Lessons Learned and Success in Simulation

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Introduction

As demonstrated by a recent Suncor Energy project, simulation saves time and money during plant start-up and ensures systems function effectively when abnormal situations arise. In addition, simulation is well suited for validation of plant design, verification of control configurations, and testing of “what-if” scenarios by engineers and operators.

The follow white paper describes Suncor Energy’s successful use of dynamic simulation within its Alberta, Canada, oil sands operations. The paper discusses best practices for simulator programs and provides key learnings for Honeywell UniSim project design, testing and implementation.

Background

Suncor Energy, Inc. is an integrated energy company based in Calgary, Alberta, Canada. Its primary operations include oil production, natural gas, refining and renewable energy. In 1967, Suncor pioneered commercial development of Canada's oil sands — one of the largest petroleum resource basins in the world. In 2010, Suncor completed its merger with Petro-Canada, which was acquired in 2009.

Near Fort McMurray in northern Alberta, Suncor recovers bitumen from oil sands and upgrades it to refinery-ready feedstock and diesel fuel. Oil sand is a mixture of bitumen, sand and water, which must be mined or heated underground before it can be processed. Suncor’s oil sands business recovers bitumen through surface mining and steam injection technologies and upgrades it into refinery-ready crude oil products (See Fig. 1).

![Figure 1. Near Fort McMurray in northern Alberta, Suncor recovers bitumen from oil sands and upgrades it to refinery-ready feedstock and diesel fuel.](image)

Approximately 80% of Canada's oil sands are too deep to mine and must be tapped using in situ production. Increased in situ production will increase bitumen supply while reducing costs and impact on the environment.

At its MacKay River and FireBag operations, Suncor uses a steam-assisted gravity drainage (SAGD) process as part of its in situ operation. SAGD is an enhanced oil recovery technology for producing heavy crude oil and bitumen. It is an advanced form of steam stimulation in which a pair of horizontal wells is drilled into the oil reservoir, one a few meters above the other. Low-pressure steam is continuously injected into the upper wellbore to heat the oil and reduce its viscosity, causing the heated oil to drain into the lower wellbore, where it is pumped out (See Fig. 2).
Today’s Challenges

In today’s world of process control systems, the person controlling valuable plant assets should have the training and equipment needed to do their job effectively. An operator in any kind of process plant cannot afford to make mistakes, which can be costly and potentially life threatening.

Plant operators make sure all process systems are operating properly and they continuously check the operation of equipment. They often make adjustments to keep the variables of processes within acceptable ranges, and constantly check pressures, flows, and temperatures. Operators also identify potential and actual problems and quickly perform corrective action to minimize the effects.

Despite the demands of their job, many young operators have never experienced a plant turnaround or critical situation. The only way to ensure they will take the proper action during a crisis is to prepare them for it. Simulation training is needed to provide operators with realistic dress rehearsals for situations which require them to respond instinctively with competence and confidence. A simulator allows the supervisor to train and evaluate an operator objectively, spending time to guarantee that all critical aspects of operation and safety are clearly understood.

Simulation Solution

Operator Training Simulator (OTS) technology enables safe and efficient plant startup in support of Suncor Energy’s corporate commitment to “Journey To Zero” and “Operational Excellence.” Suncor is committed to providing its employees with the proper tools and technology to execute their jobs, and is now building a simulator for each new project within the company.

Honeywell’s UniSim high-fidelity simulation platform was successfully built to the pre-MAT stage on Suncor’s 220k barrel per day upgrader. UniSim is a unified simulation solution supporting improved performance throughout the plant lifecycle. UniSim provides Suncor with access to advanced Honeywell UOP optimization capabilities, and has been implemented on three OTSs across seven plants (Cokers, Sulfur, Diesel, Gas Oil, Naphtha, Hydrogen and UO) for a total of 45k+ I/O (See Fig. 3).
The types of simulators in place at Suncor include: high-fidelity operator training simulators (existing plus new upgrader), FireBag Stage 3 (new), and Voyageur (new). In these operations, the UniSim solution will be used for:

- New control room operator training (e.g., start-up, shutdown, and emergency procedures)
- Existing control room operator refresher training (e.g., start-up, shutdown, and emergency procedures)
- Platform for advanced process control (APC) and optimization
- Validating DCS control and logic checkout
- Validating and improving plant operating procedures
- “What if?” analysis (scenario analysis)
- Engineering tool for developing and testing new control strategies

**Best Practices**

Suncor Energy’s simulator program was based on an integrated team philosophy of owner, supplier and other third parties. The keys to success included comprehensive and quality plant data/information, timely delivery of a quality DCS database/training system to facilitate training, and a high-fidelity simulation platform with the same look and feel as a real system and plant. The program also allocated sufficient time for effective operator training, and benefited from strong corporate and team commitments.

Based on Suncor’s experience, the recommended “best practices” for a simulator program include:

- Choose a location for the simulator room in close proximity to the main control room
- Simulator consoles and screens, as well as operator’s chairs, should replicate the main control room
- Soundproofing of rooms housing simulation equipment is a must
- Before employees are introduced to the simulator, they should be familiar with plant process to be simulated
- Training time should not exceed eight hours — there is no point in overloading or stressing out employees
- Refresher course should be conducted three months after initial training to ensure no bad habits have been acquired
- At least twice yearly, panel operators need to show competence in their position by performing emergency and start-up/shut down procedures
- Six-month simulator training prior to plant commissioning is essential for ensuring safety and time/cost savings

Project Results

For Suncor Energy, better trained operators via simulation will mean better operations: greater efficiency, less downtime, lower energy costs, less equipment damage and production loss, closer environmental compliance, and a safer operation (See Fig. 4).

![Figure 4. For Suncor Energy, better trained operators via simulation will mean better operations](image)

The current simulation program was successfully put in safe mode — on time and on budget. All engineering packages for three simulator rooms along with consoles, hardware, software, rackroom, and cable schedules have been completed.

Suncor will apply simulation throughout the project lifecycle to achieve specific operational objectives. For example, the company seeks to identify unit or process operating constraints at the conceptual design phase before capital expenditures are committed. It also wants to demonstrate APC and optimization applications before deployment, as well as fine-tune design issues such as control logic, alarms and interlocks. In addition, Suncor’s goal is to begin startup of new or modernized units or processes sooner, and complete them faster. It strives to train and develop operators on procedures and systems that are safe, optimized and environmentally friendly. The simulator program is intended to capture existing operator skills with computer-based certification and transfer best practices to new operators with hands-on practice.

Finally, thanks to advanced OTS technology, Suncor aims to enjoy improved operating rate and product quality on an ongoing basis; avoid or minimize incidents, and recover faster from abnormal situations; satisfy government regulations for operator certification and environmental operations; and provide simulation applications for improving real-time operation and control.
Lessons Learned

Suncor’s simulator program provided a number of valuable “lessons learned” for other organizations considering similar efforts. These include:

1. Initiate simulator projects when all process data are available, and the design is least likely to change from the EDS phase
   - Process data requirements include P&IDs, Cause & Effects, PFDs, Logic Narratives, Control Narratives, Heat & Material Balance, and vendor documentation
   - Design changes after initial project scope will lead to delays and extra costs

2. Verify that everything is clearly spelled out in the contract
   - Who will buy the simulator hardware, consoles, install, EWPs, etc.?

3. Make sure subject matter experts are available for defining the scope for each plant
   - Detailed functional specification (DFS) is your chance to do this — if scope is not defined, it will come back to haunt you

4. Take time to get to know the company’s players and vendor personal on the project
   - Helps build teamwork and eliminates an “us vs. them” attitude

5. Project management should inform area stakeholders of their responsibilities and manpower requirements

6. Secure management buy-in for the lifecycle of the project and beyond
   - Include updates to the simulator as the plant changes
   - Make sure there is a budget to cover additional technology investments

Summary

Suncor’s corporate and organizational commitment to health, safety and security ensured a successful simulator program. Simulation technology contributes to Suncor’s corporate business objectives via timely and effective operator training. It saves time and money, and ensures control systems will function properly when abnormal situations arise. Furthermore, an effective OTS enables training of new personnel in a resource-limited environment for safe and efficient plant start-up. This solution continuously improves control room operator skill sets to enable effective plant operation after initial start-up. It also provides Suncor with a stepping-stone for future advanced process control (APC) and optimization applications.
More Information
For more information about Simulation, visit our website at
https://www.honeywellprocess.com/
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