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 Pure Fonte Ltée	PURE FONTE LTÉE PIG IRON PRODUCTION PLANT – FEASIBILITY STUDY CUSTOMER N°: 1821
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 	TENOVA TECHINT ENGINEERING & CONSTRUCTION
	FEASIBILITY STUDY SECTION 18 CONCLUSIONS AND RECOMMENDATIONS

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 	TENOVA TECHINT ENGINEERING & CONSTRUCTION
	SECTION 16 – CONCLUSIONS AND RECOMMENDATIONS CHAPTER 18.1 FEASIBILITY STUDY CONCLUSIONS

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18.1 Feasibility Study Conclusions

18.1.1 Technical and Environmental considerations

18.1.1.1 Geotechnical

The geotechnical investigation, performed for this FS, confirmed that the Saguenay plant site fulfills the requirements for a plant of this type. The presence of bedrock close to the ground level minimizes excavation and concrete foundation requirements., in particular for the heavy-load parts of the plant such as the storage dome, the DR tower and the EAF foundations.



Figure 18.1-1.: view of the project site during the month of November 2015



Figure 18.1-2.: Project team discussing geotechnical considerations at the APS offices

18.1.1.2 Metallurgical process

The metallurgical process considered in this study for the transformation of iron ore pellets to nodular pig iron of has no commercially unproven characteristics. The process is based on standard well known iron transformation principles and will not represent unforeseen technology risks, either from an equipment or process perspective.

The purchase of IO pellets shifts the pelletizing operation to a third party upstream the value chain simplifying the PURE FONTE LTEE. production process. The availability of pellets from multiple sources in Canada, as well as foreign countries, means raw material availability is not a project risk.

The ENERIRON[®] direct reduction process is not only a well-established state-of-the-art process for the pre-reduction of iron ore, it is also considered by reputable independent companies the “most elegant” of the available DR processes. PURE FONTE LTEE. has chosen a proven direct reduction technology with commercially successful reference plants in operation today, including in north America.

The melting process equipment, the Electric Arc Furnace, is a commonly used to melt direct reduced iron. There are several plants in operation that melt hot high carbon DRI in an EAF, providing successful commercial references for this portion of the PURE FONTE LTEE. process. Moreover, the combination of a DR reactor hot feeding DRI to an EAF is in operation at the Ternium (NYSE:TX) plant in Monterrey, Mexico. This plant will be the training site for PURE FONTE LTEE. operators. So not only the DR-EAF process is very common, and skilled labor would not be a problem to hire, but also plant operators will be trained in a very similar facility, shortening the learning curve and the time to reach full productivity.



Figure 18.1-3.: Hot DRI charge in the EAF of Ternium and the Energiron Plant of Nucor, Louisiana

The last piece of the process relevant to production of nodular pig iron is the pig casting machine, which is the oldest of the two possible industrial equipment able to produce valuable high purity pig iron. Machines of this type have been in operation for decades in north America and the supplier lined up for this part of the equipment is the most reputable in the market.

Taking into account the above, no metallurgical testing is required to prove the feasibility of the process because of the fact that the same type of pellets considered for this FS have been already tested and used in the same type of DR module and their reducibility has been proven. Furthermore, the type of DRI to be produced has been melted in EAF furnaces commercially and successfully. The process steps proposed by PURE FONTE LTEE. are proven at commercial scale.

18.1.1.3 Environmental considerations

The equipment considered for this FS is the best in class for that type of duty. The environmental impact study has demonstrated that the technology considered for this project is the best available technology and the environmental requirements of Quebec can be met. At the present stage, the environmental impact study – prepared by SNC Lavalin – has been submitted to the authorities in Quebec and is under review. We don't expect major issues in such review.

Moreover, it is important to note that the adoption of the DR technology for the production of pig iron is in line with the guidelines of the Paris agreement on climate change. As also pointed out by the DOE during the recent EIA Energy Conference in Washington DC on July 12, 2016, DRI is less energy and carbon intensive than the alternative routes and by using natural gas instead of coal provides a lower carbon footprint and much less GHG emissions [1]



Figure 18.1-4.: Pano-view of the Saguenay River from Port Saguenay wharf

18.1.1.4 Constructability

This FS has been commissioned by PURE FONTE LTEE. to Tenova so that the design basis, engineering data and drawings developed in this phase would constitute the basis for the future project. To that regard Tenova, in collaboration with Techint Engineering and Construction has designed foundation, building and all the balance of plant structures, piping, wiring, cabling, etc. in compliance with the local applicable standards and norms. Moreover, SNC Lavalin has provided valuable information relevant to the design concepts common to Quebec. The result of this process is a simplified constructability, which not only reduces to the minimum possible the capital expenditure, but also allows a timely execution of the construction phase.

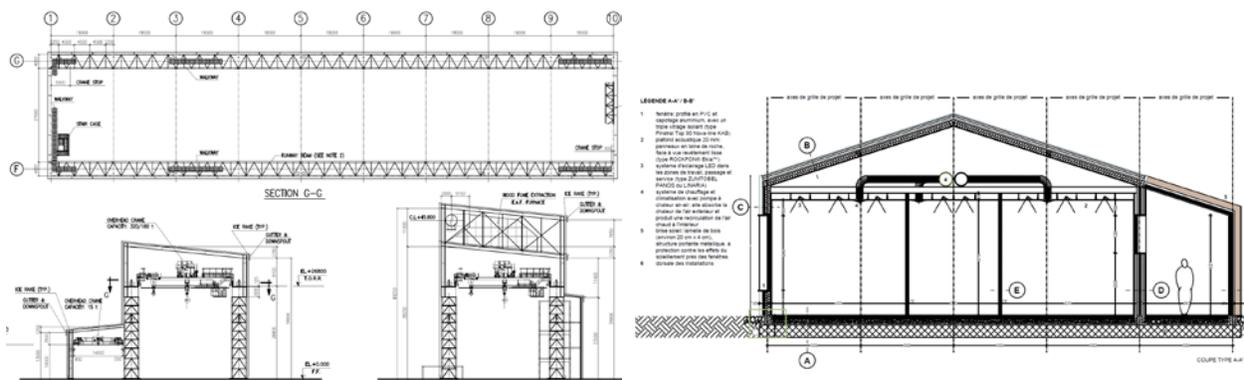


Figure 18.1-5.: design views of the main building and the admin offices as defined in this FS

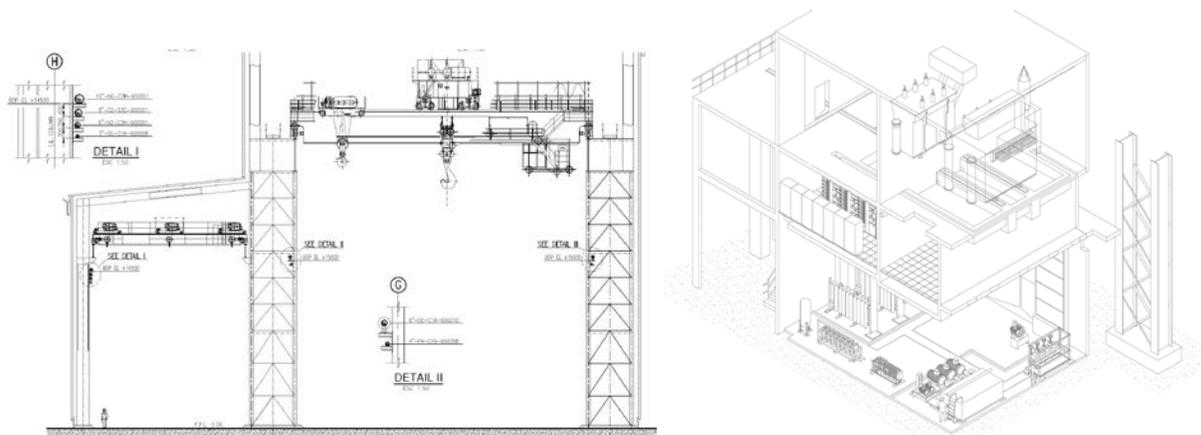


Figure 18.1-6.: Cross section of the main building and 3D view of the EAF transformer room building

18.1.1.5 Logistics and project execution

Considering the above comments on constructability, and logistics of the site location outlined in Section 4 of this FS, the plant as defined does not present hurdles to shipping equipment and construction material or project execution.

The plant site is less than 2.5 km from a port accessible by large ships. The road between the port and the site does present a short part with a 12% inclination, but the freight forwarders and construction companies engaged for the Capex estimate are familiar with the site and have demonstrated ability to accomplish the required activities.



Figure 18.1-7.: Construction of the DRI tower for the Nucor Louisiana project

The climate conditions of the project site require a well-planned project timeline and a timely execution of the civil, concrete and building erection activities, so that during the winter time, equipment erection would be executed inside the buildings. Thanks to the industrial construction history of the region, skilled labor is not a risk factor.



Figure 18.1-8.: Construction of a building designed by Techint E&C for Tenaris (NYSE:TS) in Bay City, TX and domes built in Fermont, Québec for Cliffs Iron Mine.

18.1.1.6 Process Guarantee

One of the distinctive characteristics of this FS is the fact that it has been executed by a joint group of reputable companies with very large experience in process equipment and metal transformation plants (Tenova), industrial plant design (Techint Engineering and Construction) and direct execution experience in the region of Quebec (SNC Lavalin). The involvement of these companies from day one of the project definition has permitted all of them to define with accuracy a process, design and execution plan that is in line with today's technologies and project construction possibilities.

For what concerns the transformation process of IO pellets into high purity pig iron, Tenova has already committed itself in providing to PURE FONTE LTEE., or the EPC contractor for this project – should that be the final project arrangement - a **comprehensive process and productivity guarantee (CPPG)**.

Under the assumption that Tenova would be responsible for the supply of the process equipment and the auxiliary equipment directly affecting process and productivity performance, the CPPG would guarantee the following: provided that the plant will be built in line with the rules and construction standards of Quebec and with the required execution quality, provided that PURE FONTE LTEE. will make available the defined raw materials, the required energy and labor, Tenova guarantees the expected quality of product (high purity pig iron) at the expected rate of productivity (425,000 metric tons per year).

That means that from the entrance of the raw material in the premises of the plant to the shipment of high purity pig iron out of the plant, Tenova takes under its responsibility the process and the equipment productivity inside the plant. That also means that the process risk is shifted from PURE FONTE LTEE., a new-co, to an experienced industrial equipment supplier with a wide track record of successful projects in the field of direct reduction and metal making plants. In addition to that, it has to be underlined that not only Tenova is a reputable OEM supplier, but it is also part of a larger industrial group, Techint, which produces millions of tons of steel per year in plants all over the world, with a history of success from 1945.

The CPPG is a distinctive feature of this FS, that with a different FS executor, other than the above mentioned group of companies, would not be present at this early stage of the project.

18.1.2 Social and Economic considerations

18.1.2.1 Social considerations

Based on the assumptions of the Opex analysis, the average salary of PURE FONTE LTEE. workers and employees will be at the top of the current range of salaries for the same disciplines in the area of Saguenay. By all means this is a very important project characteristic, which will provide PURE FONTE LTEE. access to the best labor skills in the area and will also improve the retention ratio of workers and employees, to secure a future of stability for the company. The area of Saguenay is historically a metallurgical region and PURE FONTE LTEE. will become one of the most attractive places where local workers, technicians and employees will want to work for.

18.1.2.2 Benefits to Quebec

PURE FONTE LTEE. is considering to invest significantly in the local and provincial community. For the Construction Phase it is foreseen a total capital expenditure potential to Quebec of C\$257m. During Construction phase the total construction jobs will be around 400, with total labor cost of capex equaling C\$102m (included in the above figure of C\$257m).

During the Operating Phase, PURE FONTE LTEE. will have an annual total operating costs of C\$141m. Raw material purchases will be 60%, with material sourced out of Quebec mines, Energy costs will be 25%, with electricity and natural gas procured from Quebec companies. Wages & maintenance will be 15% of the annual operation expenditure. The total direct job count is estimated at 110, with a total annual payroll of C\$8.8m

As said, PURE FONTE LTEE. will purchases raw materials from within Quebec (iron ore, lime etc.) adding value to provincial minerals prior to export.

PURE FONTE LTEE. will be the lead company for the development of Port Saguenay: PURE FONTE LTEE. will be the first permanent industrial tenant in the intermodal industrial zone of Port Saguenay. The Port of Saguenay will benefit from having their first lead anchor tenant in attracting other opportunities to the Port. PURE FONTE LTEE. will not be a competitor of any current industry of the region, in fact a complement to that: The MPI project would be a significant customer of current iron ore exporters.

18.1.2.3 Low cost model

In today's challenging times for the mining and metals industry, the projects that have succeeded from an economical point of view have a common characteristic: the low cost model. Projects like the flat steel plant for the automotive market of Severstal in Mississippi, today owned by Steel Dynamics (NYSE: STLD), the rebar plant of Commercial Metals Company (NYSE:CMC) and in particular the DRI plant of Nucor (NYSE:NUE) in Louisiana – all set in the last few years – have in common the adoption of the state-of-the-art technology and a business model that foresees regional raw materials and considers selling the product in the same regional area, to leverage on low cost freight both ways. Conversely, projects like the one of Thyssen Krupp in Alabama, where beyond project cost overruns the business model was considering very large volumes of transoceanic shipments for both raw materials and in part also for products, has been a failure, because during the economy downturn, the reduced margins were not able to repay the large investment.

PURE FONTE LTEE. has adopted a low-volume, niche-market, low-cost business model. Benefits of that are the reduced capex requirement, the secure margins thanks to the high added value products and operational continuity in a fluctuating economy.

Therefore, the low cost model of PURE FONTE LTEE. will guarantee stability to the company.

18.1.2.4 Market and contracts

As just seen in the above paragraph, PURE FONTE LTEE. will enter in a niche market, the high purity pig iron. As seen in this FS, this is a market that is fairly stable with growth potential. High Purity MPI is used in several applications as: Engineering Castings, Heavy Engineering Plant & Equipment, Original Equipment Manufacturers, Petrochemical & Oil Production Sector, Aerospace Applications, Shipping Construction, Transportation, Infrastructure & Railway Stock, Mining, Quarrying & Minerals, Energy Sector & Power Production, Hydro Applications, Pump & Valve Manufacturers, Rolling Mills & Steel Production, Special Engineering Cast Iron Castings, Architectural Castings, Decorative Castings. Some of these sectors (aerospace, transportation, etc) are in rapid growth and others are also potentially expected to grow or start to recover. In this market scenario, the investment of PURE FONTE LTEE., as the sole high purity MPI producer of north America, is strategically correct, geographically accurate and economically sound.

As seen in the FS, PURE FONTE LTEE. will not constitute a threat for any regional peer, nor any north American metal manufacturer, as there are no producers of high purity MPI in the NAFTA area. PURE FONTE LTEE. will instead be a very important partner for the NAFTA specialized foundries, which now have to purchase their raw material from overseas (Brazil, Russia).

18.1.2.5 Financial considerations

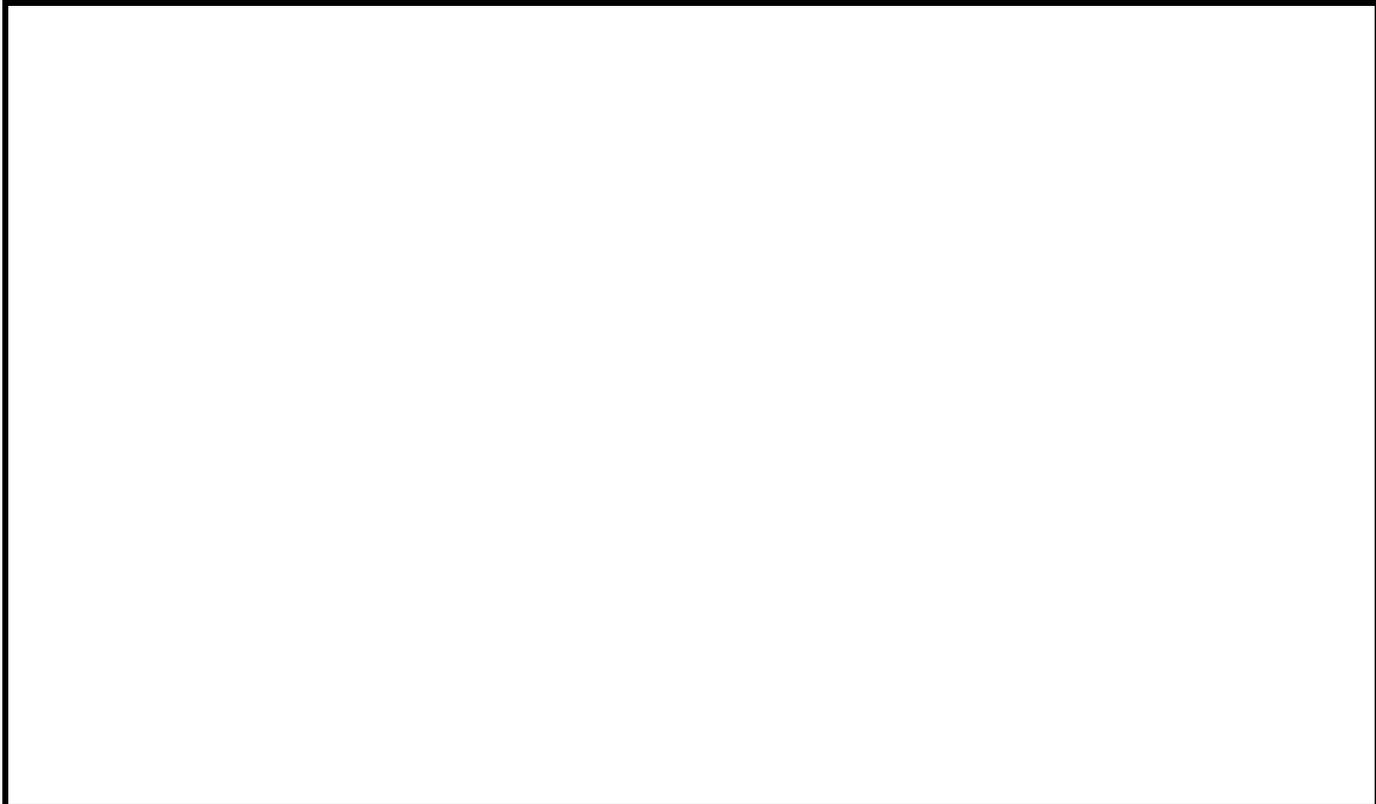
Assuming a hypothetical exit in year 5, the PURE FONTE LTEE. project provides an IRR for the shareholders of over 20% at a 6.0x exit multiple. The expected project IRR can be classified as favourable for an industrial project in a mature and established industry.

Nevertheless, it shall be remarked that the financial analysis has not been done in the best case scenario, as the current mining and metal industry is at its lowest values in decades. With that said a levered IRR based on 20 years of cash low above 17% is a good outcome.

NPV @ 8% post-tax	US\$m	153.2
Unlevered		
IRR (assuming 6.0x EBITDA exit multiple in year 5)	%	13.6%
IRR no exit (based on 20 years of cash flows)	%	13.5%
Payback	yrs	6.4
Levered		
IRR (assuming 6.0x EBITDA exit multiple in year 5)	%	20.5%
IRR no exit (based on 20 years of cash flows)	%	17.5%
Payback	yrs	6.1
EBITDA - average p.a.	US\$m	62.3
Plant operating cost (inc. SG&A, D&A & Int)	US\$/t	301.6

Table 18.1-1.: Results scenario analysis post-tax

It also has to be remarked that the payback of about 6 and half years is also to be considered favorable, given the market circumstances.



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	<p>TENOVA TECHINT ENGINEERING & CONSTRUCTION</p>
	<p>SECTION 18 – CONCLUSIONS AND RECOMMENDATIONS CHAPTER 18.2 RECOMMENDATION</p>

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Chapter references

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18.2 Recommendations

This chapters outlines some key recommendations for PURE FONTE LTEE. to consider moving forward with this project, but do not represent a complete list of risk mitigation factors or a comprehensive set of suggestions to secure a seamless project execution.

18.2.1 Permitting

As discussed in various sections of this FS, PURE FONTE LTEE. has already started the process of environmental assessment as defined by the “*Regulation respecting environmental impact assessment and review*” of the MDDELCC. This Regulation establishes a procedure subjecting certain projects, which affects the environment.



Figure 18.2-1.: Environmental impact assessment and review process in Southern Québec [1]

As of the date of issuance of this FS, PURE FONTE LTEE. is at stage 3 and 4 and meetings with MDDELCC are scheduled for the authorities to analyze the dossier presented by SNC Lavalin, the consultant firm that PURE FONTE LTEE. has retained for the permitting management.

It is important that the process equipment supplier is maintained engaged and timely informed, so that any variations relevant to environmental constrains are immediately communicated and that it will not constitute a delay or re-work in project execution

18.2.2 Procurement and Supply Chain

For this FS, the process equipment and also the auxiliary equipment has been quoted based on firm proposals from equipment suppliers and vendors. That information has been gathered by Tenova and has been quoted on a DAP Port Saguenay basis (Incoterms

2010). Those quotes include supervision for commissioning and spare parts for the commissioning period, so the level of accuracy is quite high for a Class 2 AACE Feasibility Study. What these quotes are not considering at the moment is the currency exchange rate risk. For what concerns the construction cost, the estimate has been considering recent projects in the area and the relevant standard rates for labor, concrete, excavation, etc. based on SNC's extensive experience and data base, but not firm quotation.

While the supply-chain analysis up to this point is deemed to be sufficient for the FS, a continuous monitoring of the cost is recommended, as in fact the fluctuation of the price of steel, copper and other metal, as well as local construction costs and currency exchange can have an impact on the project return.

18.2.3 Project Structure

For a project of this size, in terms of volume and process complexity, it is recommended to reduce to the minimum the number of suppliers directly engaged by PURE FONTE LTEE.. As a matter of fact, being PURE FONTE LTEE. a new-co with no direct experience as a company in greenfield projects, the involvement of experienced firms in project construction and industrial metal plants and equipment supply is material to the success of the project.

It is possible that the typical EPC project structure and the fees associated to that would have a negative impact to the project financials, so to mitigate that risk, it can be possible to consider an EPCM structure where the number of actors is limited to up to two companies: one for the process and auxiliary equipment supply and one for the project construction.

As already out lined in the chapter 18.1, Tenova has already informed PURE FONTE LTEE. of the fact that a Comprehensive Process and Productivity Guarantee (CPPG) would be extended to PURE FONTE LTEE. in case of engagement in the supply of the mentioned equipment. In fact the equipment estimate already considers that case.

Should a construction firm, such as SNC, make the same type of proposal, extending a project completion guarantee (PCG) in case of full construction responsibility, then PURE FONTE LTEE. would have mitigated the process risk and the construction risk.

18.2.4 Detailed Engineering phase

It is not possible to foresee the duration of the permitting phase. Despite all the good efforts from both sides of the table – PURE FONTE LTEE. in providing timely information to authorities and the authorities in prioritizing this project in their calendar – the permitting process requires a set period of time for a thorough analysis, in compliance with the rules set and in respect to the commitment that such authority has with the community where the project has to be implemented.

This FS has outlined that the process defined and the equipment specified is the best in class for such type of industry, so no major issues are expected. To that extent, PURE FONTE LTEE. can then consider to provide some bridge capital to start certain basic engineering activities that are propaedeutic to the definition of detailed information needed for the project execution.

Areas where it would be important to start this bridge engineering activity are: the electrical substation, the process gas heater for direct reduction, the excavation and foundation engineering for buildings and heavy load equipment, other long lead items such as electrical transformers or other electrical components.

18.2.5 Market routes

An interesting characteristic of the project, as outlined in this FS, is that the plant layout will not only permit PURE FONTE LTEE. to double its production capacity in the future, but - if the market conditions will allow and PURE FONTE LTEE. will found merit in pursuing alternative markets - the plant could be transformed from a pig iron production plant into, alternatively:

- HBQ – High quality bar, through the adoption of decarburization equipment, secondary metallurgy equipment (such as ladle furnace and vacuum degassing) and continuous casting machine
- Small structural profiles and merchant bars – also through the adoption of decarburization equipment, secondary metallurgy equipment (such as ladle furnace and vacuum degassing) and continuous casting machine
- Special Ingots – through the adoption of decarburization equipment, secondary metallurgy equipment, vacuum degassers, ingot casting equipment and vacuum ingot re-melting

All three of the above indicated alternatives are in line with PURE FONTE LTEE.'s low cost model, niche market and high margin.

The PURE FONTE LTEE. plant layout has been designed in such a way that a transformation project like that will not hamper the pig iron production for most of the project duration, minimizing the down time required for the change.

So it is recommended to PURE FONTE LTEE. to keep monitoring those potential other niche markets, that will become a complement to the high purity pig iron and may eventually improve the IRR for the overall project.

18.2.6 Product quality and technology improvements

PURE FONTE LTEE. will become the only supplier of high purity pig iron in north America, as discussed in the FS, but PURE FONTE LTEE. has an even bigger potential to that regard, which is to become the supplier of a product that so far is not present in the market, which is high purity granulated pig iron.

As a matter of fact, so far the foundry market, which is the pool where PURE FONTE LTEE. will sell its products, has always been buying high purity MPI in the form of ingots. The reason for that is that high purity MPI is not produced in a different shape and form. At the present, several basic pig iron producers, among which the well-known Indian company Tata Steel, have started to produce and market granulated pig iron. Granulated pig iron has the advantage of being less Opex intensive to produce (due to a lower maintenance cost to the casting operation), it is a better material to store, transport and handle from a logistic stand point and also it is a material that requires less energy to be melted by the end user, either a small foundry or a large steel plant.

Tata steel sells granulated BPI to steel companies and so far the consensus is that the material is very well received and order books for Tata are filling up.

The situation for PURE FONTE LTEE. is slightly different, because the pool of clients for high purity MPI is smaller and these clients are typically resistant to change.

The opportunity is there though to add value to PURE FONTE LTEE. product output and it is recommended to engage clients in the discussion of receiving high purity MPI in this different shape – essentially – to their final benefit. Should that happen, PURE FONTE

LTEE. may have on the market a totally unique type of product that can be sold to an even higher margin, increasing the IRR.

18.2.7 Human Resources

PURE FONTE LTEE. has been so far successful in proceeding at a good pace thorough the phase of pre-feasibility and feasibility study for this project. Part of the reason for that is the lean structure of the company and the straight forward internal organization, which has not hampered the work of all firms engaged in this activity. At this point, though, the next phase of the project would require a larger pool of people from PURE FONTE LTEE. side, because the branches in which this project will be developed are going to me many and a larger engineering team shall be set by PURE FONTE LTEE. to proceed forward. It is thus suggested to consider hiring a few individuals, with project experience in the metal field and possibly also experienced with the area in which the project will be located, so that the next phases of the project will maintain the good speed that the project has so far.

It is also important to start investigating the human resources that may be lined up for the plant once the project will be completed. Finding the right plant manager and his team is a crucial exercise that may take several months to be accomplished successfully. In the next few months, PURE FONTE LTEE. may consider hiring a specialized recruiting firm to proceed with such investigation.

18.2.8 Social

The area of Saguenay is not just well known for its metal routes, mostly in the field of aluminum, but also for its very important secondary education in the field of metals and metallurgy, with university courses, doctorate programs and research centers. This is a very interesting opportunity for PURE FONTE LTEE., to start engaging with them and maintain a partnership relationship that will be of mutual advantage: the university can have a new industrial partner to work with and PURE FONTE LTEE. can utilize the university resources to study new applications for its products, improve the quality of the same and potentially consider the definition of new products.

18.2.9 Market

In paragraph 18.2.3 it has been discussed how to mitigate the process risk and the project construction risk. The third major risk for a project of this type, is the market risk. Based on the FS results, PURE FONTE LTEE. shall be able to engage discussions with high purity MPI traders and end clients to discuss potential off take agreements.

Once the project will start the funding phase, the issue relevant to the project security package will be raised and it would be essential to have a certain proportion of the yearly production already committed to a specific client or trader under an off-take agreement on a take-or-pay basis. Although this may slightly reduce the profit for that volume of product, it mitigates the market risk

18.2.10 Project Economics

The Economic Analysis section of this FS has mentioned that the possible Tenova supply may be accompanied by an export credit financing facility. The Italian export credit agency, SACE, has already been informed, as directed by PURE FONTE LTEE. and it has also expressed its interest in being part of this project. Potentially, up to 85% of the full contract value.

So far, the financial model of PURE FONTE LTEE. is considering loan fees and interest rates that, combined, constitute a higher cost compared to what could be arranged through an export credit financing. Therefore, there is the possibility of improving the IRR of the project by engaging in conversations with SACE at an early stage, because typically the due diligence required by export credit agencies can be quite important and lengthy.

It is also recommended that PURE FONTE LTEE. would hire an accounting firm for auditing the financial model, in particular to review the tax section. So far, the corporate tax considered for the financial model is of 27%, but the likelihood that the all-in tax bracket in which PURE FONTE LTEE. would fall may be lower, considering all possible tax deductions and credits that are available under the fiscal regulations of Quebec. That would also constitute an improvement of the IRR of the project.

18.2.11 Risk map

This high purity pig iron project, as any industrial project, contains inherent risks that must be considered from the perspective of the plant owner, its shareholders and the financing partners. The following chart is a matrix representation of only some of these potential risks and their importance. While risk likelihood and risk complexity (or manageability) are expressed in percentages – very likely to happen = 100%, unlikely at all to happen = 0% – the size of the bubble provides an idea of the risk intensity, or the economic impact that such risk would have on the project in case risk not being mitigated properly.

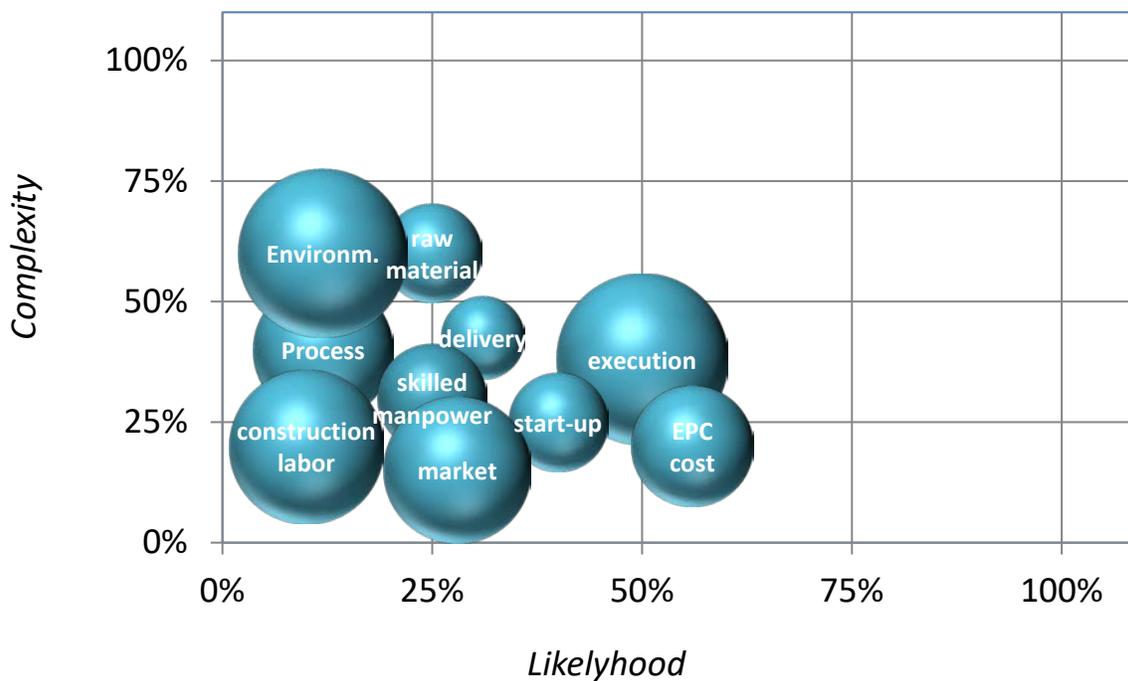


Figure 18.2-2.: Risk Map