COSIA CHALLENGE

Mobilizing the world's minds and resources to improve environmental performance.

Technologies that Improve Existing Once Through Steam Generator (OTSG) Performance

SOLUTION DESCRIPTION:

New technologies focused on reducing/eliminating fouling in steam generators for Steam Assisted Gravity Drainage (SAGD) and Cyclic Steam Stimulation (CSS) produced water recycle.

UPDATED: June 1, 2017

All projects are evaluated and actioned as they are received.

CHALLENGE SPONSOR:

COSIA's **Water EPA** is sponsoring this challenge.

The Water EPA is seeking solutions which **reduce water use and increase water recycling rates at oil sands mining and in situ (in place) operations without causing negative environmental impacts in other areas.**

COSIA has four Environmental Priority Areas (EPAs): Water, Land, Tailings, and Greenhouse Gases (GHGs).

For more information on this COSIA Challenge please visit **www.cosia.ca/challenges**

Canada's Oil Sands Innovation Alliance (COSIA) accelerates the pace of environmental performance improvement in Canada's oil sands through collaborative action and innovation. COSIA Members represent more than 90 per cent of oil sands production. We bring together innovators and leading thinkers from industry, government, academia and the wider public to identify and advance new transformative technologies. Challenges are one way we articulate an actionable innovation need, bringing global innovation capacity to bear on global environmental challenges.

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WHAT TO SUBMIT TO COSIA

COSIA requires sufficient non-confidential, non-proprietary information to properly evaluate the technology.

Some items that will be especially important to present in your submission are:

- Concept and basic unit operations
- Technical justification for the approach (e.g. laboratory batch or continuous experiments; pilot or demo plants; process modeling; literature precedent)
- Describe quantities and qualities of utilities and consumables that are required including quantity and type(s) energy inputs
- Capital and operating cost estimates if available based on described capacity targets including basis of cost estimation, including estimation scope, contingency, etc
- 3rd party verified comparison of your proposed technology. 3rd party verifiers should be reputable, independent engineering companies if possible
- IP status of your proposed technology
- What operating environment restrictions might your technology face:
  - Explosive atmospheres
  - Severe weather
  - Power fluctuations

FUNDING, FINANCIALS, AND INTELLECTUAL PROPERTY

COSIA Members are committed to identifying emerging technologies and funding the development of the technologies to the point of commercialization, while protecting the Intellectual Property (IP) rights of the owner of the technology.

COSIA Members have funded over 400 projects to date, totaling over $1 billion.

Successful proposals can receive funding from COSIA members to develop and demonstrate the technology in an oil sands application. Multiple technologies may be funded, at the discretion of the Members.

HOW TO SUBMIT TO COSIA

Submit a summary of your solution using COSIA's Environmental Technology Assessment Portal (E-TAP) Process, available at: **http://www.cosia.ca/initiatives/etap/idea-submission-form**

Please note: ETAP is a staged submission process. The initial submission requires only a brief description and limited technical information. Upon review by COSIA, additional information may be requested. Instructions for submission are provided on the ETAP site.

All information provided is non-confidential. COSIA will respond to all submissions.

#0019: TECHNOLOGIES THAT IMPROVE EXISTING ONCE THROUGH STEAM GENERATOR (OTSG) PERFORMANCE

DETAILED SOLUTION DESCRIPTION

The COSIA Water Environmental Priority Area Steering Committee has identified technologies which can improve the operation of exiting OTSG's which as a priority for improving the environmental performance of the oil sands insitu operations. This challenge relates to technologies that would improve operating steam generator performance by:

- minimizing or eliminating tube fouling and scaling, thereby extending the time between cleaning,
- enabling the OTSG to be run at higher steam quality (producing more steam from every unit of water fed into the OTSG),
- receiving lower quality water and operating at similar steam output yet reducing the OTSG tube fouling rate, thus reducing water treatment impact;
- Develop a method for cleaning steam generators during operations (there are currently no commercial methods), or developing a better and/or faster method for cleaning the steam generator tubes off line allowing more steam to be produced with the exiting equipment, and reducing the waste produced during the shutdown / cleaning / re-start cycle;
- developing an online OTSG cleaning procedure, therefore eliminating downtime and maintaining optimal plant environmental efficiency
- Monitoring in real time (during operation) OTSG fouling and scale and/or tube wall temperature throughout entire length of the OTSG, enabling cleaning to be carried out only when needed when the OTSG tubes are at risk of over heating

In the insitu industry, steam generators operate for between 6 months and 2 years, after which they are taken offline for 2-4 days for cleaning. The cleaning is done by pushing a variety of pigs through the OTSG pipes to scrape off the scale that has formed on the tube walls.

Technologies of interest could include (but are not limited to):

- A new chemical additive that encourages transport of organic and inorganic constituents in the feed water through the steam generator
- Coatings that allow for longer operation between cleaning by providing a smooth, durable (abrasion-proof), and anti-fouling/scaling surface without restricting heat transfer (novel coatings must take into account the current cleaning practice of pushing pigs through the OTSG tubes to dislodge the scale)
- Novel method to track hot spots throughout the length of the steam generator tubes, allowing for more accurate monitoring that eliminates the cleaning frequency uncertainty, and leading to longer period of operation between cleaning.
- Etc.

Desirable proposals include:

- Proposals with data from lab-scale experiments using Oil Sands water
- Proposals with experience in relevant service in other industries
- Retrofit able technology

Typical steam generators in Insitu Oil Sands service operate with SiO_2 < 50 mg/L (minimum, < 25 mg/L desired); Ca/Mg <0.5mg/L; TDS 1,000- 8,000 mg/L; TOC>250mg/L; Oil and Grease <1.0mg/L, at ~80% steam quality delivering 10-15MPa steam at the outlet. Tube wall temperature can reach up to 400°C.

Natural gas is the preferred fuel, however others could be considered, and the technology must be able to operate on a large scale (50-100 MW thermal, ~150-300 t/hr of steam) with high efficiency (>85% on a higher heating value (HHV) basis).

Improvements to the reliability of the current style of steam generators are of interest to the Water EPA.

#0019: TECHNOLOGIES THAT IMPROVE EXISTING ONCE THROUGH STEAM GENERATOR (OTSG) PERFORMANCE

BACKGROUND

The most common recovery process employed for producing oil from deep oil sands reservoirs (geological formations), is known as Steam Assisted Gravity Drainage (SAGD). In this process, steam is generated at a Central Processing Facility (CPF), transported to well pads, and injected into a horizontal well bore within the formation. The heat supplied by the steam warms the heavy oil in the reservoir, allowing it to flow via gravity into a second well bore that captures the oil water mixture and produces it to the surface with the hydrocarbon at temperatures of over 180°C, and high levels of impurities, including salts, metals, silica and organic compounds

Typical steam requirements in these types of processes range from 2 to 5 barrels or more of water per barrel of oil produced.

Because of the large water requirements, recycling and reuse of the water used in the steam production is mandatory both to protect the environment and to minimize costs. Current recycling rates are 90% or more. Make-up water can be sourced from brackish water formations to further minimize environmental impacts.

The produced oil water mix is separated, and the remaining water is then treated to be pure enough for steam generation. This produced water has high levels of impurities, including salts, metals, silica and organic compounds. It currently needs to be treated before being fed to the boilers.

Preparing this boiler feed water continues to be challenging with present technologies as they require significant energy inputs and are very capital intensive. Current treatment steps still leave current technology boilers vulnerable to fouling and scaling, which leads to loss of efficiency, tube failures and downtime for cleaning and repairing.

A boiler technology that can create high purity steam from treated water while eliminating fouling and increasing steam quality is sought. A technology that can be retrofit to existing equipment is preferred.

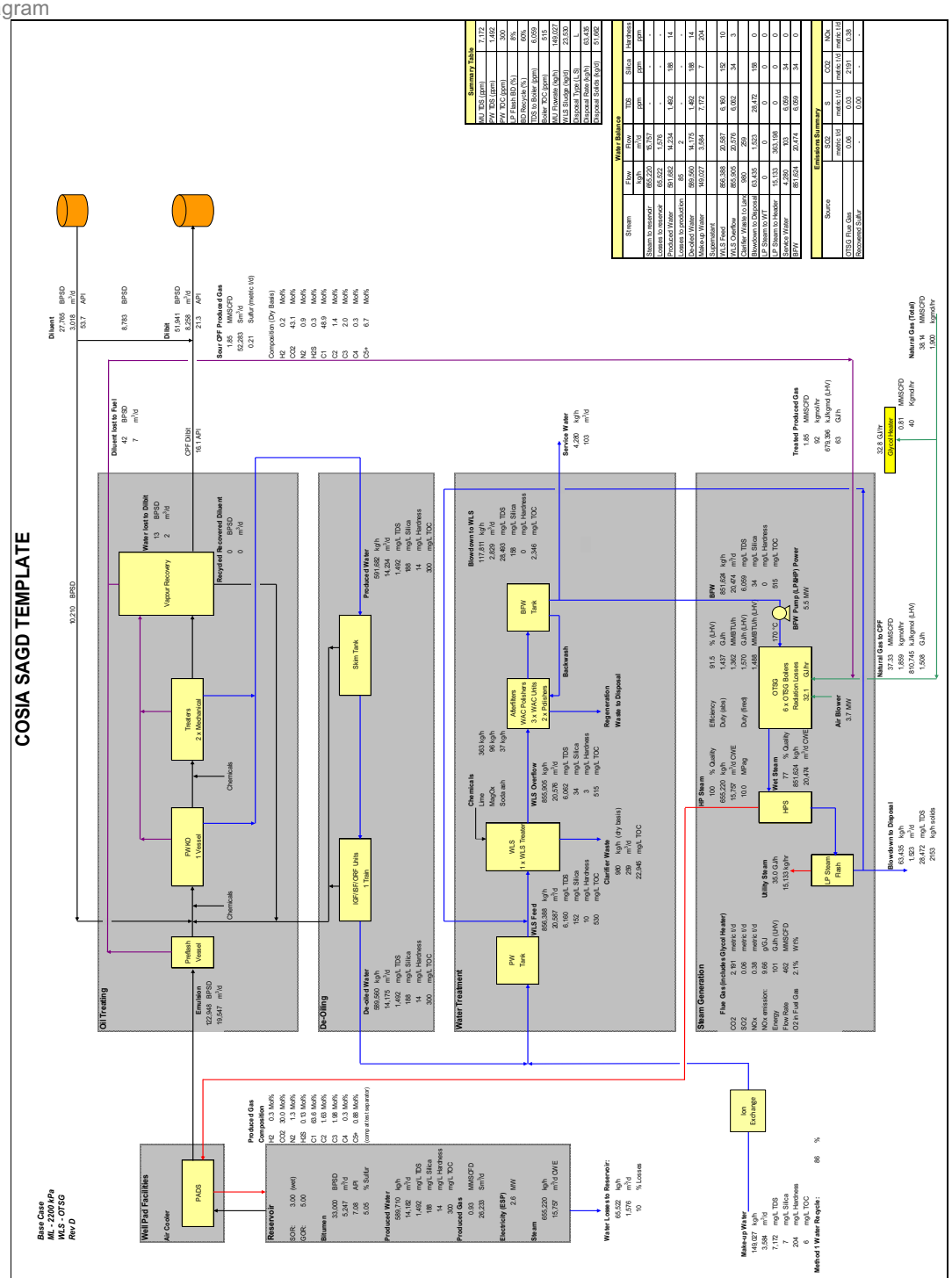
APPROACHES NOT OF INTEREST

The following approaches are not of interest:

- Approaches that have not demonstrated proof of concept
- Configurations that produce steam that is co-mingled with other products (such as the products of combustion from the boiler, or nitrogen)

ADDITIONAL INFORMATION

Supplemental Information – Typical SAGD Flow Diagram



#0019: TECHNOLOGIES THAT IMPROVE EXISTING ONCE THROUGH STEAM GENERATOR (OTSG) PERFORMANCE

Supplemental Information – Typical SAGD Energy Flow Diagram