cost structure over time. The value of this opportunity is highly dependent on the mine life forecasts, which must be reflected in Power Purchase Agreements (PPA) and provide adequate duration in order to project finance the large capital expenditure required for construction. The terms of the PPAs, including the quantity and reliability of the power and the credit worthiness of the parties, would ultimately determine the price of power required to service capital expenditures of the Project, and these terms have yet to be negotiated.

The Project is a major undertaking with capital costs commensurate with projects in northern Canada. In turn, the Project has the potential to bring substantial social, economic, and environmental benefits to the Project partners, the regional inhabitants and particularly the South Slave residents, and the NWT. The specific rationale for developing the Project is presented in following sections.

5.3 PROJECT RATIONALE

5.3.1 Environmental Benefits, Energy Planning, and Sustainability

5.3.1.1 MAJOR REDUCTION IN DIESEL CONSUMPTION AND GREENHOUSE GAS EMISSIONS

The Project would allow displacement of up to 56 MW of existing and/or planned diesel generation by zero-emission and renewable hydropower generation. At anticipated generation reliability rates, the Project would supply 390 GWh of energy per year to the mines. This clean energy supply would replace annual consumption of approximately 101 million litres of diesel, which corresponds to approximately 2,025 Super B Train loads each winter on northern roads. This level of diesel displacement equates to a reduction in greenhouse gas emissions of 280 kilotonnes of CO_2 annually.

The reduction in greenhouse gas emissions from diesel displacement at the mine sites would far exceed the stated near-term objectives of the GNWT. In 2007 the GNWT Greenhouse Gas Strategy targeted a 10% reduction of 2001 GHG levels by 2011 – for GNWT energy use only. Subsequent to construction, the Expansion Project would

reduce total annual NWT GHG emissions on average by 16%, a significantly greater achievement. This total does not include additional long-term reduction in emissions from mine fuel transport. In fact, the Taltson Hydroelectric Expansion Project stands to provide greater GHG emission reductions than all other currently-planned GNWT efforts combined.

5.3.1.2 SUPPORT OF THE NWT ENERGY STRATEGY

As a result of NWT greenhouse gas emission forecasts developed in 1998, the GNWT created a series of energy policies with multi-spectrum directions, targets and actions. The most recent policies, "Energy for the Future, Energy Planning for the Northwest Territories" (GNWT 2007), and its predecessor the "NWT Energy Strategy" (GNWT 2003), built on previous studies and strategies with similar goals and objectives.

The goals of the Expansion Project support the policies, principles, and strategic actions stated in these documents, including the following specific principles from "Energy for the Future":

- Encourage Aboriginal equity positions in energy development projects and work in partnership with all stakeholders towards sustainable energy solutions for the benefit of all residents.
- Ensure energy development and management decisions support the high quality of the natural environment and biodiversity of ecosystems, recognizing the absolute importance of the long-term protection of these natural systems to economic, social, and cultural well-being of NWT residents.
- Using available fiscal and regulatory tools, promote the use of renewable energy for industrial developments that contribute to a lasting legacy of affordable and sustainable energy for the benefit of all residents.

The latest 2007 GNWT strategy also defines five objectives for achieving the 2007 energy plan goals; the Expansion Project would assist the GNWT in meeting two of these:

1. "Develop NWT petroleum and other energy resources, maximize their benefits to northerners and reduce reliance on diesel fuel."
2. "Create the policy and planning environment to:
    - Reduce energy costs and GHG emissions in the NWT;
    - Promote efficient regulatory processes with respect to energy; and
    - Maximize the benefits to northerners of NWT energy resource development",

As well, the Expansion Project supports the key directions of the NWT Energy Strategy (GNWT 2003), namely:

- make energy services sustainable and affordable;
- develop NWT energy resources; and
- ensure protection of the environment.

The Expansion Project is therefore directly aligned in many aspects with the general development policy framework advocated by recent GNWT energy strategies.

5.3.1.3 LIMITED ENVIRONMENTAL FOOTPRINT

Within the Taltson Basin, the Expansion Project utilizes existing infrastructure associated with the Taltson Twin Gorges Generating Plant, constructed in the 1960s. As a result, the new facilities would have a very small incremental footprint and associated impact. Operationally, the Expansion Project largely uses enhanced water management within existing and new control and generation facilities to develop additional energy from water now spilled.

The facilities required for the Expansion Project would result in greater regulation of Nonacho Lake and minor hydrological changes in the Taltson River watershed between Nonacho Lake and Tsu Lake. These changes would not be significantly different from the Twin Gorges operations in the period of 1964 to 1986, with its use primarily to support the Pine Point Mine operation. The Expansion Project would utilize the existing Twin Gorges Forebay with very limited alterations. No additional flooding would occur in any of the lake systems associated with the Project, with operational water levels remaining very similar to that which have existed historically in the Taltson River. Reduction in flows in Trudel Creek, now used as a spillway, would occur and have been the subject of specific studies.

A new transmission line would connect the Twin Gorges site to the mines along a linear corridor with a cleared width of approximately 30 m through the zone below treeline. In fact, over a significant portion of the southern alignment, the line runs through rocky terrain with limited vegetation and burned areas where only scrub brush has regenerated. In many locations the line would span over ravines and other terrain features that could be left undisturbed. The line would be constructed almost exclusively through winter road access and temporary tracks, with hand clearing in sensitive areas, and helicopter tower setting in the summer/autumn. Access impact would therefore be very low.

The existing transmission corridor to Fort Smith and beyond would continue to be used for the existing customer base, and would not be affected by the Project.

5.3.1.4 INCREASED WINTER ROAD LONGEVITY AND REDUCED IMPACTS

The reduction in fuel hauls over the winter road system associated with the diesel displacement would significantly reduce the risk associated with accidents and spills, reduce truck-related impacts on the terrain, and reduce existing wildlife impacts associated with the truck traffic. In addition, this reduction of truck traffic would be expected to open up availability on the winter road system, which has operated at or near capacity in recent years.

5.3.1.5 REDUCTION IN FLOW AND EROSION DAMAGE ON TRUDEL CREEK

As the Expansion Project would allow greater regulation of the flows entering and leaving the Twin Gorges Forebay, Forebay water levels are expected to be much more stable than is currently the case. This stability would allow much greater control over releases into the Trudel Creek system over the South Valley Spillway. As the very large spills currently occurring have caused erosion in the Trudel system, the enhanced management of these flows would very likely result in much less bank erosion, which could be considered a major improvement to overall water quality conditions in both the lower Trudel and downstream Taltson River systems.

5.3.1.6 OPTIMIZED RESOURCE UTILIZATION

The original development of 18 MW at the Twin Gorges facility was sized specifically for the Pine Point Mine load. There was little data available or consideration of the site potential, as no other load was forecast. Since 1986 and the mine closure, the existing plant has operated at less than 50% capacity, and has used only about 25% of the available annual flows, with 75% of the water spilled into Trudel Creek. Current studies show that the Twin Gorges site could support reliable generation with an installed capacity of over 50 MW, and potentially up to 74 MW, with very limited modifications to the basin facility footprint. The Taltson Hydroelectric Expansion Project in the range of 50–75 MW would therefore represent a much more optimized utilization of the energy resource naturally available at Twin Gorges, largely achieved through enhanced water management. As the incremental impacts would be low, the net benefits from the Expansion Project are far greater than would be expected from the development of a new power source at a site with no historical disturbances.

5.3.1.7 SUSTAINABILITY

Hydroelectric generation facilities generally have extremely long lifetimes, and provide predictable sustainability for periods longer than for which economic conditions and specific operating requirements can usually be forecast. The existing Twin Gorges plant, constructed ostensibly for the relatively short mine life of Pine Point, continues to reliably supply power after 42 years of operation. While costly in terms of initial capital investment, sources of renewable and reliable generation generally prove to become tremendous regional assets. The Taltson Expansion Project would easily outlive all of the mines that are forecast to become initial customers, and with other loads that would arise, would no doubt continue to bring substantial benefits to the South Slave region for many decades to come. Chapter 18 – Sustainability contains further discussion on and evaluation of the Project as a sustainable development.

5.3.2 Social Benefits

5.3.2.1 OWNERSHIP

The ownership structure, comprising the Akaitcho First Nations, Métis Nation, and NTEC 03, provides a unique opportunity for collaboration and cooperation among the Aboriginal nations of the region. The Project has potential to build common interests and working ties among the Aboriginal groups. By undertaking a joint venture between a Crown corporation and Aboriginal Nations, the Project builds trust and may introduce opportunities for similar undertakings in the NWT in the future.

5.3.2.2 SOCIO-ECONOMIC BENEFITS

The Taltson Hydroelectric Expansion Project is a business venture designed to be completely self-supporting and ultimately to bring acceptable economic returns to the Project owners. While initially requiring a large capital expenditure and necessary debt structure, the debt arrangement is designed to be paid down through energy sales to the proposed new customers over relatively conservative (short) assumptions of mine life. As this debt is repaid and cash flows from electricity sales continue to be realized, revenue in the form of profit would flow to the Project owners. If new customers are found to replace those currently identified, longer-term revenues would

also accrue. On the basis of the current financial model, the Project is anticipated to bring very positive socio-economic benefits to the South Slave region.

Over the longer term, this Project offers a viable and stable source of revenue to all of the Project owners. In addition, the employment of tradespersons people during the three-year period of construction would generate opportunities for residents of the North and South Slave areas. The Project would also employ a small complement of skilled staff during operations – providing yet further opportunities for those seeking longer-term employment.

5.3.3 Economic Benefits

5.3.3.1 Life Extension of Existing Twin Gorges Power Station

The existing power generation facility at Twin Gorges is now 42 years old, and the storage structure at Nonacho Lake is 40 years old. Portions of the latter are likely to need replacement in the near future. The Taltson Hydroelectric Expansion Project, in addition to the new facility requirements, would include significant refurbishment of the generation infrastructure at the Twin Gorges power facility, as well as the complete redevelopment and upgrade of the existing structures at Nonacho Lake. These refurbishments would result in enhanced operational efficiency and reliability of the existing and new plants for many years. The inclusion of this life extension work in the Expansion Project represents a direct benefit to the existing customer base served by the current Twin Gorges plant.

5.3.3.2 Existing Mine Life

As noted, both the generation plant and transmission line would have life spans far in excess of the current diamond mine operational lives as estimated by their owners. Reducing operating costs of the mines through lower rates on hydroelectricity may permit extension of these mine lives well beyond the presently forecast life spans.

5.3.3.3 New Customers

The potential for future energy customers to emerge when mine closures occur could be a major economic driver in the development of other industries in proximity to the line route and in the Slave Geological Province. The Project infrastructure would become a large-scale energy corridor for the southern NWT, extending both north to the mines and west to Hay River on the original facilities. Power could also become available to Yellowknife or potentially to southern customers, subject to suitable market conditions for power in those locations in the future.

5.3.3.4 LOCAL AND REGIONAL ECONOMICS

Construction of the Project would generate considerable employment and business opportunities in the NWT, both in the economically depressed South Slave region and in all communities around Great Slave Lake.

Typically, hydro projects are large construction projects but once operational they do not contribute significantly to employment. While long-term employment offered by the Project would be fairly minimal, substantial benefits would continue to be realized through the ownership structure.

5.4 TECHNICAL FEASIBILITY

5.4.1 Infrastructure Design and Operation

The Taltson Hydroelectric Expansion Project comprises quite standard facility design, and builds from a sound existing infrastructure at the Twin Gorges site. The existing dam, spillway, and generating station were designed and constructed to conservative standards and with refurbishment of the existing plant, would continue to provide fully satisfactory service well into the future. The operation of the new and existing facilities can be easily integrated, as they would be sourcing water from the same Forebay. A key consideration would be the extreme climate conditions that can exist at the site, and the remoteness of certain facilities, which must be properly incorporated into facility design for successful year-round operations.

The existing transmission line has been well maintained, and can be integrated into the Expansion Project without significant modification. The new transmission line is of relatively standard voltage and components. While long in extent and requiring special design considerations for electrical stability, it is anticipated that fully reliable line operating conditions can be achieved.

5.4.2 Site Conditions

The civil works associated with the Expansion Project are reasonably large, but quite straightforward, and site conditions are considered very favourable for the proposed design. Excavations required for canals and powerhouse facilities are all surface-based, and expected to be primarily in fresh, competent granitic rock. No adverse conditions in so-far as acid generating rock, adverse run-off issues, or other major environmental risks are anticipated.

The transmission line routing is primarily in rock in the southern sector, and does not present particular technical challenges, other than access for construction and maintenance. In the northern sectors, permafrost is known to exist along the route, and special considerations would be required for tower foundations. Ample precedent exists for construction of reliable tower settings in this environment, and this experience would be drawn upon during construction.

5.4.3 Hydrology

The Project hydrology, being the key feature in the facility design, is considered highly reliable. The availability of long-term production data from the existing plant and WSC flow data for the Taltson River in the vicinity of Twin Gorges provides a sound starting point for all aspects of Project definition involving basin hydrology. These include the development of new water management requirements and the associated impacts, the assessment of the site potential, the optimal sizing of the plant, and the prediction of anticipated average generation characteristics for various sized plants.

Longer-term hydrological trends appear to be improving in terms of estimated annual run-off at the site, though seasonal trends may also be altered by climate change. With the significant storage available in Nonacho Lake, small seasonal variation in runoff would not impact plant operations. While early years of operation of the original plant experienced several multi-year dry periods, nothing like those dry periods has occurred for over 25 years, and this trend is encouraging.

5.4.4 Construction

The logistics of construction the Expansion Project are noted to be challenging, but this in itself is not unusual in larger-scale northern projects. As with other recently completed northern projects, the construction program is highly dependent on the use of winter roads for materials delivery. Continued assessment of feasible access provisions and the development of a set of alternatives would be undertaken as the detailed design and construction scheduling is developed. Recent events on other winter road corridors in the NWT indicated that the construction feasibility and the lifespan of any particular winter road in any particular year is generally not considered amenable to reliable prediction, and would remain a Project risk.

With the assumption that suitable winter road corridors can be achieved for delivery of the required materials, weather would remain the main unpredictable variable that may influence construction feasibility. Realistic schedules would be employed that allow for some disturbance from weather events.

Another significant logistics issue would be the requirement for storage of significant volumes of materials delivered in the winter but not required for use until the following year. Fortunately, the Twin Gorges site where this issue is most prevalent provides for fully adequate laydown areas for storage.

5.4.5 Supply and Demand Balance

The site capacity assessment undertaken within the Project design to date has indicated a good balance with anticipated load demands from the existing customer base and those provided by the mine clients in early discussion. This balance occurs both in terms of peak power demand anticipated, and in annual average energy requirements. The final plant design and size would necessarily take into account the updated energy requirements of the four diamond mines (existing and proposed) as well as hydrological constraints, cost/benefit analysis, and any environmental requirements that may arise through the Regulatory process.

Loads provided from initial discussion in 2006 were published in the 2007 Project Description to support Project sizing at 54 MW total, and are shown in Table 5.1. These figures indicate a reasonable balance between peak demand, including line losses, of about 53 – 58 MW, and the plant output of 54 MW, assuming that all mine peak loads would almost never occur simultaneously. The plant at 54 MW is not able to provide the full requirement for energy delivery to the mines due to line losses.

Table 5.1 — Plant Sizing at 54 MW and 2006 Demand Requirements

Customer	Peak Load at Load Centre (MW)	Capacity Delivery Losses (MW)	Total Load at Twin Gorges (MW)	Annual Energy Requirements (GWh)
Forts Smith, Resolution, Fitzgerald/Hay River	8-13	Included	8-13	65
Ekati Mine	11	0.4	11.4	100
Diavik Mine	9	0.2	9.2	75
Snap Lake Mine	12-14	0.1	12-14.1	100
Gahcho Kué Mine	10	2.42	12.4	80
Line Losses				28
Total Demand	50–57	3.2	53-58	448
Plant Output			**54**	**431**

The anticipated power needs at the individual mines are now subject to confidentiality agreements that were signed with each of the mine customers, but in general, load demand is noted to have increased. This is in part a driver to consider the larger plant size. An aggregated demand expectation is shown in Table 5.2. The current annual energy requirements from the three existing and one proposed diamond mine now ranges between 400 - 450 GWh annually with peak demand in the 60 MW range. Considerable growth potential is expected as mines intensify underground mining operations and increase electricity consumption. Depending on the sequencing of mine production, this rising demand is expected to exceed average production capacity even for the larger plant.

Table 5.2 — Plant Sizing at 74 MW and Updated Demand Forecast

Customer	Current Peak Load (MW)	Current Annual Energy Requirements (GWh)	Forecasted Annual Energy Requirements (GWh)	Estimated Lifetime
Fort Smith, Fort Resolution, Fort Fitzgerald, Hay River	8-13	65	65	Indefinitely
Diavik, Ekati, Snap Lake, Gahcho Kué (proposed)	50-60	400 – 450	450 – 550	10-20 yrs
Line Losses	7	50	> 50	
Total Demand	**65-80**	**515-565**	**565 – 665**	
Plant Output	74	506	Limited by Hydrology	

Note: Mine energy requirements and load profiles are now subject to confidentiality agreements

To cover hydrological variability and both scheduled and unscheduled outage periods of the hydropower and transmission system, all mine customers would require backup diesel generation operationally ready in accordance with at least their minimum operational and heating requirements. Shutdowns in the hydropower supply system would trigger diesel start-up and load transfer through an automatic transfer switch.

As the mines close, generation capacity would become available to new customers or new markets. These could be in the form of new mines, additional draw by the remaining customers, or construction of other transmission facilities to link a new market to the Project. The current financial forecast and business case does not depend on future customers becoming available as the diamond mines close.

5.4.6 Conclusions

There are no technical hurdles that represent fatal flaws for the design, construction and operations of the Taltson Expansion Project. With proper consideration of unique climate conditions and remoteness issues, the design of the Project facilities would follow standard practices for hydroelectric plants. The site conditions are considered favourable and low risk for the proposed development. Construction logistics would present challenges, particularly for site access, but would be developed and implemented by Contractors with experience in the north, where such issues are regularly encountered. The Project hydrology is considered sound and offers plant sizing which accords well with anticipated demand from the existing and new mine customers.

5.5 ECONOMIC FEASIBILITY

The mandate of the development team and the Project owners has been to evaluate the viability of the Taltson Hydroelectric Expansion Project as a transparent business venture with risk/reward structures comparable to other major private infrastructure projects. The economic viability of the Project is therefore being tested with up-to-date and realistic financial models on financial structure terms that reflect the private finance market. The possibility of a territorial government backstop (but no funding) on some aspects of the financial structure remains under review, and no commitment has yet been established on this issue. Ultimately, the economic viability and the need for government backstops would be dependent upon the contract quality of the power purchase agreements negotiated with the diamond mines.

Key to the viability assessment is accurate hard cost estimates for all of the Project components, and a realistic development schedule. These estimates were first completed in 2004 and updated in mid-2006 to account for inflation in commodity prices and labour and to include the most recent Project technical requirements, and have been revisited in 2008. Within the hard costs, reasonably significant contingencies are carried (typically in the range of 15% overall) to account for unknowns, delays, and other design and construction risks. This level of contingency is fairly standard for hydropower projects of this nature. The direct or hard cost estimates are exclusive of certain forms of contract-specific costs, which are generally carried in the financial model.

The current financial assessment results are confidential information. However, the most recent modelling clearly indicates that, with the current set of baseline assumptions and expected rates of return, electrical energy delivery from the Taltson Hydroelectric Expansion Project can be made to all of the mine sites at prices competitive with their anticipated marginal cost of production for diesel generation. As there is little long-term inflationary risk associated with hydropower generation, these delivery prices are also expected to be very stable over time, a factor that is extremely attractive to the mine customers, particularly in light of pronounced market volatility in recent months.

The difficulty with testing the validity of these estimates is looking forward to the conditions actually in place as the Project moves into construction. Hard cost estimates are based on current commodity and supply quotations, which have escalated substantially between 2004 and 2008. However, once capital costs are ascertained, little or no volatility would remain in the price of hydroelectricity going forward. This is in stark contrast to the price uncertainty common to North American petroleum markets, and is one of the main commercial selling points of the Expansion Project. The recent unprecedented volatility in global commodity markets, uncertainty in the construction sector and tighter lending in financial markets makes it very difficult to assess the validity of current capital cost estimates for the Project. As a result, all of the critical assumptions and resulting analysis would have to be re-examined as the Project moves nearer to a construction decision.