IPRO 302

Zero Liquid Discharge

The Problem

Sargent and Lundy asked IPRO 302 to find the best way to totally eliminate the waste water discharge from a power plant in Nevada

What's so bad about waste water?

Coal fired powerplants take in clean water, and discharge dirty waste water.

Waste water has high concentrations of nitrite, ammonia, ash, and other contaminants that you don't want to let into the environment.

Zero Liquid Discharge

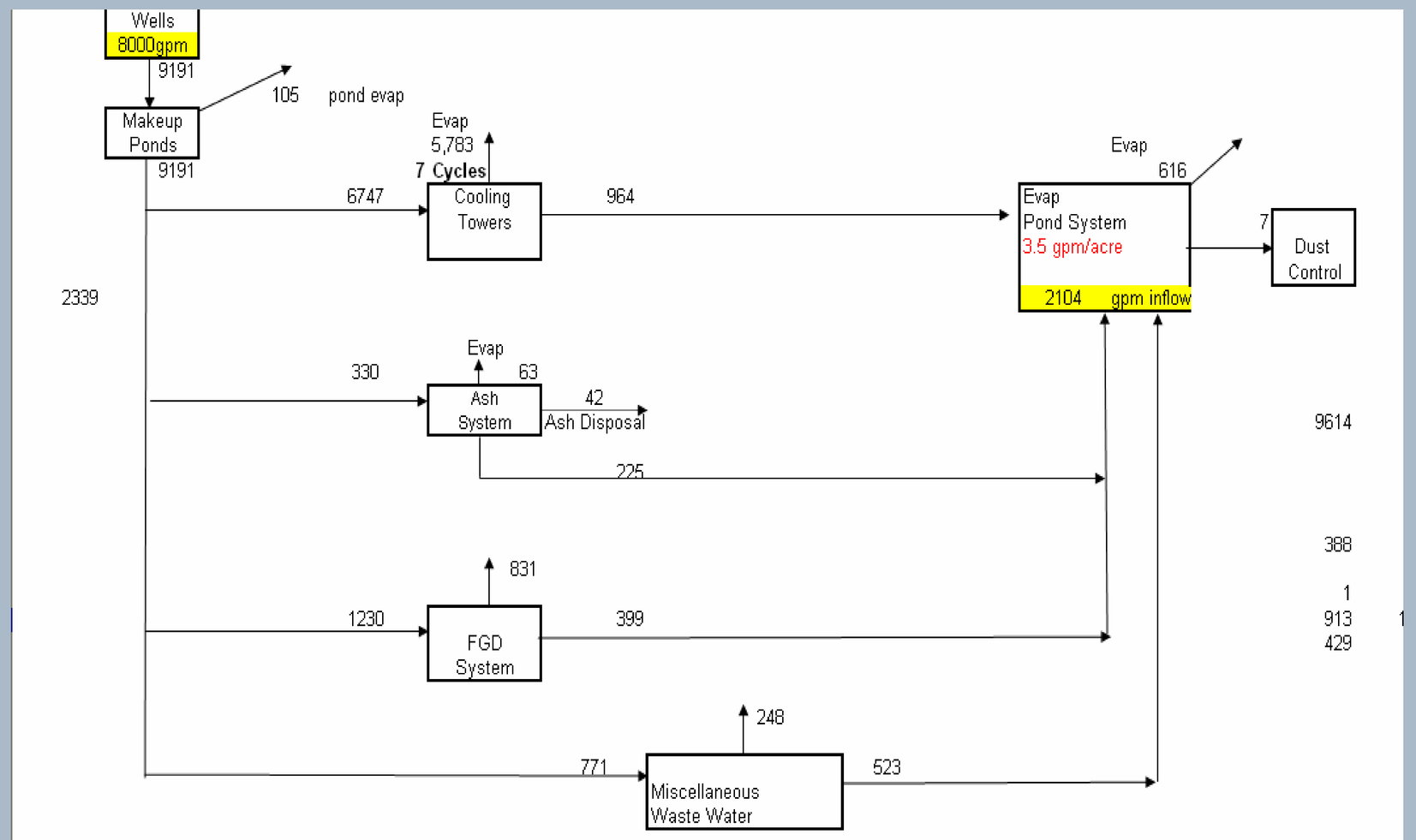
The solution to all of our problems, Zero Liquid Discharge totally eliminates waste water from reentering the environment.

Water Balance

Next, the most technical step in finding the optimum Zero Liquid Discharge solution, was to determine the water balance.

A water balance accounts for all the water in the power plant at different locations. We then will know the concentrations of each stream of the adjusted power plant flow chart above.

We need these concentrations to make sure our system can handle the load.



A full scale Water Balance is very complicated, however the above chart is a simplified version of the water balance for the most efficient zero liquid discharge design process.

The road to a solution…

Zero Liquid Discharge isn't a new idea. Several methods are already widely used by the industry. We had to determine the best combination that would yield both an inexpensive, and effective solution.

Technologies	**Key Factors**
▪ Evaporation Ponds	▪ Cost
▪ Brine Concentrators	▪Capital Costs
▪ Reverse Osmosis	▪Operating Costs
▪ Deep Well Injection	▪ Performance

So many options…where to start?

Our chemical balance was low enough that each of our suggested technologies would be able to handle the incoming stream loads. We now need to determine which system or combination of system would will be the most economically friendly to Sargent & Lundy.

Evaporation Ponds

Evaporation ponds are 3-5 ft deep ponds that expose discharged water to sunlight over maximum surface area to facilitate evaporation. The pollutants that were in the water are left in the pond.

Evaporation ponds are required to be built with a poly vinyl liner that prevents leaks. In most cases they also have fencing around the perimeter to protect local wildlife.

HydroPure
Clean Water. Clean Energy. Clean Living.

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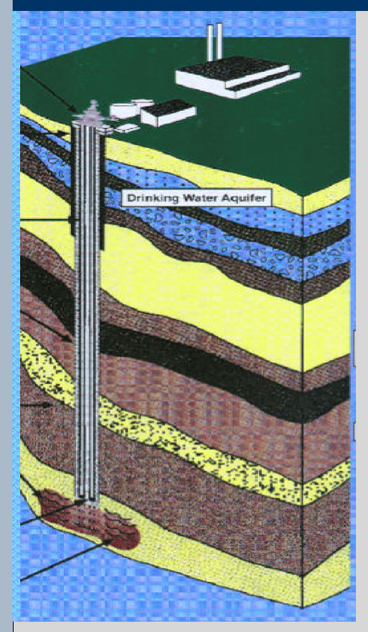
Sargent & Lundy LLC

Deep Wells



Deep Wells are permanent storage sites underground where waste water is injected.

Nevada state law prohibits the use of deep wells throughout the state, so this is not a feasible option.

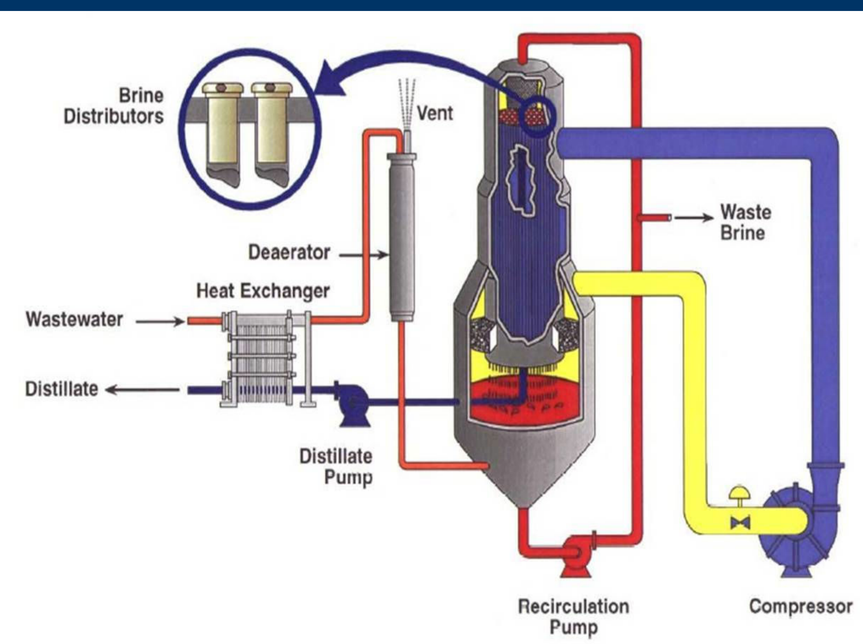
Reverse Osmosis

Reverse Osmosis relies on a membrane filtration system to separate discharge fluid into clean water and concentrated sludge. This technology has low upkeep costs, but has a very high capital cost, making it impractical for smaller scale plants.

Brine Concentrator

Also known as a Vapor Recompression Evaporator, brine concentrators separate waste water into outlet streams of clean water and sludge.

Brine concentrators are very efficient, and allow up to 95% water recovery, however they are expensive to build and maintain.



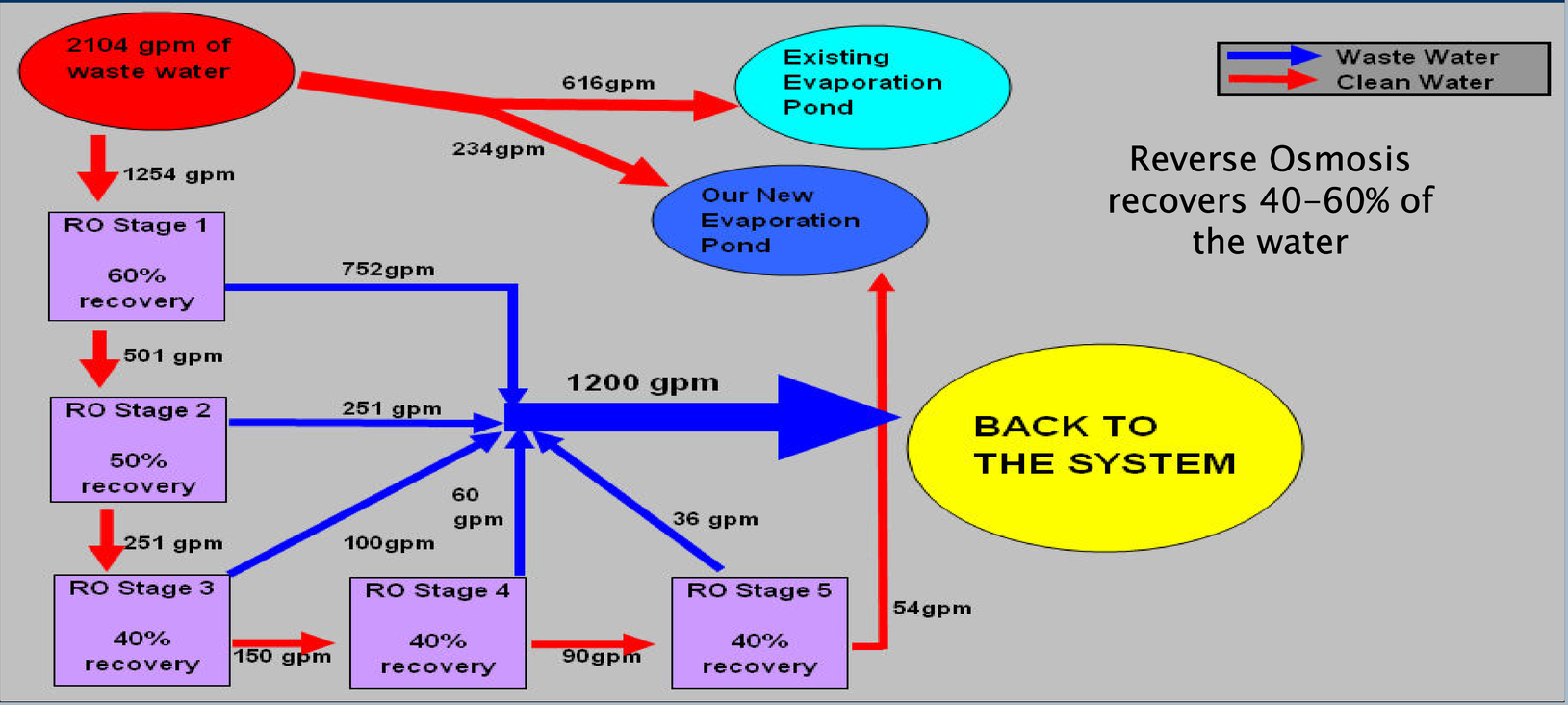
Factors that contribute to the Design Cost

Evaporation Pond
- -Land Area
- -Drainage pump
- -Piping
- -Pond Liners
- -Perimeter Fencing
- -Bird Netting

Brine Concentrator
- -Materials
- -Energy
- -Labor
- -Installation
- - Construction Prices
- - Contractor Expenses

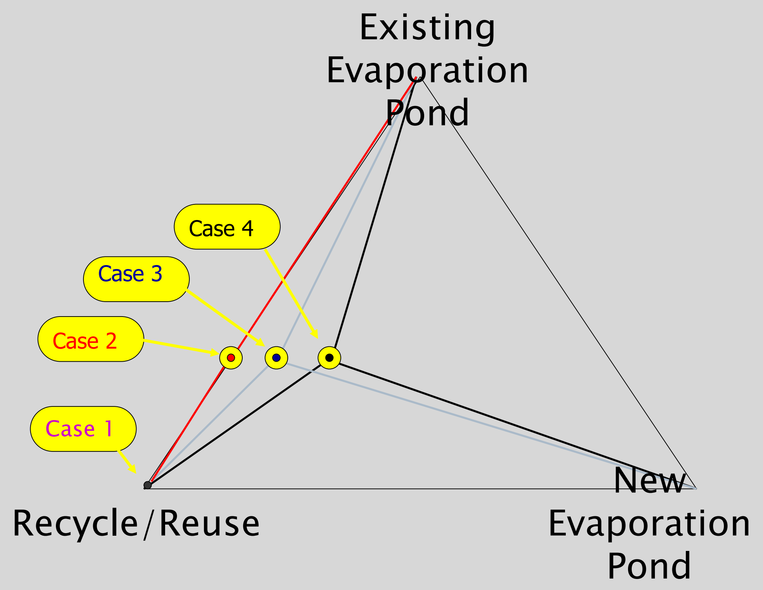
Reverse Osmosis
- -Membrane Replacement
- -Chemical
- -Labor
- - Installation
- -Material/piping

How Our System Works



Reverse Osmosis recovers 40-60% of the water

Possible Cases

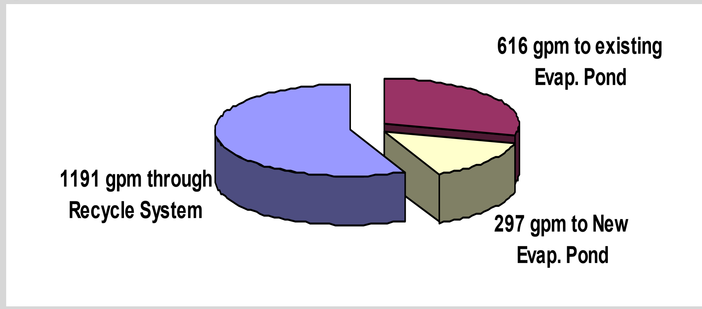


Costs to run Zero Liquid Discharge

	Case 1: 2104gpm	Case 2: 1488gpm	Case 3: 1300gpm	Case 4: 1191gpm
Evap. Pond	$0	$0	$1,824,824	$2,292,282
Brine	$175,442,083	$133,239,424	$119,689,985	$111,652,263
RO	$122,280,924	$86,480,045	$75,733,803	$69,218,907

And the answer is…

The most economical model for zero liquid discharge is a combination of a new reverse osmosis recycle system, full use of the existing evaporation pond and an additional evaporation pond.



Our Suggested System Shown Left