Hydromet Development and Commercial Nickel Processing Plant Update

Presentation to
the Newfoundland Branch of the
Canadian Institute of Mining, Metallurgy and Petroleum

by Joe Shirley, Project Director
Voisey’s Bay Nickel Company Limited

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A multi-phased US$155 million R&D program is being conducted to extend the application of hydromet technology to process Voisey’s Bay nickel concentrate.
Hydromet R&D Program

- Integral part of Development Agreement with Province of Newfoundland and Labrador.

- Final results of R&D program will be used as a basis to determine technical and economic viability of using hydromet technology to process nickel concentrate
  - If process is not technically and economically viable, a conventional matte refinery will be built at Long Harbour.
Why Hydromet and Not Smelting?

Hydromet offers the potential to:

- Eliminate problems related to SO$_2$ emissions and workplace environment
- Increase in nickel and cobalt recovery
- Reduced energy demands compared to conventional smelting + refining
Hydromet Technology Development

- Hydromet processing for nickel laterite ores have experienced limited success
  - Three PAL plants built in Australia in the 1990s
  - None had demonstration plants and all had disastrous start-ups

- A commercially-viable process for treating nickel sulphide concentrates has not been demonstrated
R&D Objectives

- Develop and apply key enabling technologies that results in a process that is:
  - Simple
  - Reliable
  - Flexible
  - Economically viable
  - Environmentally acceptable

- Test the flowsheet to validate the process chemistry and (where possible) engineering assumptions

- Establish the engineering design criteria for the next phase of development

- Establish risks and ways to mitigate

- Establish capital and operating costs
Simplified Hydromet Process

Nickel Concentrate

Crushing & Grinding

Pressure Leaching

Solid/Liquid Separation

Effluent Neutralization

Residue to Disposal Pond

Copper Solvent Extraction

Neutralization

Purification Solvent Extraction

Cobalt Solvent Extraction

Cobalt Electrowinning

Nickel Electrowinning

Copper Metal

Nickel Metal

Cobalt Metal
Demonstration Plant Interior
Autoclave
Operating Plan

- Continuous operation, 24 x 7
- Short autoclave shutdowns between campaigns, maintenance, inspection and modifications as required
- Operate until December 2007
- ~150 people - 4 operating crews
- 90% local workforce
- 24 people transferred from ITSL
Demonstration Plant – One Year Later

- Started October 20, 2005
- Zero disabling injuries
- Zero environmental incidents
- 4 campaigns completed
- Concentrate treated: 500 tonnes
  - Nickel extraction on target
- Finished Nickel production: 70 tonnes
- Residue treatment and disposal studies initiated
- Design input being provided for pre-feasibility study
- Process troubleshooting and optimization ongoing
  - Challenges in process and product quality
    - trace metal impurities to be removed
    - physical characteristics of finished product
    - equipment limitations
Commercial Processing Plant at Long Harbour
# Hydromet vs Matte

<table>
<thead>
<tr>
<th>Hydromet</th>
<th>Matte Refining</th>
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<tbody>
<tr>
<td>50,000 tonnes/yr of finished nickel</td>
<td>50,000 tonnes/yr of finished nickel</td>
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<tr>
<td>Feed – Ni Concentrate (20% Ni)</td>
<td>Feed – Ni Matte (55% Ni)</td>
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<td>• 250,000 tonnes/year</td>
<td>• 100,000 tonnes/year</td>
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<td>Process Steps</td>
<td>Process Steps</td>
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<tr>
<td>• Crush and grind</td>
<td>• Grinding</td>
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<tr>
<td>• Chlorine Pre-Leach</td>
<td>• Atmospheric Leach</td>
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<td>• Pressure Leach</td>
<td>• Oxidation Pressure Leach</td>
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<td>• Iron/Gypsum Removal</td>
<td>• Non-oxidation Pressure Leach</td>
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<td>• Copper SX</td>
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<td>• Impurity SX</td>
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<td>• Cobalt SX</td>
<td>• Nickel EW</td>
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<td>• Nickel EW</td>
<td>Residue Management</td>
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<td>Residue Management</td>
<td>• Sub-aqueous</td>
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<td>• Sub-aqueous</td>
<td>• 400,000 tonnes/year</td>
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Commercial Nickel Processing Plant

Project Timeline – 2006-2011

• Schedule driven by concentrate shipments from Labrador
• Construction to be complete when 355,000 tonnes of nickel-in-concentrate has been shipped from Labrador
**Commercial Nickel Processing Plant Development Schedule**

<table>
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<tr>
<th>ACTIVITY</th>
<th>2006</th>
<th>2007</th>
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<td>Environmental Assessment</td>
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<td>Feasibility Studies - Hydromet &amp; Matte</td>
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Environmental Assessment

- Project Registered in March 2006
- Baseline studies program underway
- EIS guidelines issued 30 October 2006
- Open house community briefing sessions being held
- EIS to be submitted in Q1/07
- EA Review completed by Q1/08
Work Plan To Date

2006 – Pre-feasibility Studies – Both Options

- Geotechnical Drilling
- Capacity Design Basis
- Process Flow Diagrams
- Design Briefs
- Conceptual Layouts
- Water Management Study
- Materials Handling Plan
- Construction Plan
- Procurement Plan
- Equipment List
- Logistics Plan
- Labour Studies
- Capital and Operating Estimates
- Maintaining close interface with Demo Plant Team
Commercial Plant Site

Water Supply

Process Plant Site
Commercial Hydromet Processing Plant
(General Layout)
Process Plant Site
Process Plant Layout
Comparative Scale
Demo Plant and Commercial Plant
Commercial Nickel Processing Plant
(Looking East)
Construction Contract Packages

- Earthworks
- Wharf Development
- Bathymetric Survey
- Concrete Supply
- Process Buildings
- Mechanical, Piping, Electrical, Instrumentation and Controls
- Concrete Batch Plant
- Security Services
- Materials Handling
- Fencing
- Tanks
- Concrete Testing Services
- Survey Services
- Geotechnical Services
- NDT Services
- Environmental Services
Business Opportunities
Construction Phase

- Accommodations
- Laundry Services
- Food and Beverage
- Warehousing
- Propane Supply
- Fuel Supply
- Safety Supplies
- Brush Cutting
- Rubber Lining
- Construction Supplies
- Trucking/Transportation
- Logistics Management
- Bussing
- Courier Service
- Janitorial Services
- Waste Management
- Snow Clearing
- Water Supply
- Dust Suppression
- Sand Blasting
- Stevedoring
- Cranes
- Equipment Rental