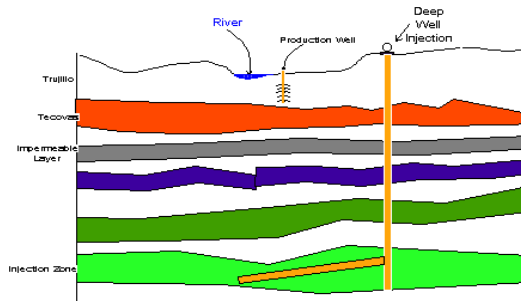


IPRO 302

Deep Well

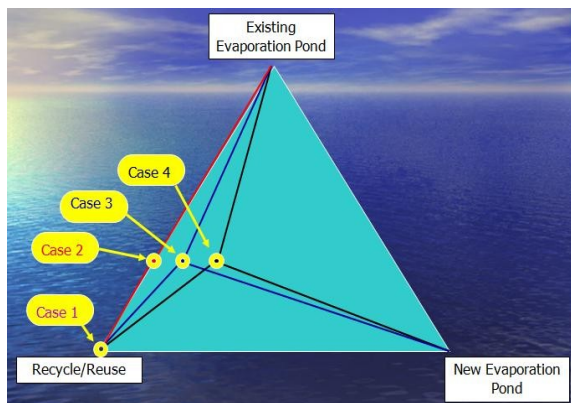
Deep Wells are permanent storage sites underground where waste water is injected. Nevada state law prohibits the use of deep wells throughout the state, so this is not a feasible option.

Schematic of Deep Well Injection Plan



So Many Options

Once each technology was understood, we came up with several different zero liquid discharge models. To find the total cost of each model, we had to perform a water balance on each one.



Case 1: Evaporation Pond = \$0

Brine Concentrator = \$175,442,083

Reverse Osmosis = \$122,280,924

Case 2: Evaporation Pond = \$0

Brine Concentrator = \$133,239,424

Reverse Osmosis = \$86,480,045

Case 3: Evaporation Pond = \$1,841,824

Brine Concentrator = \$119,689,985

Reverse Osmosis = \$75,533,803

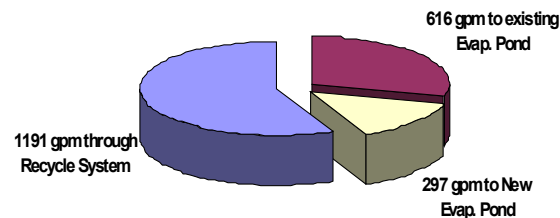
Case 4 Evaporation Pond = \$2,292,282

Brine Concentrator = \$111,652,263

Reverse Osmosis = \$69,218,907

AND THE ANSWER IS....

The most effective and least expensive model for zero liquid discharge is a combination of a reverse osmosis system, and 2 evaporation ponds (case 4).



COSTS TO RUN ZERO LIQUID DISCHARGE

Evaporation Pond = \$2,292,282

Reverse Osmosis = \$38,565,507

Annual = \$4,501,223



IPRO 302

Zero Liquid Discharge



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Problems

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 power plants take in clean water and discharge dirty waste water, which has high concentrations of contaminants that are harmful to the environment.

Zero Liquid Discharge

This method totally eliminates waste water from reentering the environment.

The Solution is the best combination of technologies that would yield both an inexpensive and effective solution.

Technologies

- Evaporation Ponds
- Brine Concentrators
- Reverse Osmosis
- Deep Well Injection

Evaporation Ponds

3-5 ft deep ponds that expose discharge water to sunlight, ambient temperatures, and maximal surface area to facilitate evaporation. The pollutants in the water are dried and sealed to prevent environmental contamination. Ponds range from 15-60 acres.

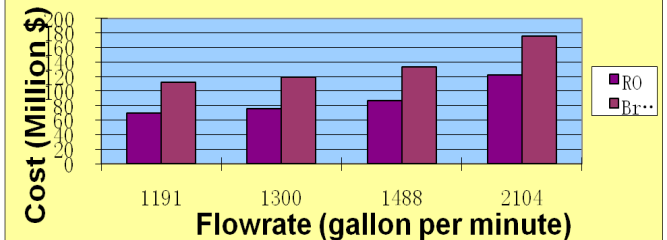


Reverse Osmosis

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.



RO VS Brine



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.

