ANDRITZ Automation

IDEAS

Simulation solutions for potash operations

The challenge: To reduce the risk to your people, your equipment—and your investment

The solution: Measure. Simulate. And profit.

In every industry, in every business, there is risk—to your people, your equipment, and your investment. Setting your operation free of these risks is what IDEAS is all about. IDEAS is a leading dynamic simulator for mining operations and is quickly becoming the standard for the potash industry, helping customers to save time, money, and resources.

Historically, dynamic models have only been implemented for two key phases of a potash project: control system staging (checkout) and operator training, typically occurring after the finalization of P&IDs.

However, since the major cost in any simulation project is the building of the dynamic model, significant value can be realized when the model is implemented at the design stage.
The result is a large increase in benefits—without a large increase in cost.

This concept of a "virtual plant" has become the standard in large mining projects around the world. We call the concept **Operational Readiness**, and it is easily applied to the potash industry.

"The IDEAS simulation software provides a 'virtual plant' to allow control designers to make modifications to process logic, months before the real start-up."

Ron Cook, Control Manager
Intrepid Potash, Carlsbad, New Mexico

IDEAS provides solutions for five key areas of a potash project:

- Steady-state heat and material balances
- PFD-based modeling with verification
- P&ID-based modeling with verification
- Control logic verification
- Operator training, including simulator and web-based training (sometimes referred to as computer-based training)

We are dedicated to working with you to help harness the power of IDEAS. With your vision and our technology, the possibilities are limitless. How IDEAS is implemented to help your project:

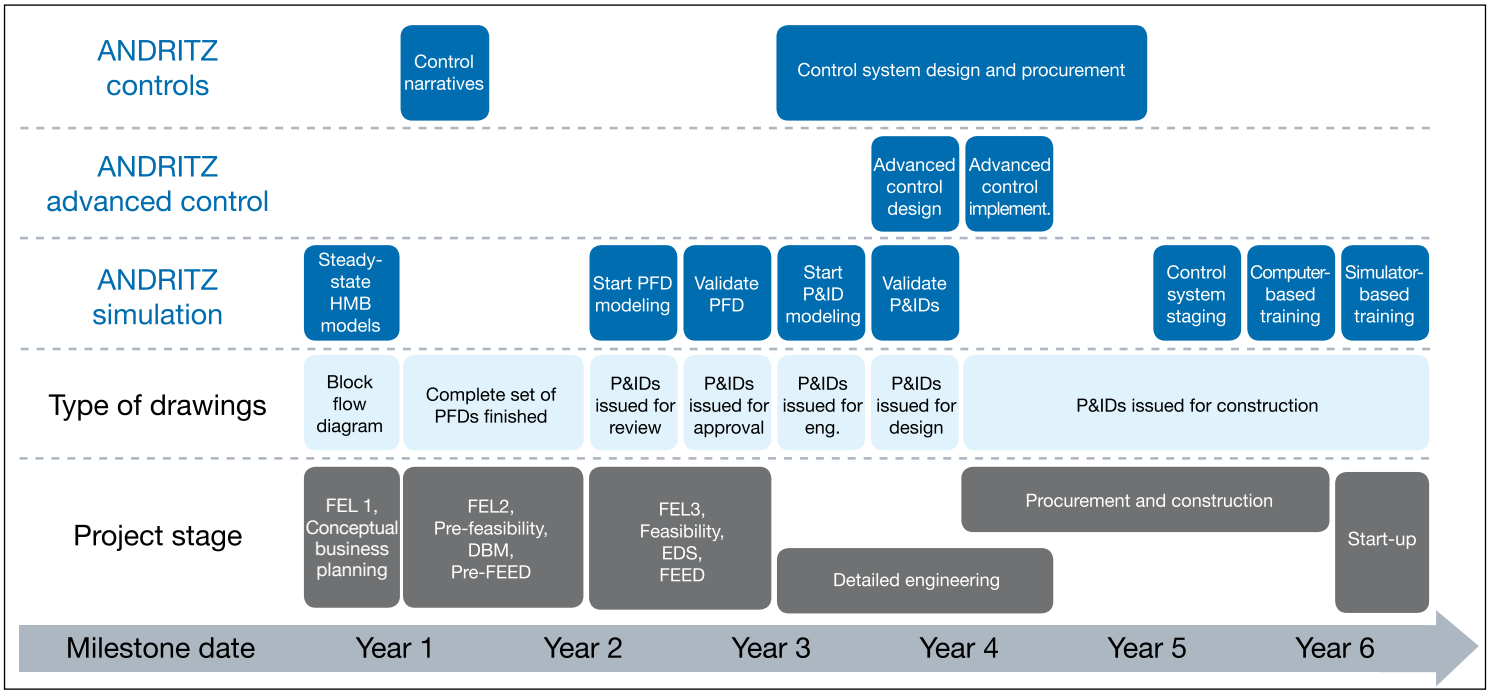
- We build process models of the facility based on PFDs, P&IDs, pump curves, and other key components of the process.
- Sitting side-by-side with the process engineers, we validate the process.
- We connect these verified models to an offline version of the actual control logic.
- We then run a simulated start-up and verify and correct control logic against this "virtual plant," months before start-up.
- The models are then used for operator training.

Find out more:

An industry leader

Greenfield potash mines under development by BHP Billiton Jansen and Agrium Vault are utilizing IDEAS dynamic modeling for process design. Newmont, Vale, Codelco, and other major mining companies around the world are also using this approach. The largest oil sands projects in Canada have employed IDEAS for design verification.

A typical potash project schedule, showing the relationship between project stages and when different simulation milestones are completed ▼



The challenge: To design a process that you know will work before you commit capital

The solution: IDEAS simulation

During the process design phases, IDEAS is a quick and powerful tool that enables users to dynamically model a complete potash project.

IDEAS helps you create a "virtual plant" environment in which process designs, modifications, and retrofits can be fine-tuned and verified, faster than in real time, before you commit to any capital costs.

Capturing the knowledge of your own process experts, an IDEAS model allows you to see your operation in a new way, unifying process areas, adding control concepts, and making design changes easier and faster to implement.

Some benefits of implementing a dynamic model at the process design stage:

- Observe heat/material balance
- Analyze options for optimizing water balance and steam consumption
- Verify that the sizing of major equipment is consistent with the design criteria and the desired dynamic response
- Run different operating scenarios
- Analyze and evaluate variable speed drive versus fixed speed drive, observing the flow changes around different areas of the model
- Consider design options for pumpboxes and storage tanks

IDEAS includes unit operation objects in libraries that enable users to effectively simulate a potash plant. These libraries feature a flexible and easily customized database that contains the material properties for components commonly used in the mineral industry. IDEAS performs mass and energy balances; tracks components, compounds, and element flow and concentration; and handles particle size distributions.

Across the mining industry, IDEAS has been used to model complex plants, including include truck and shovel operations, conveying, crushing and grinding (including high pressure grinding rolls), flotation, high pressure acid leaching, heat recovery circuits, neutralization, countercurrent decantation (CCD), autoclaves, precipitation, filtration, separation, solvent extraction, and electrowinning.

IDEAS acts as a superior tool for "what-if?" analysis of mineral production and optimization. Our models can link to operating costs, complex production logic, discrete simulation of discontinuous events, and to spreadsheets for dynamic exchange of data.

Benefits

- Create live process flow sheets
- Quickly determine flows and temperatures
- Help verify the selection of process equipment
- Make economical design decisions

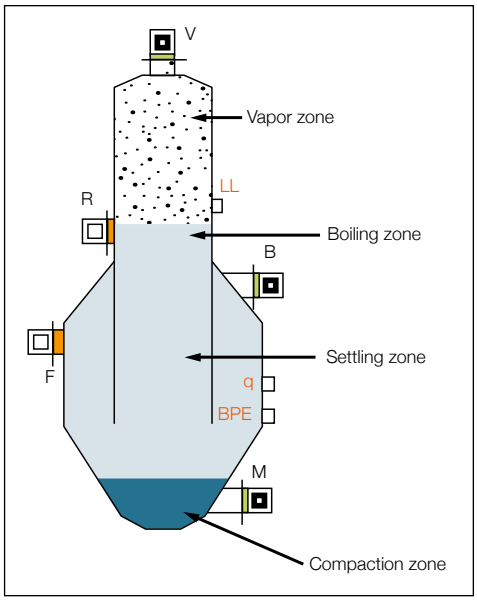
The “heart” of the solution: The evaporator/crystallizer object

A simulation model is only as good as its objects—which is why ANDRITZ AUTOMATION has put significant development into the crystallizer objects. We believe it is the heart of any potash operation.

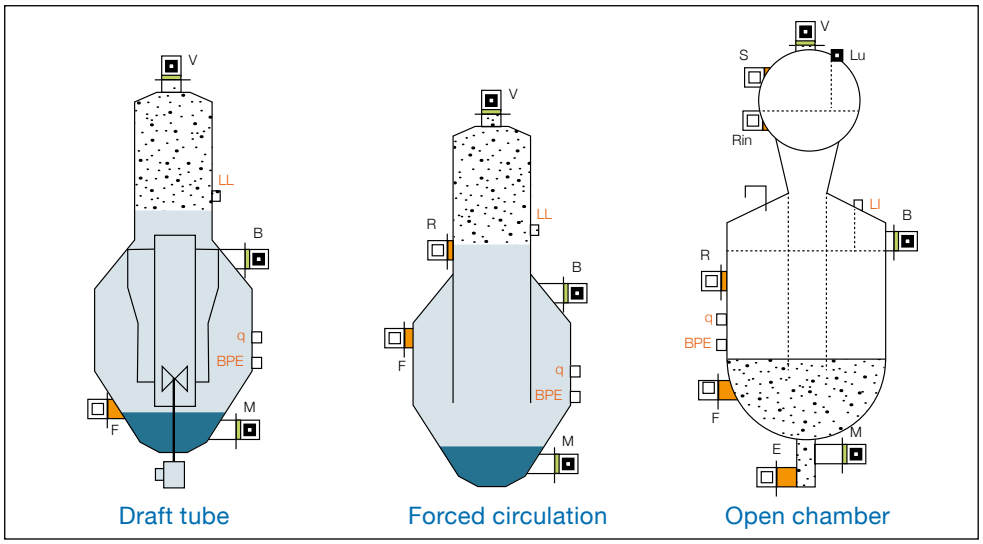
IDEAS offers three types of dynamic potash crystallizer objects: draft tube baffle (DTB), forced circulation, and forced circulation with elutriation.

Within our IDEAS object, the crystallizer is divided into four zones: vapor, boiling, settling, and compacting.

The settling and compaction zones have fixed volumes either defined by the user, or determined by the vessel’s configuration. For example, in the DTB crystallizer, the compaction zone will be located between the vessel’s bottom and the inlet to the up-tube, and the settling zone is defined between the bottom of the up-tube and the top of the up-tube. The boiling zone and the vapor zone volumes change depending on the liquid level in the vessel.



▲ The four zones of the crystallizer



▲ Three types of dynamic potash crystallizer objects are available in IDEAS.

Rigorous mass and energy balance calculations are performed for each zone and time step of the simulation. Boiling point elevation due to solids dissolved in the brine is taken into account when the vapor-liquid equilibrium is calculated.

The saturated feed brine enters the vessel and is directed to the boiling zone where it is subjected to vacuum. The vapor-liquid equilibrium for water and steam calculation results in creation of steam, which is removed by the vent to control the vessel pressure.

The evaporation of water reduces the brine’s temperature and increases the concentration of dissolved minerals, resulting in supersaturated brine. As the supersaturated brine moves down to the settling zone, solids will precipitate from the brine and crystals will be formed.

The mass of crystals formed is determined by the degree of supersaturation created by water removal and cooling of the brine, whereas the crystal’s size distribution (CSD) will depend on the crystal’s growth rate and the solids residence time in the vessel. The McCabe Delta-L Law of crystal growth is used to determine the CSD.

The crystals settle in the settling zone according to Stoke’s Law. Some fines will be withdrawn with the brine overflow stream if their settling velocity is less than the upward liquid velocity. Large crystals, with higher settling velocity, will settle to the compaction zone, displacing the equivalent volume of the liquid phase, and will be subsequently withdrawn by pumping the magma out of the vessel. Intermediate size crystals will remain in the settling zone and will be repeatedly recycled to the boiling zone where they will grow further as they are exposed to the supersaturated solution created by evaporation.

The challenge: To verify that your complicated control scheme will run your plant correctly

The solution: IDEAS dynamic simulation

IDEAS is an effective tool for control logic verification, helping to stage and test control systems quickly and accurately, reducing the steep curve to start-up.

Implementation of control logic is a difficult task, since the performance of the plant is not only dependent upon the electrical and mechanical components, but also on the control logic and the design concept used to control those components.

That's where IDEAS enters the picture. If the control logic cannot start a simulation, it will not be able to start the actual equipment. By using IDEAS for control logic verification, you will reduce costly design errors that could otherwise delay start-up.

Studies have shown that using simulation to help with start-up can correct up to 82% of control logic problems before field implementation.

The cost savings are enormous. Control logic verification translates into immediate savings through a smoother start-up and can easily realize a 200% or more return on investment.

IDEAS communicates with all major PLC or DCS equipment. Using our OPC server, OPC client, or one of our custom communication drivers, IDEAS makes the task of control system logic verification more manageable and consistent. In addition, new control logic can be tested and verified on the IDEAS simulator while the actual plant continues to run without interruption.

The biggest benefit of using IDEAS for your control logic verification is that our team works with you every step of the way. Our experts travel directly to your plant site, anywhere in the world, and work directly with the equipment vendors, control company, and plant personnel during commissioning.

Benefits

- Detect and correct up to 82% of control logic errors before field implementation
- Achieve quicker and smoother start-up, resulting in 200% return on investment

	DCS loop back	IDEAS model
I/O and loop test	✓	✓
Process-wide logic test	×	✓
Tuning constants known before start-up	×	✓
Realistic process models	×	✓✓
Remove control logic errors	×	✓✓
Remove process intent errors	×	✓✓
Verify advanced control logic	×	✓

Typical project results: PFD validation

Case scenario 1:

Reconfiguration of PFD

The drying circuit consists of a burner that heats air to a high temperature, and the air is then used to heat the potash product in a fluidized bed dryer.

The gas outlet from the dryer is fed to a hydrocyclone and recycled back to the dryer. The figures (shown left) illustrate what happens during the PFD validation process.

By working closely with the design team, the customer was able to make a simple change that resulted in a correct outlet temperature.

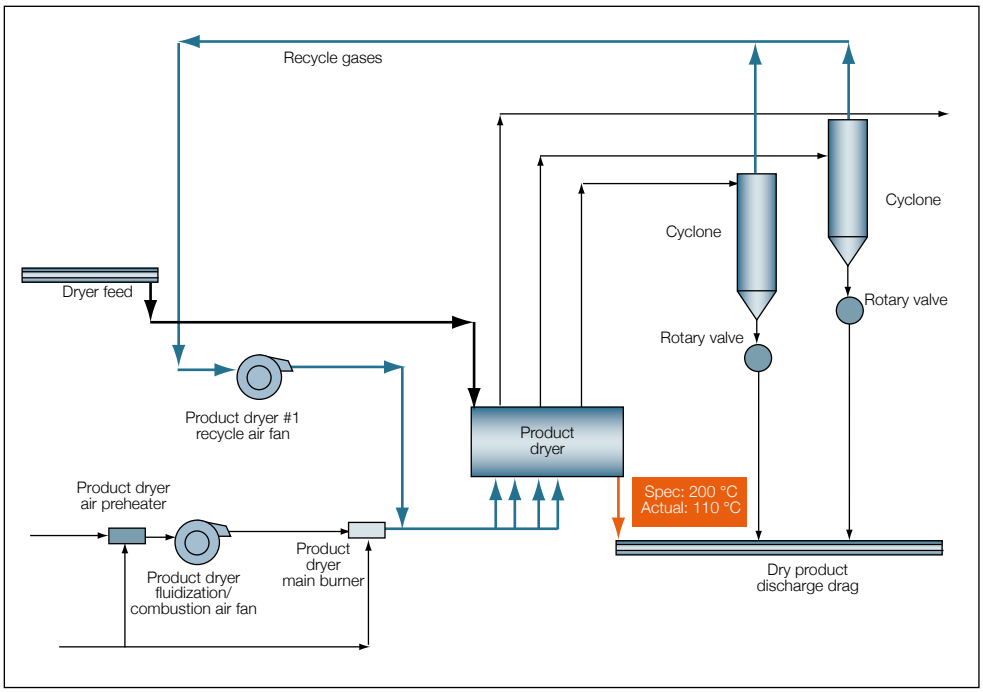
Case scenario 2:

Natural gas flow to burners

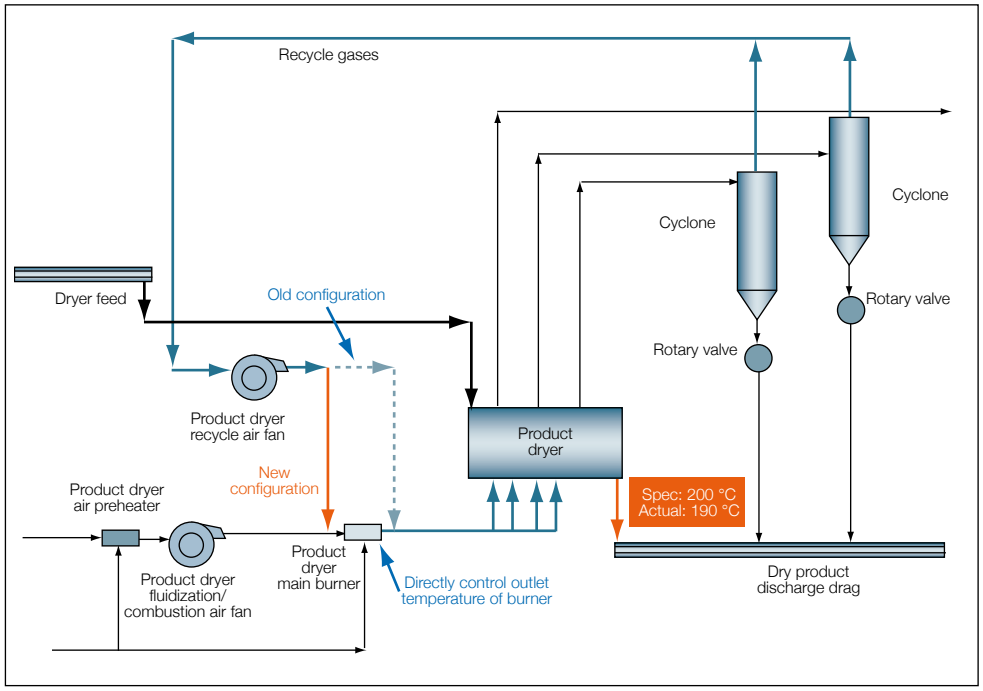
In a recent project, IDEAS modeling results uncovered an error in the natural gas flow reported in the PFDs.

While the PFDs reported 1,300 m^3/h of natural gas, the IDEAS burner model calculated that only 400 m^3/h of natural gas would be required to achieve the desired outlet temperature.

This mistake was immediately noted, so that the customer could discuss with the burner vendor.



▲ Original configuration of process in case scenario 1, showing that the published temperature (highlighted in orange) did not match the predicted temperature from the IDEAS model.



▲ Improved configuration of process in case scenario 1 after IDEAS validation shows the product dryer temperature (highlighted in orange) now meeting the specification.

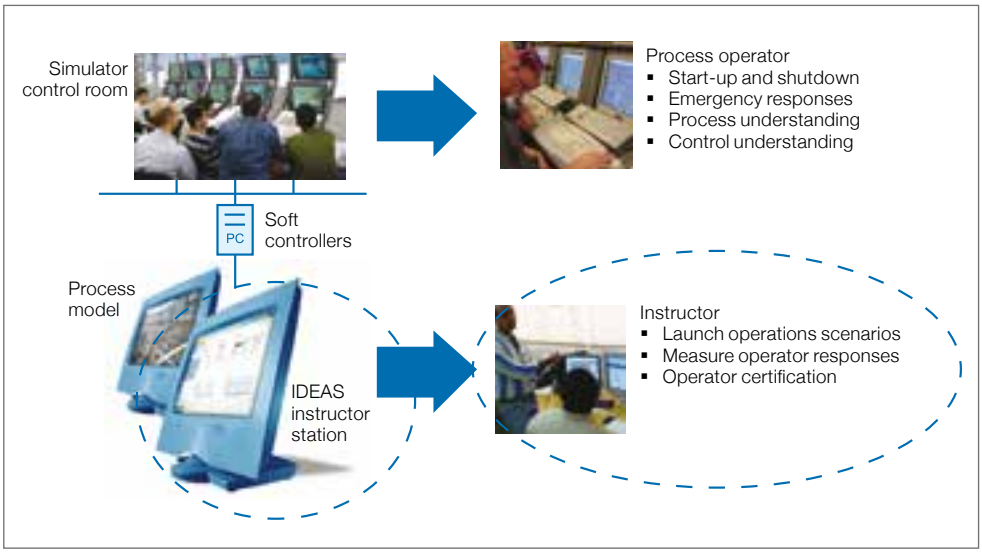
The challenge: To train your operators on a process—and meet your start-up schedule

The solution: IDEAS instructor

IDEAS is an essential tool for operator training; it works like a flight simulator, allowing trainees to gain realistic, hands-on experience without inflicting harm on themselves, the environment, or the plant.

The IDEAS instructor module can help train operators months before the actual plant is up and running. It helps produce better trained operators—operators who will start up new processes faster, react more wisely to plant upsets, and be more productive.

IDEAS instructor contains preconfigured scenarios that teach, train, and challenge trainees on process upsets, including two of the most intensive and complex procedures—start-up and shutdown. We can all imagine this scenario: a relatively new operator is on shift when suddenly a tailings line starts to sand-out. In most cases, such a scenario would have significant safety, environmental, or production consequences—but your new operator, who has practiced start-up and shutdown on the IDEAS simulator, immediately makes the correct decisions and your operation continues without incident.



▲ Where IDEAS instructor fits into an operator training system

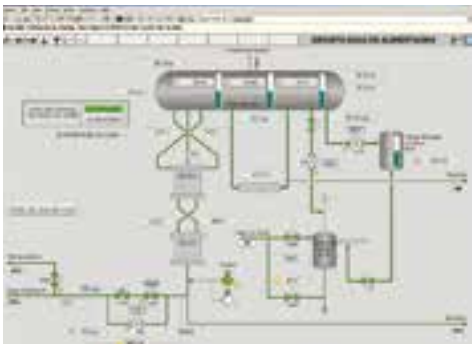
Operator interface

The simulator allows the actual plant configuration to be loaded into the training system, so that operators will be trained using the same interface (including the same logic, keyboard, and graphics) as the actual plant. The simulator enhances the learning process by actively involving the operators and providing immediate feedback without risk to production.

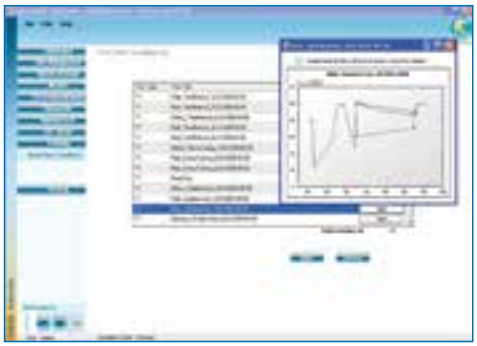
Instructor interface

IDEAS instructor software enables you to track individual employee performance, including login and fault scenario management. The operators' performance in executing start-up, shutdown, and normal operating procedures is assessed by tracking selected process variables (for example, temperature, pressure, and flow).

The view from the simulator is identical to the actual DCS screen. ▼



A screen shot from IDEAS instructor demonstrates the easy-to-use interface. ▼



Benefits

- Teach plant operators safely and reliably
- Have personnel practice intensive and complex procedures
- Monitor trainee progress and assess performance
- Standardize and create consistent training

Success story

Customer: BHP Billiton

Simulation objective:

- PFD modeling and verification
- P&ID modeling and verification
- Control logic verification
- Operator training simulator

ANDRITZ AUTOMATION is currently supplying BHP Billiton with a simulator for its Jansen project, a proposed underground potash mine located near Saskatoon, Saskatchewan, Canada.

Working closely with BHP Billiton process experts and its engineering contractor, ANDRITZ AUTOMATION is developing a model of the Jansen process that will allow the team to predict and verify process design and control behavior. It will also assist in operator training.

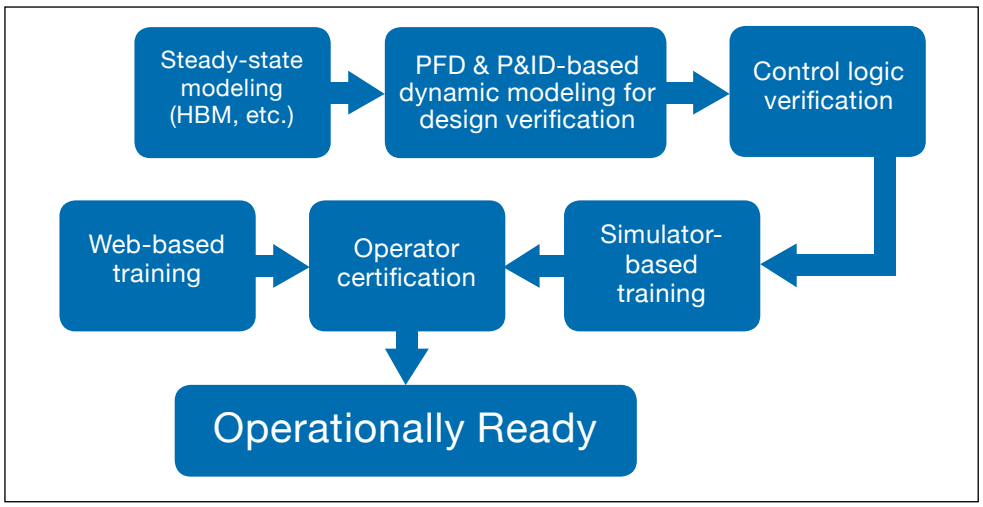
"This reflects a multi-year commitment to dynamic simulation for our company," says Kelvin Grasdal, Superintendent, Instrumentation and Control, at BHP. "The IDEAS simulator will help improve the design of both the process and the controls, and eventually power an operator training system. The objective is to use the process and control information from the IDEAS model to help the Jansen project achieve operational readiness."

The challenge: To realize the best net present value on your capital project

The solution: IDEAS simulation

IDEAS is the leading simulator for the mining industry and is quickly becoming the standard for potash operations.

IDEAS has been used to help mining operations in North and South America achieve start-ups that are faster, smoother, safer—and more economical. By using IDEAS, mining operations have realized significant savings.



▲ How simulation makes your potash project operationally ready

Simulation experts

We can model any vendor equipment and are able to communicate with every DCS supplier, so your operators train on the same graphics and logic that they will use in the actual plant.

Realistic process models

IDEAS has realistic models to accurately represent your process, based on first principles of chemistry and physics. IDEAS allows you to model your plant or process at a micro or macro level of fidelity, depending on your need.

Smooth start-up

IDEAS catches hundreds of errors in control logic before start-up, which means your plant achieves products on—or ahead of—schedule.

On-site implementation

Our personnel include experienced mining project managers who understand your industry. We travel directly to your site to work with vendors and control suppliers during commissioning.

Risk-free training

The IDEAS instructor module allows staging and operator training to take place in complete safety, without risk to your employees or the environment.

The data agrees. At one South American plant, operators used the IDEAS simulator to practice start-up, shutdown, and emergency sequences in the months prior to start-up. This allowed the operators to be better prepared when it came to the operation of the actual plant. A standardized test with approximately 300 random questions was developed to test operator competency. The test questions were given in three intervals, once before any training, once after class training, then once again after IDEAS training. The results clearly showed that the IDEAS training made a remarkable improvement in operator competency.

Student competency	
Before any training	20.3%
After classroom training	26.7%
After IDEAS training	85.0%

Ongoing benefits

Since IDEAS is modular and scaleable in design, many plants continue to use the simulator past start-up for a variety of applications, including process design and training of new operators.

Return on investment

The IDEAS simulator acts as a virtual plant that will help pinpoint plant production improvements and shorten projected start-up dates. In many cases, the IDEAS return on investment has been over 200%.

Success story

Customer: BHP Billiton

Simulation objective:

- Process modeling

BHP Billiton is the world's largest diversified resources company, with over 128,800 employees and contractors working at 141 locations in 26 countries. As such, when it came to picking a simulation standard, BHP Billiton wanted the best solution available. That is why the company chose IDEAS as its standard for process modeling for its stainless steel material group.

The decision was made after a rigorous competitive selection process lasting nine months, and in the end BHP Billiton decided that IDEAS presented the best long-term benefit.

The IDEAS simulation package possesses a number of novel advantages over its competitors, coupled with excellent customer service and development teams.

Process simulation is an important aspect of process engineering, which helps BHP Billiton develop process technology, improve operational performance, and advance their world class projects.

Not only did BHP Billiton view IDEAS as the right tool to accomplish these objectives, but they know that ANDRITZ AUTOMATION possesses the depth of resources to respond to current and future simulation requirements.

ANDRITZ Automation

Automation solutions

Release your full potential

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