June 30, 2010
Calgary, Alberta

Climate Change and Emissions Management Corporation Funding grant of $16.5 million awarded to partners Harris Corporation, Laricina Energy Ltd., Nexen Inc. and Suncor Energy Inc. for Enhanced Solvent Extraction Incorporating Electromagnetic Heating

Backgrounder

What is ESEIEH?

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Effective **S**olvent **E**xtraction **I**ncorporating **E**lectromagnetic **H**eating (**ESEIEH, pronounced "easy").** ESEIEH is a new in situ oil sands recovery process that does not use steam in heating the reservoir. In ESEIEH, bitumen is concurrently heated with electrical energy and further diluted with the injection of a solvent in a gravity drainage recovery process. ESEIEH provides advantages of lower overall energy requirements and may mitigate the need for field site burning of natural gas or fossil fuels to produce steam, thereby lowering emissions.

How does the technology work?

ESEIEH optimizes two physical properties for viscosity reduction: heating and dilution with solvents. Simply described, ESEIEH operates with two horizontal well pairs as in a base SAGD configuration, with the addition of an antenna. The antenna distributes electrical power, in the form of an electromagnetic field, which heats the bitumen and allows it to be drained. A solvent is then injected in a recipe that achieves the best balance between the combined effects of heating and dilution. The objective of ESEIEH is to be able to manage the energy used in the extraction process with greater efficiency, control and flexibility.

What is the ESEIEH project?

The ESEIEH project constitutes a field demonstration pilot to evaluate the combination of electromagnetic heating for rapid horizontal well pair start-up and sustained formation heating with concurrent injection of a solvent. The project incorporates staged yard-scale testing, numerical modeling studies and a small scale field trial. Energy reductions potentially exceeding 40 percent over the steam-assisted gravity drainage (SAGD) recovery process are projected with commensurate reduction in greenhouse gas (GHG) emissions.

Where does the technology come from?

The fundamental technology for ESEIEH originates with Harris Corporation for electromagnetic heating. Oil reservoir electromagnetic heating has been experimental for several decades but recent advances have overcome prior limitations to commercial development. ESEIEH leverages progress in material characterization, effective electromagnetic heating methods and innovative antenna designs while utilizing existing drilling and well completion practices. The technology arises from a collaboration of technical specialists in the petroleum and communications, or antenna design, industries. A depth of engineering expertise in electromagnetic power transfer and bitumen extraction processes is essential to the development of ESEIEH.

Why is this technology important?

ESEIEH presents one of a new generation of bitumen recovery technologies, which has the potential to be more energy efficient than current *in situ* processes using steam. ESEIEH carries an opportunity for significant reduction in greenhouse gas emissions, improved oil recovery and a marked increase in Alberta's recoverable reserves.

Is there a patent on the technology?

A wide range of patents specific to the ESEIEH process are currently held or pending.

Benefits of ESEIEH?
ESEIEH presents a new generation of bitumen recovery technology, which has the potential to be more energy efficient than current *in situ* processes using steam. ESEIEH carries a potential for significant reduction in greenhouse gas emissions, improved oil recovery and a marked increase in Alberta's recoverable reserves.

Why is new technology needed?
The technology is needed to provide a more effective means of *in situ* oil sands extraction while mitigating the environmental impact. ESEIEH provides the potential for improved economic access to the oil sands resource base with a lowering and better management of emissions.

What are the advantages of the technology relative to basic SAGD?
There are multiple advantages associated with the ESEIEH technology, including:

- **Recovery efficiency:** Lower energy requirements with greater control of energy distribution and lower residual oil saturations, resulting in higher bitumen recovery.
- **Water free**: Potential cases that require no source water, water processing, steam generation, water re-cycling requirements. The process will be net water positive where steam in not used.
- **Reduced CO2 emissions**: The greater energy efficiency without the field site burning of natural gas to produce steam produces lower emissions.
- **Enhanced applicability:** The technology can also be applied to bitumen deposits currently deemed "inaccessible" (i.e., located at depths deemed too deep for mining and too shallow for *in situ* steaming) The technology can be equally applied to both clastic as well as carbonate formations thereby offering potential for reserve growth.
- **Sequestration:** Emissions from power generation can be more easily captured at a central facility for sequestration, providing better carbon management.
- **Upgrading:** Potential for *in situ* chemical upgrading along with fluid upgrading

What are the environmental benefits of the technology?
ESEIEH will help to mitigate the emissions and environmental impacts commonly associated with bitumen recovery. ESEIEH displaces steam in the *in situ* recovery process, reducing the need for water sourcing and handling as well as field site burning of fossil fuels to generate steam. Burning natural gas to produce steam is currently the major source of emissions for oil sands recovery.

How does the carbon footprint of this technology compare to existing processes?
ESEIEH is expected to result in a potential 40 percent reduction in energy requirements during extraction with commensurate reduction in greenhouse gas emissions.

What impact could ESEIEH have on *in situ* economics?
ESEIEH will help to lower the cost structure for bitumen recovery. ESEIEH displaces steam in the *in situ* recovery process thereby reducing the operating and capital cost requirements for water sourcing and handling facilities. Furthermore, ESEIEH is expected to provide greater bitumen recovery at a lower overall energy cost.

How does this technology help the world meet its demand for energy?
The ultimate goal of ESEIEH is to create an emissions-efficient bitumen extraction technology that is economically and environmentally advantaged to conventional oil recovery. Proven successful, this will provide a framework to unlock an extensively larger portion of Alberta's oil sands resource, providing more barrels in both an economically advantaged and environmentally responsible manner.

How does water use intensity of this technology compare to existing processes?
As ESEIEH displaces steam in the *in situ* recovery process, it will minimize overall water consumption. ESEIEH has the potential to eliminate water use for recovery and, in fact, may result in net water production, suitable for industrial requirements.

What are the social benefits of the technology?
In addition to the environmental and economic benefits arising from ESEIEH, Alberta can expect incremental crown royalties as a result of the growth in resource development and improved project economics. The increase in oil sands activity would spur industry investment in employment and training as well as education, research and development.

JV structure:

Who is involved or who are the partners and percentage ownership?
The ESEIEH project is a collaboration of four industry petroleum and technology leaders: Harris Corporation, Laricina Energy Ltd., Nexen Inc., and Suncor Energy Inc.

The partnership is multi-dimensional, where participants provide specialized expertise and contributions. Each of the industry partners contributes approximately 21% while Harris contributes 37%.

What are the backgrounds of the companies participating?
Laricina

- Laricina is a privately held, Calgary-based company concentrating on capturing opportunities in the oil sands areas of western Canada. The Company is creating value through developing a diverse portfolio of oil sands assets using current and future innovations of *in situ* technology. Laricina has identified five core areas that present production potential in excess of 500,000 gross barrels of bitumen per day from a large concentrated resource base with approximately 4.6 billion barrels net recoverable bitumen. These assets range from the familiar oil sands in the McMurray formation to less developed and less mature Grand Rapids and Grosmont and Winterburn carbonate plays, all of which offer significant resource potential.

Nexen

- Nexen Inc. is an independent, Canadian-based global energy company, listed on the Toronto and New York stock exchanges under the symbol NXY. The company pursues three growth strategies: oil sands and unconventional gas in Western Canada and conventional exploration and development primarily in the North Sea, offshore West Africa and deep-water Gulf of Mexico. Nexen is committed to successful full-cycle oil and gas exploration and development, leadership in ethics, integrity, governance and environmental stewardship

Suncor

- Suncor Energy Inc. is an integrated energy company focused on developing Canada's Athabasca oil sands. Suncor's operations include oil sands development and upgrading, conventional and offshore oil and gas production, petroleum refining, and product marketing under the Petro-Canada brand. While working to responsibly develop petroleum resources, Suncor is also developing a growing renewable energy portfolio. Suncor's common shares (symbol: SU) are listed on the Toronto and New York stock exchanges.

Harris Corporation

- Harris Corporation is an S&P 500 company with over $5.0 billion in sales (FY 2009) that specializes in the design and support of high-power, high-reliability, mission-critical networks and radar systems. Harris has served agencies and departments of the U.S. government for more than 50 years. The company has:
    - Over 15,000 Harris employees worldwide
    - 6,500 engineers and scientists
    - 2,300 advanced degrees including over 130 Ph.D.'s
    - Global presence 150 Countries – including Canada

Why is each of the JV partners participating in this project?

- ***Laricina*** – innovation is central to the development and exploitation of Laricina's diverse asset base. ESEIEH is part of the innovation continuum that could enhance resource recovery, project economics and environmental management.
- ***Suncor & Nexe***n - have advanced bitumen production operations where the corresponding impact to climate change by immediate reduction of GHG's will be rapidly commercialized.
- ***Harris*** - Proof of concept permits to rapidly commercialize the technology across diverse applications of bitumen recovery throughout the industry as a service provider.

How will the project be managed?
The project will be managed under the purview of a management committee with equal voting rights among the four participating industry partners.

Where will technology be tested?
The technology will be tested within a McMurray oil sands reservoir environment in 2 phases, a surface field test to validate the electromagnetic heating technology and an *in situ* pilot test where electromagnetic heating will be accompanied by solvent injection.

Who will operate the project?
Details of the project operation in each phase are currently being finalized.

What rights will the partners have to the technology?
The petroleum industry partners, Laricina, Nexen and Suncor will receive a price advantage and preferential access to equipment on commercialization. Harris will own and commercialize the technology.

Project related questions:

What are the objectives of the project?
The project objectives are to provide a proof of concept of the ESEIEH process with a field demonstration pilot of the technology. Proven aspects of the technology will be commercialized as developed either in parallel with the project execution, or following completion.

What are the expected phases and costs of the project?
Phase 1 will consist of a technical feasibility study and will include a surface mine face test with a total funding of approximately $6.0 million. The target start date of Phase 1 is September 2010 and will run for one year. Phase 2 will consist of an *in situ* field pilot test with a total funding of an additional $27.0 million.

When will the project start?
The project is expected to formally start in September 2010, with a review of Phase 1 results by the end of 2011. Phase 2 would begin immediately following Phase 1, with a final review of the test results expected by the end of 2014.

What will the project cost?
The current project plan identifies a $33 million project budget for the ESEIEH pilot. The cost of Phase 1 is estimated at $6 million while Phase 2 is $27 million.

How long will it need to operate before results can be obtained?
The project is expected to run for four years through several phases. Successful results at each phase may lead to commercialization of emerging products over the life of the project.

If successful, how long before the technology becomes commercial?
A number of milestones over the course of the project may lead to commercial products as the project proceeds. However, the commercial deployment of the full ESEIEH process will likely follow completion of the project.

What reporting will be required during the operation of the project?
Contractual agreements are entered into with proponents of approved projects and proponents are responsible for regularly reporting on performance. Information about funded projects and project status information will be made available through a variety of mediums, including the Climate Change and Emissions Management Corporation (CCEMC) annual report, newsletter and website.

CCEMC and funding related questions:

What is the CCEMC?
CCEMC is a not-for-profit, independent organization with a mandate to expand climate change knowledge, develop new clean technologies and explore practical ways of implementing them. Its focus is to enhance the value of energy resources, conserve and use energy efficiently and support green energy production. Funding for the CCEMC comes from the Government of Alberta who collects it from industry.

What CCEMC issues are addressed by this project?
This project addresses multiple CCEMC issues, including:

- No potable water consumption
- Pronounced reduction in GHG emissions
- Development of an environmentally benign process for bitumen extraction using alternative energy sources
- Reduced diluent requirements for transportation
- Elimination of boiler or coke waste
- Potential displacement of fossil fuels to centralized facilities where carbon capture and storage can be effectively applied
- Reduced facility/capital/footprint

How does this project fit into the Alberta Government's energy strategy?
The technology opportunity ESEIEH provides encompasses numerous advantages for optimizing bitumen recovery, maximizing the recoverable volume and value of Alberta's bitumen resource, while permitting access to additional resource volumes from surface through to depths uneconomic for steaming. The incremental resource volumes ESEIEH can provide ready access to have the potential to double the currently recognized provincial bitumen reserves, with promises of even greater gains with a future maturation of the technology.

Where does the money come from?
The investment made by the CCEMC originates from Alberta's Climate Change and Emissions Management Fund which comes from the Government of Alberta who collects it from industry.

Companies that are required to meet the Alberta's reduction target for greenhouse gas emissions can choose to pay $15 a tonne into the Fund for emissions over the target. The Alberta government is responsible for collecting this money for each compliance year.

The Fund delivers on the goals of Alberta's Climate Change Strategy to support the development and application of transformative technologies, as well as improving Alberta's ability to adapt to climate change.

How are projects selected for funding?
Projects submitted to the CCEMC for funding consideration are subjected to a rigorous multi-step process that ensures that funds entrusted to the CCEMC are invested in accordance with its mandate to reduce greenhouse gases and invest in a balanced portfolio of projects that offer transformative solutions.

In September 2009, the ESEIEH consortium submitted the expression of interest application, made it through first round of qualifications and submitted a second round full project proposal in February 2010.

The ESEIEH project is one of 16 projects chosen by the CCEMC from over 200 initial submissions.

The following outlines the steps of the CCEMC selection process:

Initial Review
- During this initial review, members may develop questions that they wish to put to the proponents to further clarify their understanding.

Oral Presentation
- The Oral Presentation is an opportunity for proponents to verbally support their written proposal and for the Evaluation Committee to broaden their understanding and gain additional clarity on each proposal.

Third Party Review
- Each proposal is subject to a review and analysis by an expert(s) independent of the Evaluation Committee.

Evaluation Methodology
- The evaluation of full project proposals is carried out using the ProGridTM methodology, a rigorous and objective method which is used by a wide number and range of organizations to evaluate grant applications and project proposals.
- The process concludes with a Consensus Review meeting, during which all projects are discussed, a consensus decision reached for each one, and recommendations decided upon. A technical and economic risk analysis is undertaken as a part of the Consensus Review meeting.

Decision Process
- Decisions and final approvals for each project proposal are made by the CCEMC Board of Directors after consideration of the Fairness Monitor's report, project recommendations from the Evaluation Committee and Third Party reviewers.

Reporting
- Contractual agreements are entered into with proponents of approved projects and proponents will be responsible for regularly reporting on performance. Information about funded projects and project status information will be made available through a variety of mediums, including the CCEMC annual report, newsletter and website

How much funding will you receive?
CCEMC will contribute $16.5 million towards the project.

The current project plan identifies a $33 million project budget for ESEIEH, half to be contributed by CCEMC and the remaining half to be divided between Harris and industry partners.

What are the terms?
Contracting of the full terms of the agreement for funding with CCEMC will occur over the six month period between July and December, 2010.

Does CCEMC have any rights to the technology?
CCEMC will not carry any ownership rights to the technology, but will retain rights to distribute project information following a confidentiality period.

About oil sands
Canada's oil sands represent the largest single oil accumulation in the world, with currently deemed recoverable reserves of 173 billion barrels, second in size only to Saudi Arabia. "Oil sands" are a naturally occurring mixture of thick, heavy oil and water contained over a range of rock structures, primarily clastics (sandstones) and carbonates. Bitumen is defined as heavy oil that will not flow under natural conditions. Oil sands are recovered by two main methods: mining or in situ.

The technology used is dependent on the depth of the reserves. Twenty per cent of the oil sands reserves are close enough to the surface (less than 70 metres or 200 feet) to be mined with large trucks and electric shovels. The 80 per cent of oil sands reserves that are deeper (*in situ*) are recovered through advanced drilling techniques that permit steam or solvents to go down into the reservoir and mobilize the thick bitumen so it can be pumped up to the surface through recovery wells. ESEIEH is used with *in situ* methods and would replace steam in heating the reservoir.

Why are oil sands important?
Oil sands will play an important, necessary role in the global energy mix for the foreseeable future and is vitally important to the Canadian economy, Canadian jobs and energy security. The goal of the participating companies is to develop these resources safely and responsibly, using the latest technology to improve the process and reduce the environmental footprint. Experience shows that collaboration, new technology, innovative research and a shared vision between industry and government is a successful approach to meeting our goals.

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