



**NALCO** Water  
An Ecolab Company

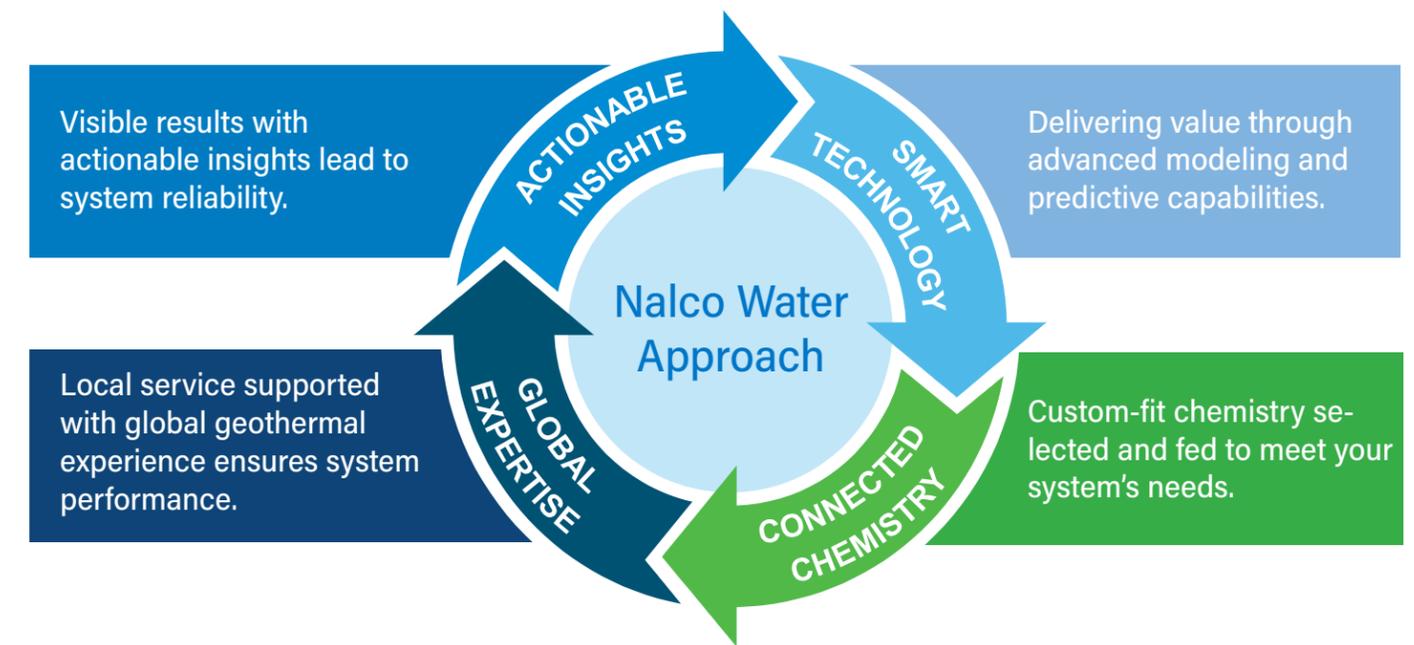
# Your Partner for Sustainable Growth

in the Geothermal Power Industry





# Your Total Solution Partner for Geothermal Power



We create and deliver value that aligns with your key business drivers.



PROFITABILITY



PRODUCTIVITY



HUMAN HEALTH & SAFETY



COSTS



ASSETS

## Ensure Your Plant's Consistent, Sustainable Performance

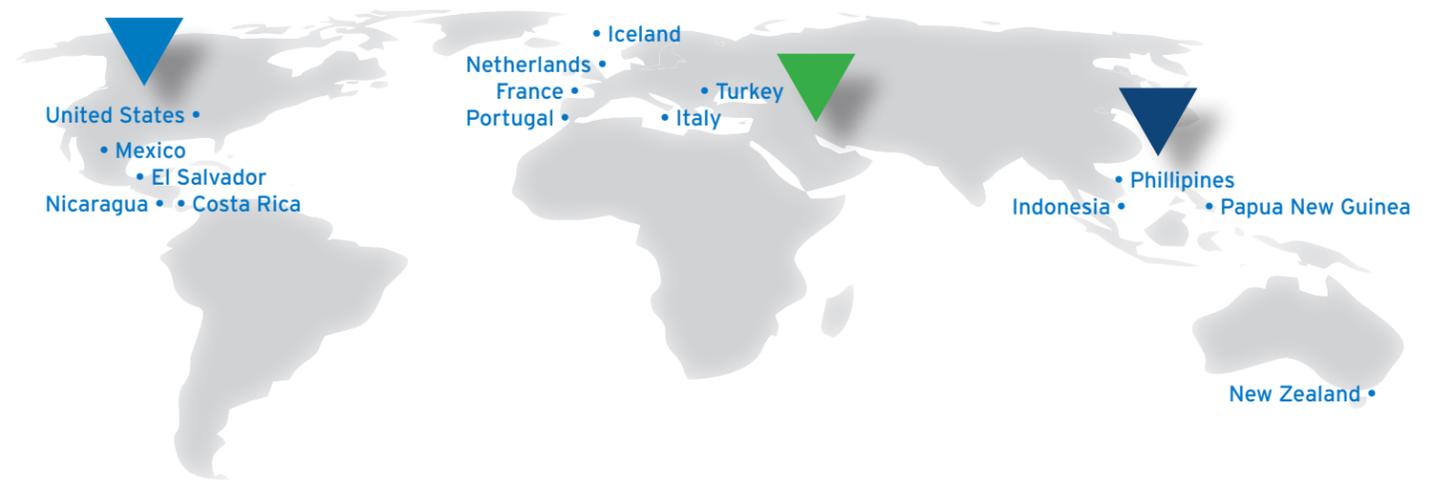
### Digital Innovation

- Geomizer™ Modeling
- 3D TRASAR™ Geothermal
- OMNI™ Performance Monitoring

### Comprehensive Solutions

- Scale Control
- Corrosion Control
- Deposit Removal
- Cooling Water Treatment
- H<sub>2</sub>S Abatement

# Nalco Water Global Geothermal Impact



## ASIA/PACIFIC Scale Control

**Problem:**  
A Philippines geothermal plant experienced near complete pipeline blockage due to scale formation at the mixing point of two wells. Scale accumulated at 0.7 inches per month and required manual removal. With no alternate diversion pipeline, productivity was down 15 MW causing lost revenue of US\$21,600 per day. The plant sought a scale control solution for amorphous silica and corrosion products.

- Solution:**
- Geomizer™ Scenario Modeling
  - Nalco Water Silica Inhibitor
  - Nalco Water Iron Sulfide Dispersant

## NORTH AMERICA Online Well Cleaning

**Problem:**  
A US geothermal plant experienced reduced electrical generation capacity due to a 75% reduction in injectivity to their injection well, which was constricted by deposit buildup. The facility endured ~\$1,200/day in lost revenue opportunity. After an unsuccessful offline acid clean, the plant sought ways to restore well capacity and remove restrictive deposits.

- Solution:**
- Geomizer™ Scenario Modeling
  - Nalco Water online chemical cleaning chemistry

## MIDDLE EAST Corrosion Control

**Problem:**  
A binary geothermal plant in Turkey experienced a total shutdown one year into operation due to severe corrosion. Investigations confirmed corrosive failure across the plant with equipment damage that took nearly two years of shutdown time to replace. After losing two years of revenue-generating productivity and equipment repair costs, the customer sought improved corrosion management.

- Solution:**
- Geomizer™ Scenario Modeling
  - Nalco Water corrosion inhibitor
  - 3D TRASAR™ Technology for geothermal corrosion monitoring

## NORTH AMERICA Cooling Water - H<sub>2</sub>S Abatement

**Problem:**  
Release of H<sub>2</sub>S gases from US geothermal plants presents both worker exposure and environmental emissions concerns. The Hudson Ranch power plant must meet an H<sub>2</sub>S limit of 3.8 lb/hr—equal to an H<sub>2</sub>S removal rate of at least 90-95%. Since typical H<sub>2</sub>S treatment systems are capital intensive, maintenance intensive and unreliable, Hudson Ranch sought a different solution to meeting their H<sub>2</sub>S limit.

- Solution:**
- Nalco Water Patented H<sub>2</sub>S Abatement Program

**PRODUCTIVITY**  
US\$7M / year savings in revenue generating capacity of 15 MW header  
US\$300,000 / year savings in revenue generation through avoiding 14 days mechanical cleaning downtime

**COSTS**  
US\$20,000 / year savings through avoiding mechanical cleanings

**ASSETS**  
Protected 15 MW header from scale deposit buildup and corrosion risk

**PRODUCTIVITY**  
US\$400,000 / year increase in revenue generating capacity through restoring 1 MW productivity in injection well  
US\$7,200 savings in revenue generation through avoiding offline shutdown time for typical cleaning methods

**COSTS**  
US\$100,000 / year savings in reduced maintenance cost compared to acid cleaning of the injection wells

**HUMAN HEALTH & SAFETY**  
Improved safety and handling compared to acid cleaning and hazards of mechanical cleaning

**PRODUCTIVITY**  
US\$1M productivity in MW generation through avoiding 4 months additional corrosion-related shutdown

**COSTS**  
US\$500,000 savings in avoided equipment cost replacement of heat exchanger tubes + 600m pipeline  
US\$50,000 savings in avoided labor and maintenance savings in corrosion repair

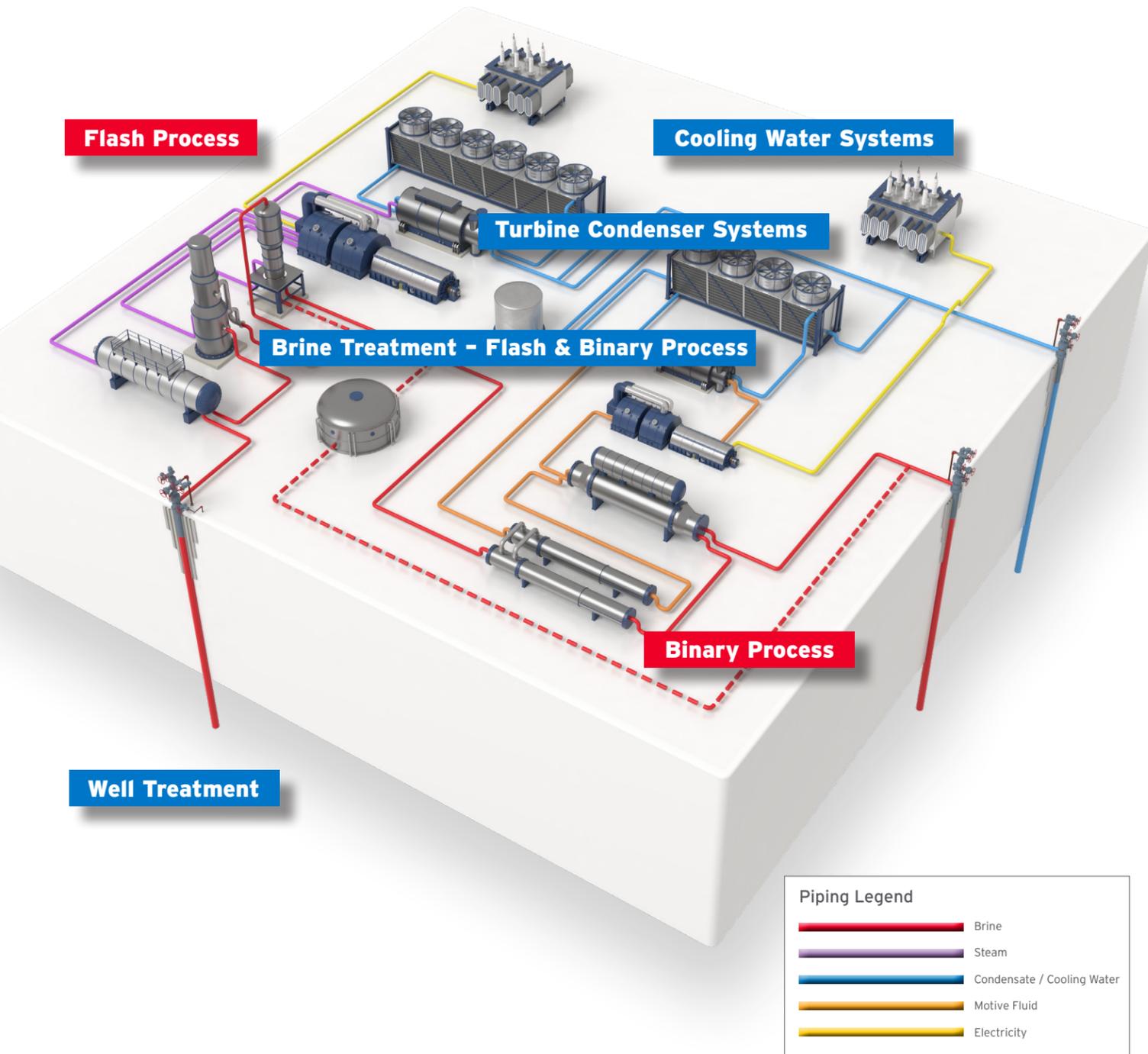
**ASSETS**  
Protected binary plant equipment from corrosive failure and replacement

**AIR**  
262 tons / year reduction in H<sub>2</sub>S emissions

**COSTS**  
\$100,000 / year in net total cost of operation for H<sub>2</sub>S compliance

**HUMAN HEALTH & SAFETY**  
Improved air quality for employees and local environment

# Total Solution Partner to Meet Your Geothermal Needs



## WELL TREATMENT

Flow restriction in production or injection well systems decreases production and increases operating costs. Nalco Water optimizes well flow by removing deposits using safe, proprietary on-line/off-line strategies and by maintaining system cleanliness with advanced scale-inhibition technologies.

Nalco Water Offerings:

- Scale inhibition –  $\text{CaCO}_3$ ,  $\text{CaSO}_4$ ,  $\text{BaSO}_4$ ,  $\text{SiO}_2$ , Metal Silicates, and Metal Sulfides (Al, Fe, Mn)
- Corrosion inhibition
- On-line / off-line deposit removal
- Geomizer™ predictive modeling
- 3D TRASAR™ Geothermal corrosion monitoring

## BRINE TREATMENT - FLASH & BINARY

Nalco Water's proprietary Geomizer modeling tool predicts brine solubility throughout the plant—informing advanced chemistry treatment strategies to inhibit scale deposits and corrosion.

Nalco Water offerings:

- Scale inhibition –  $\text{CaCO}_3$ ,  $\text{CaSO}_4$ ,  $\text{BaSO}_4$ ,  $\text{SiO}_2$ , Metal Silicates, and Metal Sulfides (Al, Fe, Mn)
- Corrosion inhibition
- Geomizer™ predictive modeling
- 3D TRASAR™ Geothermal corrosion monitoring
- On-line deposit removal
- Steam system protection

## TURBINE/CONDENSER SYSTEMS

Nalco Water can help optimize the power output of your geothermal turbines while keeping you in environmental compliance.

Nalco Water offerings:

- OMNI™ advanced analytics for surface condensers and heat exchangers
- On-line cleaning – silicate compounds, calcite
- $\text{H}_2\text{S}$  abatement
- Steam system corrosion protection
- Turbine cleaning

## COOLING WATER SYSTEMS

Nalco Water's expertise in controlling scale, corrosion, and microbial growth in cooling water systems optimizes system performance at the lowest total cost. Our solutions save water and energy by proactively managing your cooling water processes with real-time data that prepares water for optimal condenser performance with increased cycles of concentration in both flash and binary operations.

Nalco Water offerings:

- 3D TRASAR™ Cooling Water Technology
- Cooling Water Optimizer modeling tool
- Scale control
- Corrosion control
- Microbial control
- $\text{H}_2\text{S}$  abatement – patented
- Treatment of condensate make up water sources (high ammonia / dissolved gases)

\*Green indicates digital offerings

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