The use of advanced simulation software for the development of the Virtual Process Plant

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Why Use Advanced Simulation on Mineral Processing Plants?

1) Project Risk Mitigation
2) Improve Business Readiness
3) Mining lags behind other industries in utilization of advanced engineering tools
4) Lack of industry experience & engineering talent
5) Delayed startups
6) Control system problems
7) Mechanical design issues
8) Lack of trained operators

→ SAVES MONEY!
Simulation in the Mining Industry

• The mining industry lags behind other industries in detailed simulation technology – slow adopters to new technology

• There are a number of “mining specific” simulation packages currently being used (i.e. SysCAD, Metsim, etc.)

• These packages mostly deal with steady state, heat and mass balances and are used to develop Process Flow Diagrams (PFDs) and aid in metallurgical process design
What is a IDEAS Dynamic Model?

- The IDEAS dynamic model represents a significant step forward in the modeling of mining projects.
- Unlike other modeling tools, IDEAS incorporates the metallurgy AND the engineering, AND control system aspects into one integrated model.
- IDEAS is fully dynamic, allowing discrete, semi-batch, and continuous processes to be modeled in real time or an accelerated time basis.
- The IDEAS Model is the “Digital Representation” of the physical plant (“Live P&IDs”) the VIRTUAL PLANT. With the appropriate input data, it responds to changes in feed characteristics or operating conditions like an actual plant.
Creation of the Virtual Plant

P&ID

IDEAS “Live” P&ID
Model Development

IDEAS Model incorporates Newmont best-in-class technology, including:

- JKSimMet technology for crushing, grinding, and classification
- Newmont proprietary flotation recovery models
- CIL/CIP gold leach and adsorption technology
- Specific vendor equipment designs
- Sedimentation calculations for slurry lines and launders
Engineering Information Requirement

• Basic Engineering Information
  – Process flow diagrams
  – Process design criteria
  – Equipment data sheets
  – Specifications
• Piping and instrumentation diagrams (P&IDs)
• Vendor data information
• Process control philosophy documents
• Equipment elevations and line lengths
Sample Pump Curve Application
IDEAS Model Demonstration
IDEAS Conga Simulation

Newmont has been using the IDEAS Gold dynamic modeling software on a current project – Conga.

The objective is to develop and use the “Virtual Plant” model for the following activities:

• Phase 1: Development of IDEAS Gold Model from the detailed metallurgy and engineering data
  - P&ID/design validation
• Phase 2: Connecting the IDEAS Gold Model to a control system emulator package
  - Control System Testing
• Phase 3: Operator training
  - Operator Certification
IDEAS Conga Simulation

The Conga project model includes the following discrete, batch and continuous unit operations:

- Primary Crushing and Stockpile
- Screening
- SAG and Ball Mill Grinding
- Particle Size Classification
- Specific Mineral Flotation
- Solids Thickening
- Solids Filtration
- Process Water Systems
- Cooling Water Systems
- Tailings Pipeline
Conga Simulation Phase I
Design Validation Successes

• Used to evaluate competing control strategy alternatives
• Used to evaluate effects of various ore types in plant feed
• Used to evaluate various operating scenarios

Examples of the types of design concerns found as a result of the model include:
- Under sizing of conveyors/feeders
- Slurry velocities above design specifications
- Inconsistencies between plant 3D model and calculations
- Concerns over concentrate belt filter
- Slurry velocities below sedimentation velocity with certain ore types
Phase II - Control System Testing

Start Up Engineer
- Evaluate DCS operation
- Perform simulated startup scenarios
- Evaluate proposed interlock logic
- Running the “Virtual Plant”

DCS Programmer
- Input/Output verification
- DCS logic correction and re-testing
- Perform Control loop & Interlock tests

Process Modeler
- I/O overrides
- Process value checks
- Model correction and re-testing
Phase III – Operator Training

Simulator Control Room

DCS Emulator Software

IDEAS Process Model

Instructor Station

PC

Process Operator
- Start-up and Shut-down sequences
- Emergency responses
- Process understanding
- Control understanding
- Process area certification

Instructor
- Operator training simulator
- Launch operations scenarios
- Measure operator responses
- Operator certification

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Process Model Timeline

P&ID/Design Validation
- Validate engineering design
- Virtual plant runs
- Scenario testing
- Control strategy comparisons

Control System Testing
- Evaluate control logic
- Verification & correction
- Control system testing
- Initial loop tuning

Operator Training
- Operator training and certification on startup, operation, and failure scenarios

Operational Tool
- Model calibration
- Plant optimization
- Training of new engineers & operators

Project Development Phases

Basic Engineering
- Phase I

Detailed Engineering
- Phase II

Operations
- Phase III
- Operational Tool

Simulation Development Phases

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Advanced Simulation Value Proposition

Risk Mitigation
• Operate “Virtual Plant” under various conditions and scenarios before startup
• Evaluate design alternatives
• Detailed control system testing
• Control loop pre-tuning facilitating faster startup
• Engineering design quality assurance tool – lack of engineering experience/talent in the industry
• Operators trained and certified on startup, shut down, and failure scenarios

Future Operational Tool
• Tool available for plant optimization and expansion studies
• Evaluate impact of plant disturbance prior to occurrence - different ore types
• Train new engineers and operators
Virtual Plant Simulation Saves Money

• Time to Market - Reduce Startup Time – $100 – 500K / day*
• Operating Cost – Reduce Unscheduled Downtime – $5 – 50K / hour*
• Reduce Risk – Reduce Unknown Failures and Incidents $50K - $1MM / incident*

* As Presented at the CDI Users Exchange 2011, Control Dynamics
Questions?

Thank you for your time and attention