



ACCELERATING
INNOVATION

2-1689 – Automating Leach Pads with Intelligent Valve Actuation and Wireless PID Control

*San Antonio, Texas
May 2025*

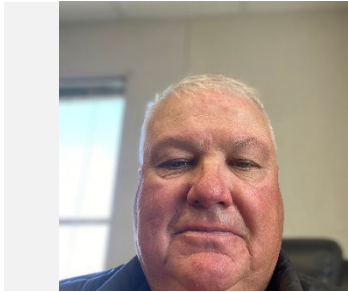
Disclaimer

The information and/or opinions expressed in this presentation are those of the authors and do not necessarily represent official policy or permission of Emerson or Emerson Exchange.

Important Reminders

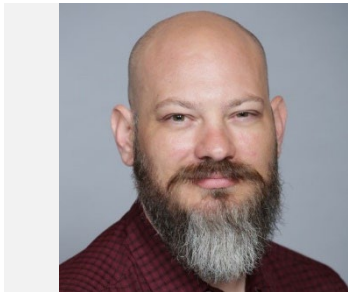
Photography and audio/video recording is not permitted in any session, or in the exhibition areas, without press credentials or written permission from Emerson or Emerson Exchange.

Inquiries should be directed to:
EmersonExchange@Emerson.com



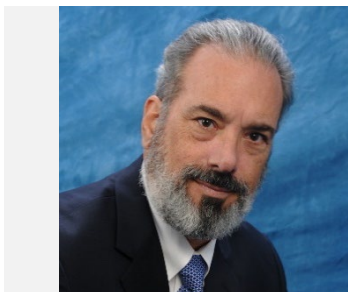
Douglas Pierce

Metallurgist II – Leaching / Freeport-McMoRan Inc.



Jason Tornquist

Sr. Account Manager / Caltrol, Inc.



Daniel Quintero-Clapperton

Global Projects & Key Accounts Mgr. Americas / Emerson



Agenda

Daniel Quintero

Douglas Pierce

Pierce / Tornquist

Jason Tornquist

Pierce / Tornquist

Team

Introduction and Case Context

Introduction to Copper Leaching and Current State

Opportunity to Improve

Solution Details and Implementation

Results and Benefits

Q&A



Freeport-McMoRan Inc.

Freeport-McMoRan (FCX) is a leading international metals company focused on copper, with significant reserves of copper, gold, and molybdenum across diverse, long-lived assets, including the Grasberg minerals district in Indonesia and major operations in the Americas. Headquartered in Phoenix, Arizona, FCX prioritizes safety and health, integrating these principles into its operations to enhance productivity and reduce costs through continuous improvement, training, and incentive programs.

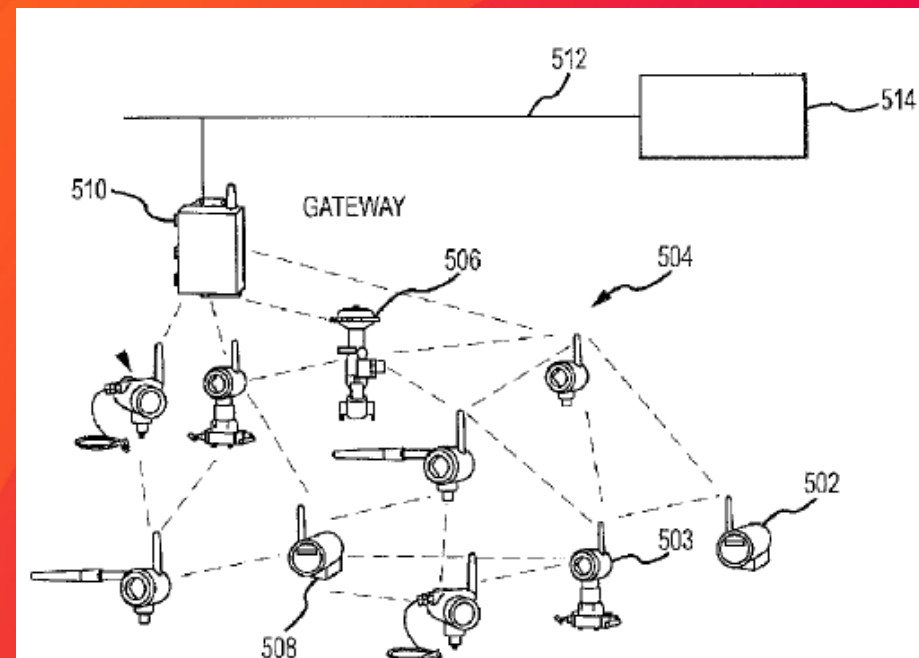
FCX is a founding member of the International Council on Mining and Metals (ICMM). Implementation of the ICMM Sustainable Development Framework across the company results in site-level sustainability programs that meet responsible sourcing objectives for the global marketplace.



Freeport-McMoRan Inc. Patents for Systems and Methods for Monitoring Metal Recovery

US 9,982,321 B2 and US 10,190,190 B2 – May 29, 2018

Various embodiments provide leaching solution monitoring module comprising a first leaching solution distribution system interface, a flow meter in fluid communication with the first leaching solution distribution system interface, the flow meter in fluid communication a 3-way pressure regulator, and a second leaching solution distribution system interface in fluid communication with the 3-way pressure regulator.



(54) **SYSTEMS AND METHODS FOR MONITORING METAL RECOVERY SYSTEMS**

(71) Applicant: **FREEPORT MINERALS CORPORATION**, Phoenix, AZ (US)

(72) Inventors: **John Warren Dean, Jr.**, Thatcher, AZ (US); **Christopher Wooten**, Morenci, AZ (US); **Chase Zenner**, Silver City, NM (US)

(73) Assignee: **FREEPORT MINERALS CORPORATION**, Phoenix, AZ (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days. days.

(21) Appl. No.: **15/539,328**

(22) PCT Filed: **Sep. 14, 2015**

(86) PCT No.: **PCT/US2015/050015**

§ 371 (c)(1),
(2) Date: **Jun. 23, 2017**

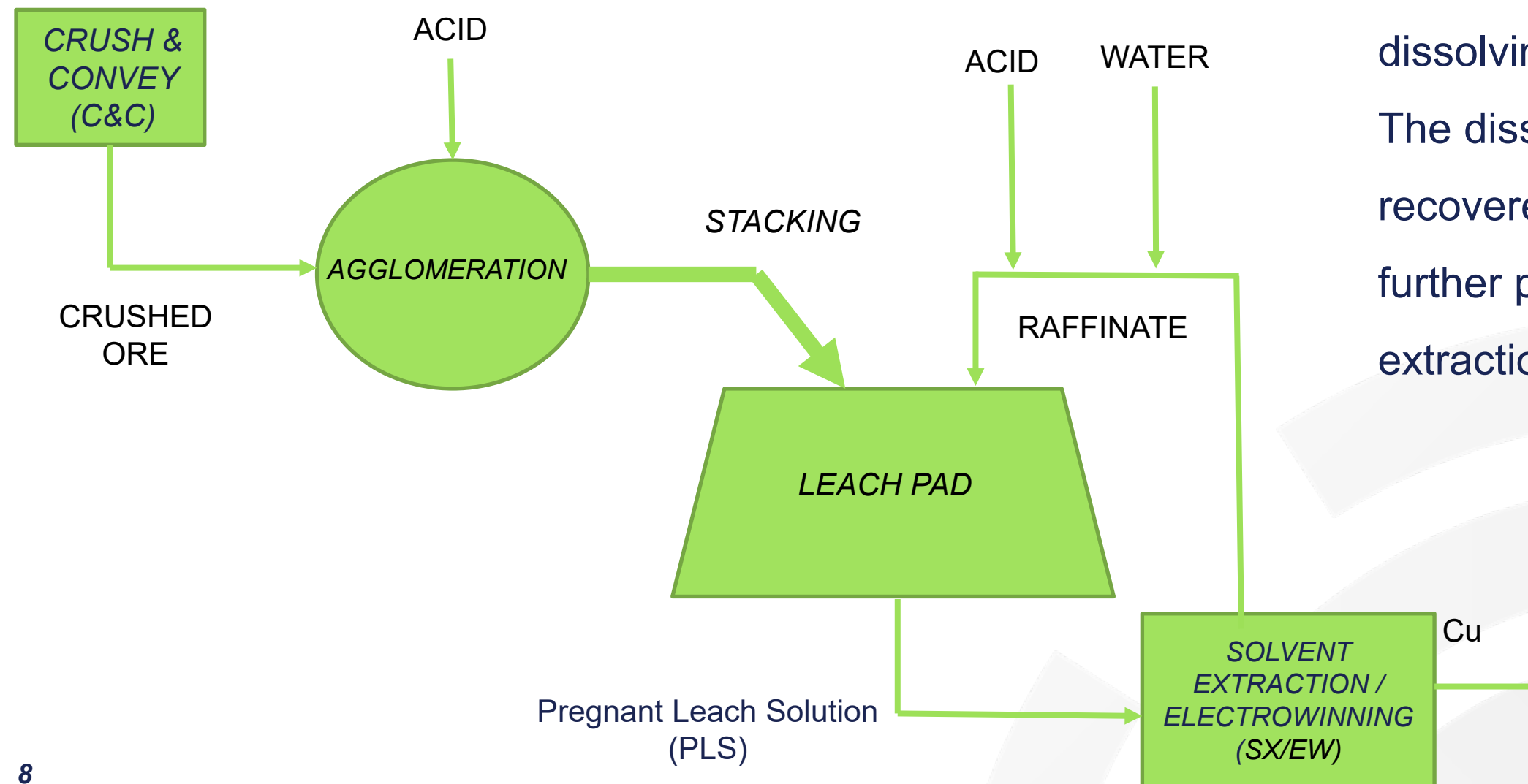
(87) PCT Pub. No.: **WO2016/108959**

PCT Pub. Date: **Jul. 7, 2016**

Brief Introduction to Copper Leaching

Freeport Safford Mine

Leaching Process



A **hydrometallurgical process** of extracting metals from ore by dissolving them in a liquid solvent. The dissolved metals are then recovered from the solution through further processing, such as solvent extraction or electrowinning.

Leach Pad Overview

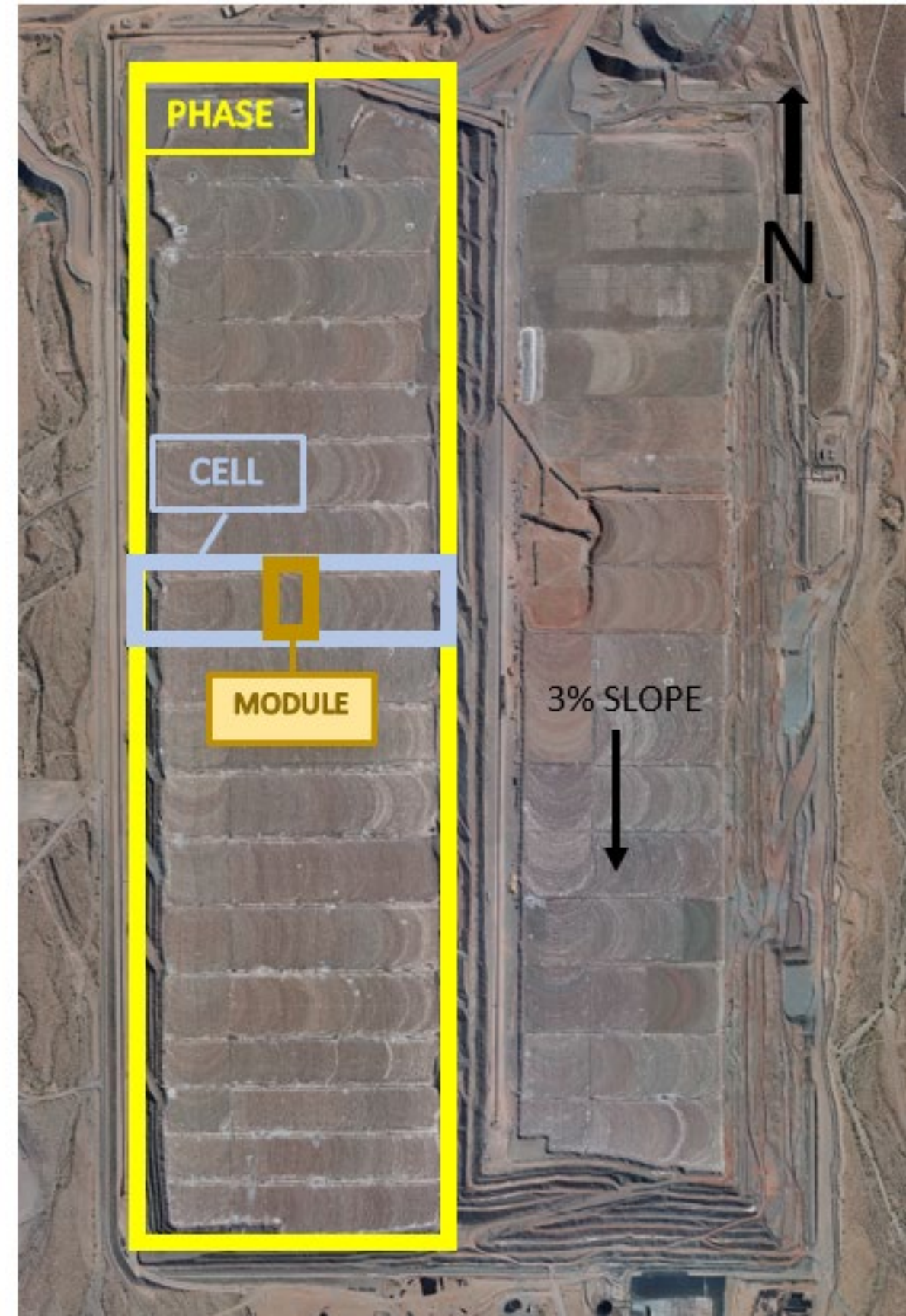


Freeport Safford (AZ) Mine



Design & Construction

- Design for max height of 350 ft., 3 phases, up to 1.6 bn tons of crushed leach ore; phase 1 is 10 lifts each, 16–20 ft. (182 mm tons).
- Lone Star leach pad incorporates 16 cells, 9 modules per cell.
- Each mod is 134,400 sq. ft. Total pad is approx. 19,300,000 sq. ft.
- The pad liner is comprised of a low permeability material compacted with Low Density Polyethylene (LDPE) geo-membrane, 2 ft. of crushed material and 2 ft. ROM material.
- Ore is stacked on the pad using a conveyor/stacker system, which includes overland, portable grass-hoppers and radial stackers.



Operation Stacking

- Ore is crushed to P80 of 0.58".
- Agglomerated with acid and water.
- Conveyed to the pad stacking east to west.
- Retreat stacking so ore is not compacted.
- In preparation for stacking after each leach cycle is completed, the area is stripped of piping and dripline.
- The surface is slightly graded and then ripped with a low ground pressure (LGP) track dozer.
- Residual drilling, stability assurance and any other necessary activities take place during the stripped period before the next lift is stacked.



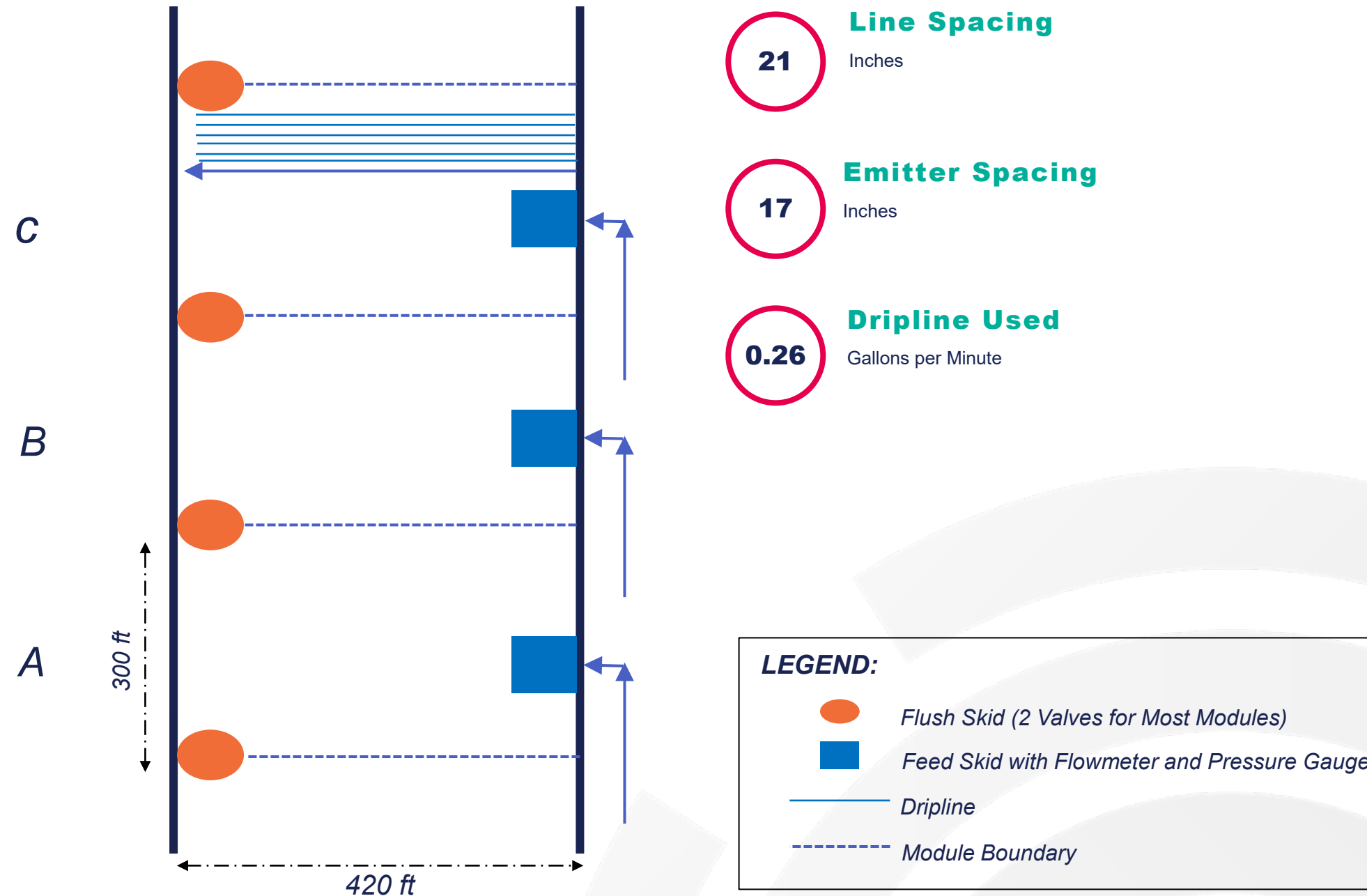
*Agglomerated crushed ore
used at FMI Safford*

Operation Stacking

- Agglomerated material placed on the leach pad by a stacker through a conveyor belt.
- Stacker retreats and stacks 1 cell at a time.
- Closeouts stacked perpendicular in relation to rest of pad.



Controls & Monitoring



Piping Installation



- Crews install new leach drip lines using ATVs.
- Drip lines are connected to feed header and flush line on the other side of the module.

Leach Pads

Location

- Located remotely, they often lack A/C power and conventional communication, making automation difficult.

Typical Size and Area

- Surface area: Can range from 100 to 500 acres.
- Lift height: Typically stacked to a height of 15 to 40 feet and higher.

Volume and Capacity

- Annual capacity: High-capacity pads can process 100,000 to 300,000 tons of ore per day in large operations.



Current State

- **Flow and pressure monitoring:** Managed using Rosemount WirelessHART® systems, providing reliable wireless communication for flow and pressure readings.
- **Lack of automation:** Despite wireless monitoring, the system lacks a Distributed Control System (DCS) or other automated controls, resulting in manual valve actuation.
- **Current setup:** Wireless flowmeters and pressure sensors are connected to manually actuated valves, all mounted on movable skids.
- **Operational challenges:** The system requires frequent manual intervention, which is inefficient, particularly for large-scale operations.
- **Labor-intensive operations:** Managing skids across multiple sites increases labor intensity and operational costs in terms of time and resources.
- **Lack of power:** Absence of A/C power at remote leach pad locations.



Opportunity to Improve

Opportunity: Raffinate Manual Valve Operation

Flow rate is a key variable in applying raffinate to the leaching pad.

While sufficient for basic operation, the current manually operated valve setup presents an **opportunity for improvement**. Automation could significantly reduce inefficiencies and costs.

Opportunity gains pursued:

- Improved control
- Improved safety
- Improved efficiency
- Improved environmental stewardship

Challenges: Power, Local PID Control

Challenges:



Lack of A/C power at remote leach pads

Traditional power sources are impractical, but solar panels integrated into the skid design can provide sufficient power for the actuators. This solution ensures self-sufficiency while supporting sustainability by reducing the operation's carbon footprint.



PID control

Proportional-Integral-Derivative control loop is executed at the actuator (Local), using flow data from sensor and the desired setpoint stored within the actuator.

Conclusion:

- Need power
- Need for automation
- Real-time adaptation
- Integration of actuators

Solution Details and Implementation

Opportunity: Solution Overview



Opportunity: Solution

Solution:

1. Bettis™ RTS-CM intelligent actuator
2. 3051SMV with conditioning orifice plate
3. THUM WirelessHART adapter
4. Solar panel skid with battery backup



Opportunity: Solution

Solution:

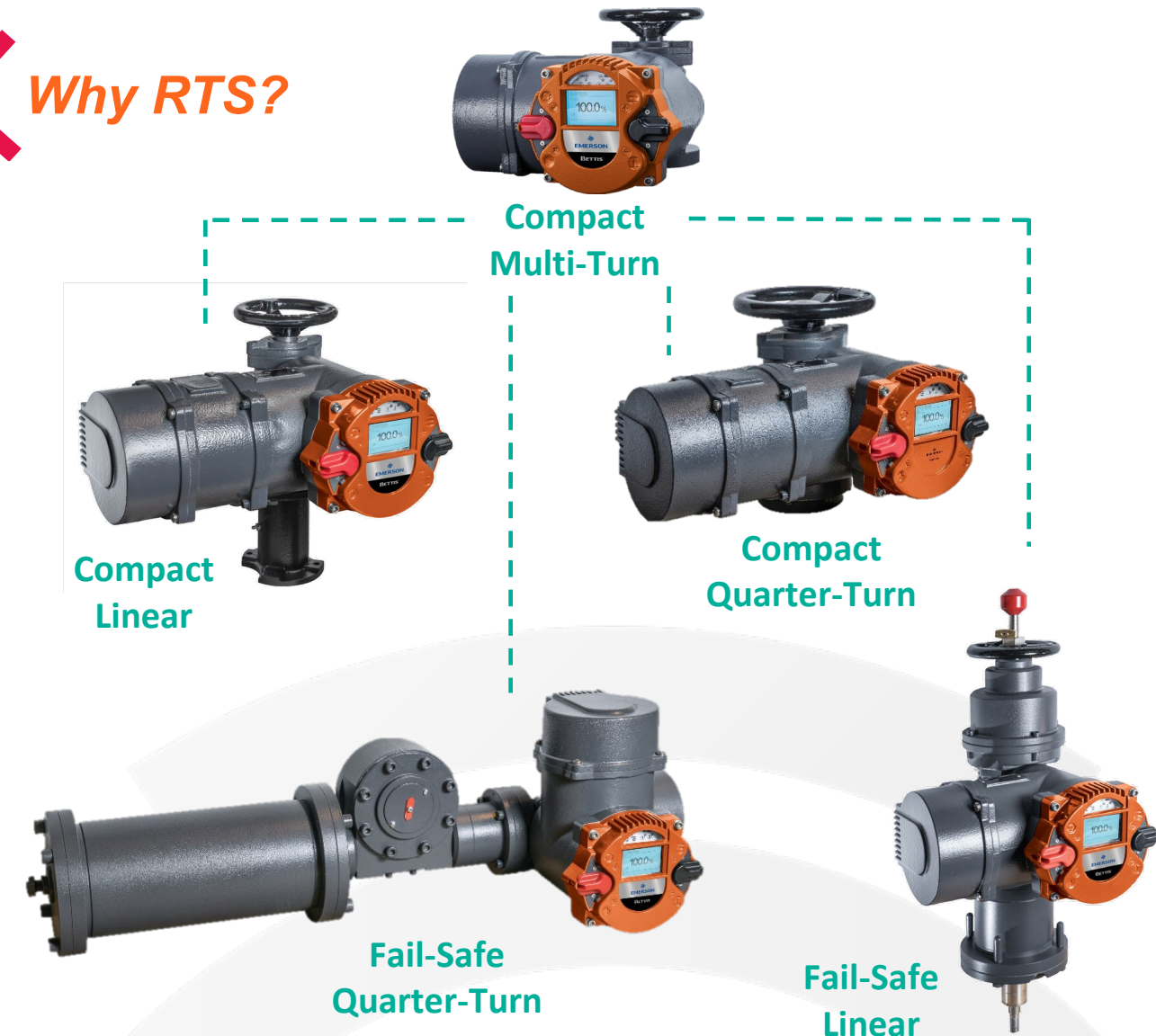
1. Manual operation inefficiencies can be eliminated with automation through the Bettis RTS electric intelligent actuator.
2. Real-time control and remote monitoring were enabled with WirelessHART.
3. Communication infrastructure issues were addressed using WirelessHART, eliminating the need for wiring.
4. 3051SMV provides pressure and flow in a single device.
5. Conditioning orifice plate allows for very low upstream and downstream pipe diameter requirements.
6. Power availability was solved with solar energy.
7. Safety risks to workforce were mitigated with by reducing the number of trips by mine personnel to manually operate the valves.



Opportunity: Solution

- ↔ Valve Size: 2"–12"
- 🌿 Lightweight, compact, zero emissions
- 🛡️ Mechanical fail-safe
- 🕒 Variable speed & PID control
- Continuous modulation S9 / Class D
- 🎯 Position accuracy
- ↔ Modbus®, TCP, HART®, PROFIBUS, PROFINET, Ethernet
- 🏆 NEC500/505, ATEX, IECEx, LVD
IP66 (NEMA 4X), IP67 (NEMA 6), IP68

Why RTS?



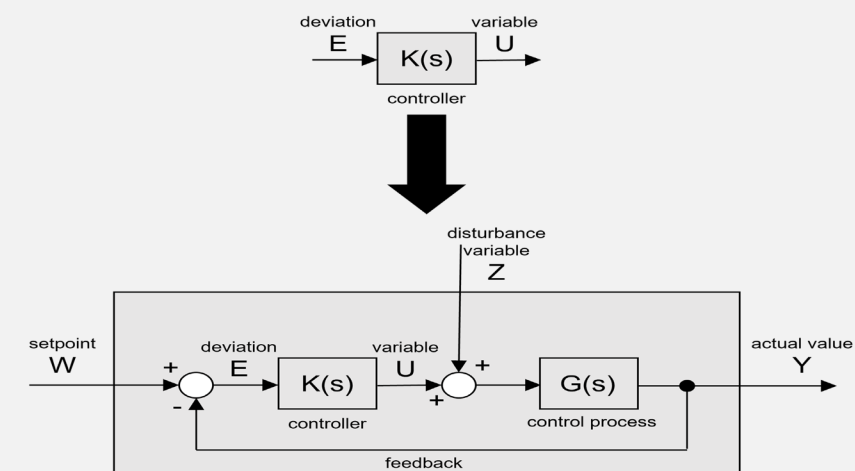
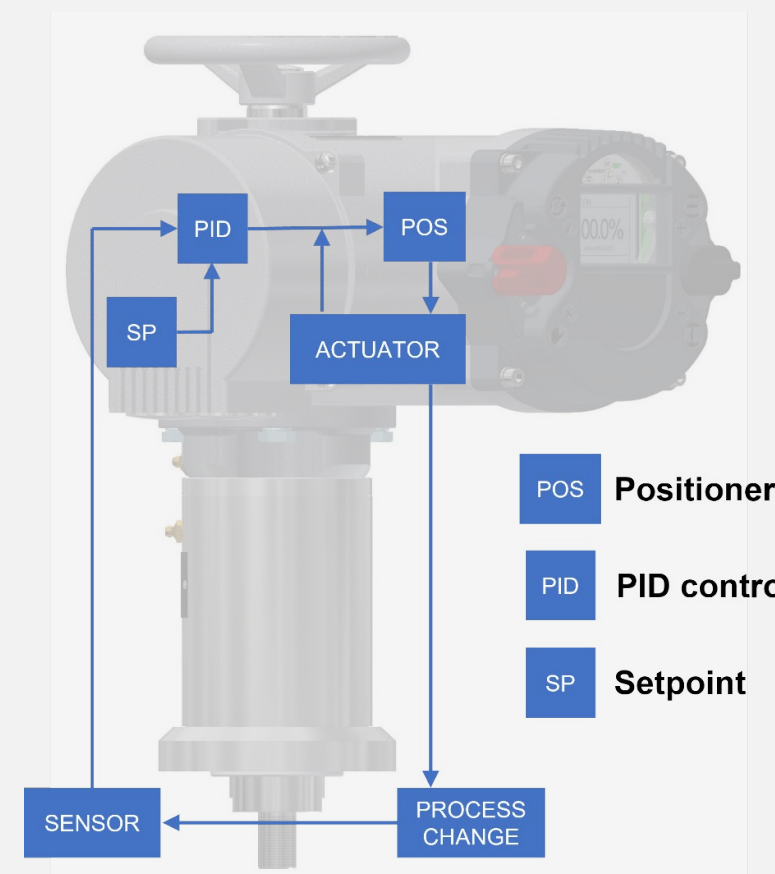
Solution: RTS PID

Solution:

1. Eliminates the need for a remote PLC or PID Loop controller.
2. Allows for real-time control and remote monitoring via WirelessHART.
3. Bluetooth® communication allows for SmartTool programming from laptop.

Limitations:

1. PID programming is difficult but manageable.
2. Difficulty increases without SmartTool.



Schematic Closed Loop Control

Solution: Detail Pictures



Leach control skid as deployed

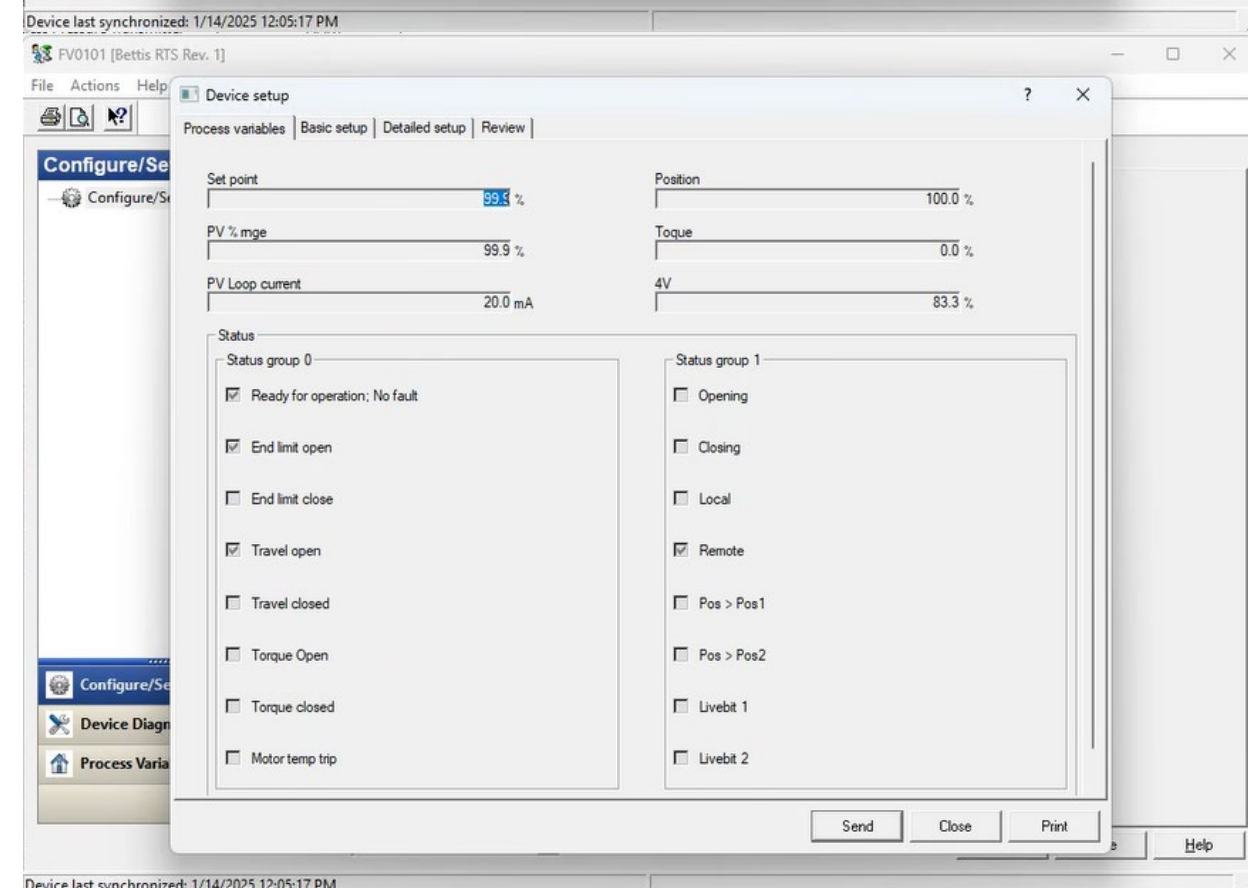
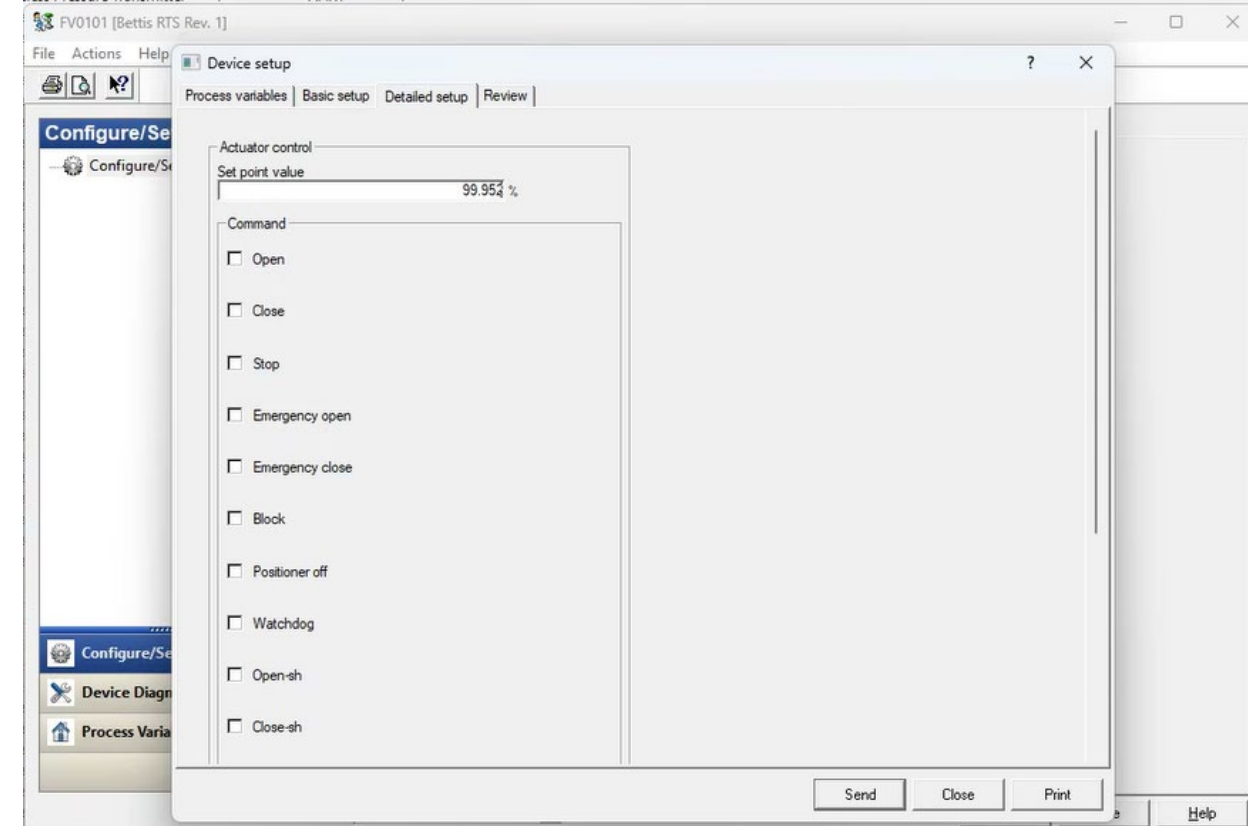


Solution: AMS

1. RTS actuator and all parameters are viewable in AMS.
2. PID setpoint is available on the Detailed Setup tab and can be adjusted.
3. Process variables tab shows Position, Setpoint, and Flowrate.

Limitations

1. RTS transmits and refers to all process and setpoint information in a percentage scale (0 – 100%). No engineering unit conversion natively.
2. Once connected and communicating with HART, AMS or a TRES communicator are the only ways to adjust the PID Setpoint value.



Results and Benefits

Results and Benefits

The implementation of Emerson's RTS actuators, WirelessHART communication, PID control, and solar-powered skids has significantly transformed the efficiency and sustainability of remote leach pad operations. The key benefits realized include:

- 1. Reduced manual intervention:** Automating valve control minimizes the need for manual adjustments.
- 2. Real-time adjustments:** Enables real-time adjustments to flowrate.
- 3. Reliable remote communication:** WirelessHART network allows seamless communication without the need for costly wired infrastructure.
- 4. Precision in flow management:** PID controllers provide precise control over flow rates, ensuring process consistency and accuracy.
- 5. Energy independence:** Solar power makes the system self-sufficient, reducing reliance on external energy sources and aligning with sustainability goals.
- 6. Enhanced safety:** Remote control reduces the exposure of personnel to environmental hazards.
- 7. Cost savings:** Automation reduces operational costs by lowering labor needs and improving efficiency.
- 8. Increased Sustainability:** Renewable energy supports environmental objectives, reducing the carbon footprint of the operation.

Best Practices & Lessons Learned

- Make sure that components are matched to process media (e.g., stainless steel vs. carbon steel).
- Follow best practices for wiring (labels, ferrules, fork/ring).
- Lack of indication on THUM makes troubleshooting wiring mistakes difficult.
- Allow for extended setup time for PID parameters.
- Wireless Gateway must be 1410S; 1410 and 1410D are not compatible.
- Gateway must be running firmware revision 6.7.7 or higher.
- RTS HART DD (device description) needs to be loaded into TREX and AMS. Otherwise, it is confusing to know what each variable represents.



Questions?



EMERSON EXCHANGE 2025

ACCELERATING
INNOVATION

Thank You