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IMPERIAL IRRIGATION DISTRICT

December 23, 2009

Mr. Jose Figueroa-Acevedo
California Regional water Quality Control Board
Colorado River Basin Region 7
73-720 Fred Waring Drive, Suite 100
Palm Desert, CA 92260

Subject: Pollution Prevention Plan for the El Centro Generating Station NPDES Permit No. CA0104248

Dear Mr. Figueroa-Acevedo:

Enclosed is the Pollution Prevention Plan for the El Centro Generating Station (ECGS) as required by the California Regional Water Quality Control Board Cease and Desist Order R7-2009-0049. The plan details the analysis of pollutant sources, pollution prevention alternatives analysis, and the implementation plan.

IID is monitoring the copper, selenium, and cyanide levels in the effluent waste stream as required by the NPDES permit. Also, IID is monitoring the use of all chemicals and corrosion levels in the ECGS cooling water systems in an effort to maintain the lowest possible concentration of copper, selenium, and cyanide in the effluent waste stream.

If you need any additional information, please contact Michael Taylor at (760) 339-0506.

Sincerely,

Michael J. Taylor
Gen. Superintendent Generation Plant
Energy Production

Enclosure:

cc: H. Olstowski
M. Taylor

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File: 7A 0128003 ; IID El Centro Generating Station (ECGS); B. Order R7-2009-0020

CALIFORNIA WATER CODE SECTION 13263.3

Pollution Prevention Plan

El Centro Generating Station
485 E. Villa Rd.
El Centro, CA 92243

December 22, 2009

Prepared by:

Imperial Irrigation District
El Centro Generating Station
P.O. Box 937
Imperial, CA 92251

BOARD ORDER R7-2009-0020
NPDES No. CA0104248
CEASE AND DESIST ORDER No. R7-2009-0049

1.0 INTRODUCTION

On May 21, 2009 the California Regional Water Quality Control Board, Colorado River Basin Region adopted CEASE AND DESIST ORDER NO. R7-2009-0049 for the El Centro Generating Station (ECGS). As required by this Cease and Desist Order (CDO), a Pollution Prevention Plan (PPP) has been prepared for free cyanide, copper, and selenium in order to effectively reduce the effluent concentrations by source control measures.

2.0 FACILITY BACKGROUND

Imperial Irrigation District (IID) owns and operates the ECGS power plant located within the city of El Centro. The plant consists of two steam units (i.e., Units #3 and #4) and one combined cycle unit (i.e., Unit #2). The steam units are rated at 46 megawatts (MW) and 77 MW, respectively, and the combined cycle unit is rated at 117 MW (i.e., 85 MW gas turbine and 32 MW steam turbine). All units are cooled using water circulated through unit-specific cooling towers. The facility has a potential to discharge a maximum of 0.995 million gallons per day (MGD) of industrial cooling water to Central Drain No. 5, which flows into the Alamo River and in turn flows to the Salton Sea. Based on current levels of operations of make-up water intake averaging at 1.5 MGD, the average discharge from ECGS to the channel is approximately 0.5 MGD.

Cooling tower circulating water must be treated continuously to maintain the maximum operating efficiency. Water is the bioreactor of life and is both a catalyst for the growth of organic material, especially at the various temperature gradients found in cooling towers, and a medium for inorganic particle circulation. If a buildup of excessive suspended matter in the circulating water of the cooling tower is allowed, it will eventually find flaws in the tower piping and cause blockages and other problems in the piping and pumping apparatus of the tower. This situation will reduce the overall ability of the tower to exchange heat and lower the overall efficiency of the heat transfer.

Additionally, in any tower, make-up water must be added to offset general system losses. This make-up water affects the pH of the water in the system. If the pH is too acidic or alkaline, it can cause corrosion on galvanized cooling towers. As a result, any cooling tower in which the water is left untreated will have high maintenance and energy requirements.

Successful water treatment seeks to mitigate both organic and inorganic circulation through biological remediation and settling of inorganic particulates, while also controlling the pH of the water. For most closed-loop cooling towers, the following types of chemical injections are required

- ♦ Corrosion inhibitors
- ♦ Scale inhibitors

♦ Dispersants

♦ Biological control agents

♦ Coagulants

♦ Flocculants

Internal chemical treatment in the IID cooling towers includes chlorination as an oxidizing biocide and sulfuric acid for pH control. The effluent water is de-chlorinated using a disulfide-based solution prior to discharge to Central Drain No. 5 via an outfall pipe. Table 1 provides a summary of the cooling water treatment chemicals currently used at ECGS.

Table 1. Process Water Treatment Chemicals

Chemical Brand Name	Major Chemical Components	Use
Nalco 1336	Sodium Tolyltriazole	Corrosion Inhibitor
Nalco 7320	Dibromoacetonitrile 2,2-Dibromo-3-nitrilopropionamide Polyethylene Glycol Sodium Bisulfate	Microorganism Control Chemical
Nalco 73202	Sodium Formaldehyde Bisulfite	Cooling Water Dispersant
Nalco 7396	Tetrapotassium Pyrophosphate	Water Stabilization
Nalco 7408	Sodium Bisulfite	Bisulfite Based Dechlorinating Agent
Nalco 8103 plus	Phosphate based anionic polymer	♦ Coagulant and Flocculent ♦

3.0 Analysis of Pollutant Sources

3.1 A description of the sources of pollutants.

Based on the water analyses, two (2) sources contribute to the presence of constituents of concern (i.e. free cyanide, copper, and selenium) in the discharge stream:

- ♦ Metals being added to the process water as it passes through the cooling cycles, and
- ♦ Minerals already present in the source water and are further concentrated through the cooling cycles.

Cyanide is not believed to be in the source water or added in the prosess in any significant quantities. Analysis of the effluent have always been non-detect (ND), however, the detection limit was 5.0 µg/l which does not demonstrate compliance with the new discharge limit. Future testing with lower detection limits is required to resolve this.

3.2 A comprehensive review of processes used that result in the generation and discharge of the pollutants.

3.2.1 Metals added during Process Operations

Chemicals used at the facility to treat the cooling water and process water, presented in Table 1, have been reviewed for potential contributions to the metals/mineral contents in the process water. None of these chemicals were found to contain any of the target minerals in significant concentrations. In addition, the amounts of the chemicals injected are considered negligible compared to the water volume passing through the cooling towers. Therefore, it can be concluded that the chemical injection is not one of the sources that contribute to the increased concentrations of the target minerals.

Another possibility of the increase in the metal concentrations through the cooling cycles is from the equipment. Equipment corrosion, especially corrosion of the condenser tubes, contributes some metals to the process water. Therefore, a review of the water analysis at all cooling units in the ECGS was conducted. The condensers tubes at ECGS are made of brass (copper and zinc) and cupronickel (copper and nickel). A large surface area of condensers, ranging from 10,000 to 20,000 m^2, is exposed to the cooling tower water, leading to potential corrosion. Combining factors such as the high process water flow rate and the large metal surface area of the condensers, even a very low corrosion rate can significantly increase the concentration of copper released from the condensers to the water stream.

3.2.2 Minerals present in Source Water

According to the Summary of Typical Make-up Water and Effluent Water Quality in Table 4, copper and selenium are the target minerals largely present in the source water. The minerals are concentrated by way of evaporation in the cooling towers (approximately 4 cycles of concentration) and through the Reverse Osmosis Demineralization (RO/Demin) process at 80% recovery rate used for boiler make-up and gas turbine inlet evaporative cooling water processes. These processes eventually lead to the increased concentrations of these minerals at levels that become a compliance issue in the discharge water stream.

Table 4. Summary of Typical Make-up Water and Effluent Water Quality

Constituent	Make-up Water	Effluent Water
	Concentration (µg/L)	
Copper (Cu)	< 12	40-190

Selenium (Se)	1.7 – 2.2	5.5 -10
Free Cyanide (CN)	< 5	< 5

(1) 2008-2009 Monthly Effluent Reports
(2) 2008 Canal Water Analyses from URS Corp Wastewater Discharge Compliance Strategy Report dated January 26, 2009
(3) USGS Water Data Report 2008 for Site No. 09522000

4.0 Pollution Prevention Alternatives Analysis

4.1 Provide a description of existing pollution prevention and wastewater treatment methods used by the discharger.

The ECGS typically operates from May to October which are peak demand months for electricity generation. During these months, ECGS relies on a constant and reliable water supply for its process and cooling needs. The generating station utilizes up to 4.9 MGD of fresh water from the Dogwood Canal for this purpose.

Dogwood Canal is one of the earliest built open irrigation canals in the IID, which draws its water from the central main canal. Of particular concern are the levels of copper (Cu), and selenium (Se) that may be present in the canal source water used as the cooling tower make-up. These minerals will be discussed throughout the report as target minerals.

A maximum flow of 0.995 MGD (average flow 0.5 MGD) of process water is discharged from ECGS into the Central Drain No. 5. A significant amount of process water, consisting of the difference between total input and discharge, is lost to evaporation. The major wastewater stream discharged from ECGS consists of blowdown from the cooling towers. Other contributing wastewater streams include the following:

- Steam Generators;
- Evaporative coolers;
- Wash wastes;
- Floor drain wastes;
- Condensate wastes;
- Demineralizer ion exchanger wastes
- Fuel pipeline hydrostatic test water; and
- Reverse Osmosis (RO) membrane reject wastes.

The final effluent is discharged through outfall 001 to Central Drain No. 5 in the North East Quarter of Section 32, T15S, R14E, SBB&M.

Pollution prevention is currently accomplished by controlling corrosion and limiting cycles of concentration in the cooling towers.

4.2 Water Treatment Options - Provide an analysis of pollution prevention activities that may reduce the generation and/or discharge of pollutants, including the application of innovative and alternative technologies. Discuss any adverse environmental impacts that may be caused by the use of these methods.

Several alternative strategies were evaluated to address both source water and process chemicals/corrosion contribution. Available and proven technologies for minerals removal from wastewater were examined as part of the evaluation. The evaluation of treatment options took into consideration the following factors:

- Wastewater chemistry;
- Existing wastewater discharge permit issued to IID, ECGS by California Regional Water Quality Control Board, Colorado River Basin;
- Future discharge requirements;
- Treatment feasibility, including technical and cost effectiveness;
- Waste generation; and
- Ability to achieve compliance with NPDES regulatory criteria.

Section 4.2.1 presents two options for source water treatment. Sections 4.2.2 to 4.2.3 present wastewater treatment options incorporating corrosion control improvement, wastewater purification, and waste mineral reduction. Each recommended option is referenced as numbered in the cost matrix presented in Section 4.3.

These options were evaluated based on the literature reviews of proven and proposed treatment methods for minerals removal, and discussions with key vendors. All designs presented in this report are conceptual and must be validated through pilot testing before proceeding with detail design for implementation. A detailed description of each option is presented as below.

4.2.1 Source Water Treatment

A source water treatment option, which treats the make-up water entering ECGS system prior to the process water stream, was evaluated.

4.2.1.1 Reverse Osmosis (RO)

Technology considered most applicable for managing the source water is Reverse Osmosis (RO), which can reduce the Total Dissolved Solids (TDS) as well as metal/mineral contents.

The benefit of this type of source water treatment is the reduction of mineral concentrations as well as the reduction in TDS concentrations at the source. RO can improve the number of cycles in the cooling towers and thus, increase the level of water conservation at the facility. However, the drawbacks for this option are the high equipment costs associated with it and treatment inefficiency due to the high volume of water (i.e., 4.9 MGD) circulating in the cooling towers. Additionally, the most prominent drawback of this approach is its inability to control the potential contamination of the process water induced by metals added during the cooling process. The concentration of metals contributed from condenser tube_corrosion will exceed the regulatory NPDES limit and require additional discharge water treatment despite the RO source water treatment.

Because of the treatment inefficiency of the RO source water treatment, this alternative is regarded as an unfeasible option for ECGS.

4.2.1.2 Makeup Water Conditioning System

The concept of the Make-up Water Conditioning System, developed by Advanced Chemical Technology, Inc (ACT), is to completely remove all calcium and magnesium from the influent/make-up water by high efficiency ion exchange softening process to prohibit scaling compound forming in the water. The cooling tower can virtually achieve zero blowdown discharge using this technology by maximizing the cycles of concentration. Although silica will not be removed from the make-up water, the silica shall be in either dissolved form or non-adherent amorphous form without the presence of divalent metals (e.g. calcium and magnesium), which eliminates the potential of silica scaling within the cooling units. Minerals, including sodium, silica, chloride and sulfate etc., will be concentrated inside the cooling tower basin. However, they will not post as a concern, since the water in the basin will be transported for offsite disposal periodically instead of being discharged as a constant waste stream.

The main advantage of the ACT process is the lack of a wastewater discharge stream, therefore, eliminating the need to comply with current and future NPDES requirements. The removal of scaling compounds allows the plant operations to maximize the cycles of concentration in the cooling towers and leads to zero-blowdown discharge – no waste stream. The precipitation in the cooling tower basin will require cleaning about one (1) to three (3) times per year.

Addition of corrosion inhibitors would also be eliminated since remaining silica in the circulating water will form sodium polysilicate, which serves as a corrosion inhibitor directly inside the tower basin. The only chemical which will be required to be added to the cooling cycle is a biocide for Legionella bacteria control. Other bacteria and algae growth is inhibited by high TDS and high pH (>9) thereby reducing the amount of biocides required.

However, several factors may affect the treatment and cost efficiencies of this technology. High level of TDS present in the circulating water might increase the corrosion potential. A filtration treatment system will also be required for iron removal prior to the softening process and will increase the capital cost of the system. A corresponding method of disposal is necessary for the highly concentrated circulating water. A preliminary cost estimate of the system can be found in Section 4.3 – Cost Matrix.

Because of regulatory requirements limiting TDS (due to particulate emissions from the cooling tower) in the circulating water systems, this alternative is regarded as an unfeasible option for ECGS.

4.2.2 Corrosion Control Improvement

ECGS currently uses Nalco 1336, Sodium Tolytriazole (TTA), as a copper corrosion inhibitor and Nalco 7320 (halogen) as a microbiological control chemical. TTA protects copper metallurgies by forming an inhibitor layer on the metal surface. However, TTA has one primary shortcoming when used in cooling water treatment programs -the chemical is susceptible to degradation by the halogen. The degradation of TTA when coming in contact with halogen raises several concerns:

- Reduced efficiency -copper and brass alloy corrosion forms reducing the efficiency of TTA as a copper corrosion inhibitor.
- Increased dosage -TTA reacts with the biocide chemical and gets consumed in the bulk cooling water. In order to maintain an adequate supply for the large copper surface area, more TTA has to be added to the system. This results in a higher material cost for TTA.

In order to prevent the increase of copper concentration due to condenser tube corrosion, the investigation of new technology that can better reduce the level of corrosion in the condenser tubing is recommended.

4.2.2.1 Halogen Resistant Azole (HRA)

The application of a better corrosion inhibition technology would provide the benefit of reducing metals in the process water to meet wastewater discharge requirements and would also extend the life of the condenser tubes, which in turn provides economic benefits. Although a new corrosion inhibiting technology may lead to some technical issues in the process of transitioning from one technology to another, as well as potential costs for monitoring the change, benefits of a more efficient corrosion inhibition technology outweigh its shortcomings.

Several commercially available corrosion inhibiting chemical alternatives were evaluated. Of the technologies examined, a new patented azole molecule treatment, developed by General Electric Water and Process Technologies (GE Water), showed to be promising for the implementation at ECGS. The technology is referred as Halogen Resistant Azole (HRA). HRA is an azole-based material that develops an inhibitor layer similar to other azoles, without degradation in the presence of halogen-based oxidizing biocides. This allows HRA to remain efficient in the cooling tower water and hence ensure better corrosion protection for copper and other similar metallurgies. From an environmental perspective, the chemicals in HRA are environmentally safe and are made from EPA permitted substances according to GE Water. Other chemical companies offer comparable products.

In order to determine the effectiveness of HRA developed by GE in comparison to the current corrosion inhibitor used at ECGS, a six week pilot test was conducted. The test was performed by GE Water representatives under the supervisions of URS and IID personnel. A detailed discussion of the pilot test and results is discussed in the following Section. HRA cost is provided in Section 4.3 and is calculated based on the cost provided by GE in the pilot test proposal in Appendix C. The estimated cost assumes GN8103 and AZ 8103 will be fed continuously for 6 months and AZ8104 will be fed once every 3 months.

4.2.2.2 Pilot Test

The pilot test aimed to evaluate the effectiveness of GE patented corrosion inhibitor products - HRA AZ 8103 and AZ 8104 along with the use of GN 8104 (advanced corrosion inhibitor polymer). The corrosion inhibitors were added in Unit 4 Cooling Tower to protect the brass condenser tubes from corrosion and thereby reducing the copper level in the wastewater discharge. The test lasted for 6 ½ weeks, from August 5, 2008 to September 15, 2008. Monitoring measures implemented for the pilot test included daily onsite copper level test, chemical dosage test, chlorine residual readings, oxidation/reduction potential (ORP) readings, and biweekly laboratory tests

4.2.2.3 Pilot Test Conclusions

A comparison was made between the currently used Nalco corrosion control products and GE HRA products on their efficiencies in reducing the copper concentration in the process water. The results of this comparative analysis are presented in the table below. The average copper concentrations at ECGS in May and June 2008 were used as the baseline data for the application of the Nalco corrosion inhibition products. Average copper concentrations, from samples taken during the Pilot Test, were used as the input data for AZ8104 and AZ8103. Please note that only copper concentrations data from the second to fifth weeks were used due to the volatility of data collected from other weeks.

	Nalco1336 (May & June)	**GE – AZ 8104 & GN 8104 (August)**		**GE – AZ 8103 (September)**	
Copper (ppb)	243	184	25% lower	100	59% lower

The results indicate that the HRA products have a greater level of efficiency over the Nalco products as proved in the pilot study. The HRA product AZ 8103 has reduced the copper concentration to 100 ppb, demonstrating good corrosion protection for the brass tubing inside the cooling tower.

Although a significant reduction of copper concentrations in the effluent water was observed, the copper level remained higher than the discharge limit imposed by the NPDES. Concentrations for selenium also remained to be above the permitted levels. A potential cause of the high concentrations may be the relatively high concentration in the source water. Therefore, it can be concluded that using corrosion inhibitors alone are insufficient to ensure compliance for the NPDES discharge limit. A post treatment technology is necessary to serve as a polishing step to further reduce the concentrations of those target metals prior to discharge.

4.2.3 Wastewater Purification / Recycle

Since the HRA corrosion control technology cannot effectively reduce the copper concentration to below the NPDES discharge limit and is unable to treat other target minerals, an additional wastewater treatment shall be introduced prior to discharge.

4.2.3.1 Reverse Osmosis (RO)

RO technology is a commonly used method to treat wastewater with significant TDS and mineral concentrations. It utilizes membrane separation to force clean water to pass through membrane, while retaining solutes in the non-permeable side. It can reduce most of the solutes in water to a very low level. The technology is intended for effluent treatment application, allowing the recovery of process water to be recycled in cooling towers.

The advantages of RO include:

- ♦ Minimal chemical addition;
- ♦ Ability to reduce minerals to low concentrations; and
- ♦ Production of high quality water which can be recycled to the cooling process.

Potential drawback for this option is the generation of an additional waste stream at ECGS, as well as additional capital and O&M costs from the operation of the RO equipment. Depending on the TDS concentration, flow rate, recovery rate, electrical costs, and type of membrane, the O&M cost could be anywhere from $1.5 to $2.75 per thousand gallons (kgal).

Another challenge for the RO system is the disposal of the concentrated waste stream (also known as "brine"). The most common disposal methods include ocean discharge, crystallization, deep well injection, and evaporation ponds. The combination of the RO technology and various brine disposal methods are explained in 2006 Wastewater Discharge Compliance Strategy Report (URS). After discussions with key vendors, two (2) disposal methods were explored as the most feasible options – evaporation pond and crystallization.

4.2.3.3 Fixed RO + Filtration + Evap Pond

A typical fixed RO system generally operates with a 70 -90 % recovery rate, which can significantly reduce the wastewater stream volume. URS examined the GE Water's Hero™ process for this treatment sequence. GE Water stated that the Hero™ can achieve a recovery rate of over 90%. The system utilizes three (3) processes to remove TDS and minerals – cation exchange, degasification reducing scale buildup and increased pH for optimized operation condition. However, the Hero™ system is a relatively small unit and may require multiple units to manage the cooling water flow rate at ECGS. This would multiply the capital costs for this technology. A filtration unit can also be added to the process to further purify the cooling water. The purified water will be recycled back to the cooling operations and in turn dilute the concentrations of minerals in the cooling tower.

4.2.3.3 Microfiltration + Seawater RO + Evap. Pond

In order to lower the capital cost of waste water treatment, a Microfiltration system can be added as a pre-RO treatment process. The advantage of the Microfiltration technology is that it can handle large solids and does not require any polymer addition. The Microfiltration units overcome the effect of anti-scalants to reduce the volume of silica in the water. Silica reacts with Magnesium to form sludge and scaling compounds. Less silica means a lesser volume of sludge required to be treated for disposal. After the wastewater passes through the Microfiltration units, the filtered water will be further polished by a RO system. The RO can remove any additional minerals remains in the water to achieve the low discharge limit imposed by NPDES. The entire system cost is presented in Section 7.5 and the Siemens cost proposal is attached in Appendix E.

4.2.4 Waste Mineral Reduction

4.2.4.1 Biological Treatment

Several biological treatments exist commercially to reduce mineral concentrations in wastewater. These treatments consist of the application of a bioreactor containing microbial organisms (sustained in a media), which feed on specific minerals. URS examined the possibility of applying such a biological treatment at ECGS, by examining commercially available treatment technologies for the reduction of the specific minerals found in the wastewater from ECGS.

The investigation of available biological treatment technologies showed that it may not to be a favorable option for application of wastewater treatment at ECGS. Although some commercially available treatments (such as the ABMET/GE system -used for lowering selenium concentrations to very low levels) were found to be effective at reducing some contaminant constituents, no single treatments were found to be able to reduce the elevated concentrations of all target minerals found in the wastewater at ECGS. Microorganisms used for biological treatment are very specific in the mineral components which they extracted and used as nutrients. Finding a microorganism colony that would provide reduction of all the minerals that require reduction in the ECGS wastewater would be a very difficult and costly process. Most commercially available systems would only provide reduction of one or two mineral constituents, which would prove inefficient for the application at ECGS. Additionally, the application of biological treatment would require a continuous flow of wastewater into the reactors to maintain the microorganism culture within the media alive. Since ECGS is classified as a peaking plant and does not operate on a continuous basis, a continuous flow into the reactors could not be achieved. Therefore, a biological treatment is not recommended.

4.2.4.2 Oxidation/Precipitation – MetClean

This technology works by first oxidizing metals to a higher valent form and then precipitating metal solids from either metal hydroxide or sulfate deposits. Veolia's MetClean is an example of a package unit of oxidation and precipitation process. The basic principle behind the MetClean process is the adsorption and oxidation process of FE(II) and/or MN(II) on the surfaces of a fluidized inert material bed. These surfaces continuously grow and encapsulate the removed metals until the granulate grows to about double or triple its weight and is then replaced.

Instead of sludge, the waste product resulting from the treatment is a granule with a dry solids content of 80 to 90 percent. The amount (weight basis) of residual are only 20 to 25 percent compared to liquid sludge.

This system is effective at reducing minerals such as copper to amounts often less than 10 µg/L. However, MetClean may not be efficient in removal of selenium, especially Se (VI). It is not clear which forms of selenium is present in the effluent water.

The application of an oxidation/reduction package treatment, such as MetClean, could prove to be a more cost effective solution than other methods discussed in this report. Waste produced from the treatment is relatively smaller in quantity than other methods, and could simply be disposed by landfill. However, the application of oxidation/precipitation treatment may prove insufficient to manage all constituents in ECGS's wastewater.

As discussed above, the required low levels of Se may not be achieved without a polishing step by highly selective ion exchange mechanism, which would increase the capital cost significantly.

In addition, MetClean is mainly used in Europe, with only very few application in the United States. Most of MetClean's past projects are in small scales for flow rates between 150L/h (0.66 gpm) to 30 m^3/h (132 gpm). Thus, the effectiveness of implementing the technology in such a large scale is unverified.

4.2.4.3 Selective Media Adsorption/ Ion Exchange

This technology uses highly selective adsorption media or ion exchange resins, with high selectivity of multivalent ions, to remove minerals, such as Cu, Zn, Fe, Ni, Se, etc. The process is not intended to reduce TDS levels, but to decrease the concentrations of target contaminants to desired values.

A two-stage ion exchange (i.e., a chelating exchange column plus a scavenger column) treatment is best suited for application at ECGS. The first stage will remove copper, while the second stage will remove selenium, in the form of Selenite. This alternative can potentially reduce concentrations of Cu, Ni, Se, and other multi-valent minerals present in water (without treating TDS). Several commercially available selective resins are listed below:

- Dow XUS 43578 Copper
- Dow DOWEX M-4195 Copper
- Dow ADSORBSIA GTO Selenite

The biggest challenge of this option is that the presence of high concentration of sulfate makes the process very inefficient. Several batch tests have been conducted by Siemens showing that only copper level has been reduced near the discharge limit and all other target metals failed to be removed.

In addition to the aforementioned drawback, the application of selective ion exchange also presents the following disadvantages:

- High TDS content (post cooling tower) remaining in water may affect the treatment efficiency.
- The process may provide calcium sulfate and iron precipitation fouling.
- Irreversible organic adsorption may permanently decrease anion resin capacity.
- Selective ion resins can be damage by chlorine in water.
- A new waste stream will be created if on site resin regeneration is performed.
- pH needs to be adjusted prior to and after the ion exchange system.

Due to the unsuccessful results of the batch testing performed by Siemens, this option is considered impractical for IID at this stage unless further testing show evidence of improvement. Therefore, a cost for a selective media adsorption / ion exchange system is not proposed in this report.

4.2.5 Deep Well Injection for Disposal

Injection wells place treated or untreated liquid waste into geologic formations that have no potential to allow migration of contaminants into potential potable water aquifers. A typical injection well extends several thousand feet down from the surface into highly saline, permeable injection zones that are confined vertically by impermeable strata. USEPA Class I injection wells are generally constructed by the same rotary drilling methods used for conventional oil and gas production wells. Injection wells are easy to design and maintain and typically experience a life span exceeding 30 years. For many power generating and desalination facilities located in geologically favorable area, the deep well option has been selected as the most cost effective for wastewater disposal.

Based on review of the local geological conditions, deep injection wells are considered an effective technology for the wastewater disposal at ECGS. An application for constructing three deep injection wells has been prepared and is currently under review with USEPA's Underground Injection Control Program.

4.3 Cost Matrix - Provide an analysis, to the extent feasible, of relative costs and benefits of the pollution prevention activities described above.

The following table presents the estimated capital and operating costs for the options discussed in the previous sections of this report. Options 1 and 4 are not seen as viable options for achieving compliance.

Options	Technology	Capital Cost	Construction/ Installation(1)	Total	Monthly Rental Fee	Annual O&M/Disposal Cost
1	HRA	N/A	N/A	N/A	N/A	$120,000(2)
2	RO + Evap Pond	$10,975,000	$12,500,000	$23,475,000	N/A	$225,000(4)
3	Rental RO + Rental Crystallizer(5)	N/A	N/A	N/A	$388,000	$300,000
4	Met-Clean	$2,000,000	$1,500,000	$3,500,000	N/A	[redacted]
5	Injection Wells	$5,720,000	$9,600,000	$15,320,000	N/A	$135,000

Note:

(1) Construction/ Installation cost includes piping, site preparation, control building, and control instrument. Evaporation pond is assumed to be two (2) 3-acre double lined pond.
(2) Annual O&M Cost is estimated based on a 6-month operation period at the Plant. HRA cost is calculated based on the cost provided by GE in the pilot test proposal in Appendix C. Assume GN8103 and AZ 8103 will be fed continuously for 6 months and AZ8104 will be fed once every 3 months.
(3) GE proposal will be submitted directly to IID ECGS under a separate cover.
(4) Annual O&M Cost is estimated based industrial standard $1.0-2.5 per 1000 gallons of influent. This estimate is calculated for a 6month operation period at the Plant.
(5) Veolia rental cost is per email on 11/10/2008 from Chris Howell. Veolia requires a minimum 36-months rental contract
(6) All costs are for budgetary purpose only. Final cost shall be confirmed with contractors.

4.4 CONCLUSIONS AND RECOMMENDATIONS - Provide a description and rationale for the pollution prevention measures selected for implementation.

The evaluation presented in this report was performed by URS to aid IID in determining the best technology for their ECGS facility to remain in compliance with their current and future NPDES wastewater discharge permit (Wastewater Discharge Compliance Strategy and Treatment Option, URS Corp., 01/26/2009). Current wastewater discharge from ECGS has shown to have constituent concentrations exceeding the limits presented in the current and future NPDES permit for the site.

In order to ensure efficiency in removing all minerals which may violate the NPDES permit, URS conducted an investigation to identify the sources of the elevated concentrations and discovered that there are two main sources, which results in the high concentration of minerals in the discharge stream: 1) metals being added to the process water as they pass through the cooling cycles, and 2) minerals already present in the source water and are further concentrated through the cooling cycles.

Various wastewater and process treatment methods were evaluated based on several factors, such as treatability, cost efficiency and most important, compliance ability with current and future the NPDES discharge limit. As part of the evaluation, URS established a pilot test for the application of a new corrosion inhibitor HRA, which reduced the total amount of metals in the wastewater discharge by lowering the level of corrosion in plant equipment. The results indicate that HRA can reduce the copper concentration in the process water. However, the copper level remains above the NPDES discharge limit and HRA does not have any effect on other target minerals. Therefore, URS continued to evaluate various wastewater treatment methods to be implemented with HRA in order to provide the most viable and economically sound solution for ECGS.

Reverse Osmosis (RO) is determined to be a favored technology, due to its effective mineral removal performance. RO significantly reduces the solutes, mostly TDS and mineral, to very low levels by utilizing membrane separation to prevent them from bonding with the water. The resulting water is of high quality and can be recycled back to the cooling towers, thereby, achieving water conservation. Disposal methods, such as evaporation pond or crystallizer, will be required to properly treat the brine solution produced by RO. Further engineering design analysis of the proposed conceptual scheme will be needed to determine the design and construction feasibility, detailed capital and O&M cost, design specifications, and preliminary construction schedules.

Deep well injection is determined to be an alternate technology that will place treated or untreated liquid waste into geologic formations that have no potential to allow migration of contaminants into potential potable water aquifers. For many power generating and desalination facilities located in geologically favorable area, the deep well option has bee selected as the most cost effective for wastewater disposal. Based on review of the local geological conditions, deep injection wells are considered an effective technology for the wastewater disposal at ECGS.

5.0 Implementation Plan

5.1 Provide a statement of pollution prevention goals for the short-term (less than 2 years) and the long-term (two years or more).

The overall short term goal of the Imperial Irrigation District is to remain in compliance with the terms and conditions of the Cease and Desist Order R7-2009-0049 and the current NPDES permit conditions. The long term goal is to work towards a zero discharge solution to solve the compliance issues.

5.2 Provide a detailed description of the tasks and schedule for implementing the pollution prevention activities.

As required by CDO NO. R7-2009-0049 "The Discharger is required to prepare and implement a Pollution Prevention Plan pursuant to Section 13263.3 of the CWC. The Discharger must address the issues specified in Section 13263.3(d)(3) and shall take specific actions as indicated in the following time schedule to achieve compliance with all requirements of Board Order No. R7-2004-0086:"

Milestone	Milestone Description	Milestone Submittal	Completion Date
1	Complete Pollution Prevention Plan	Submit a Copy of the Pollution Prevention Plan to the Regional Board	December 31, 2009
2	Prepare Preliminary Design of the Reverse Osmosis/Evaporation Pond System	Submit a Copy of Design Drawings to the Regional Board	June 30, 2010
3	Complete Final Design of the Reverse Osmosis/Evaporation Pond System	Submit a Copy of Final Design Drawings to the Regional Board	December 31, 2010
4	Complete Construction of the Reverse Osmosis/Evaporation Pond System	Submit Summary and Verification of Construction Completion	December 31, 2011

5.3 Provide a description of the monitoring program designed to measure the effectiveness of the pollution prevention activities in reducing the pollutants of concern.

The IID will continue to monitor the effluent waste stream for the target metals using approved test methods. The test results will be reported on a monthly basis as part of the self monitoring report. The test results will also be compared to historical data to measure the effectiveness of the water treatment program in an effort to reduce the level of target metals in the discharge stream. The water treatment program will be modified as needed to work towards the short term goal of compliance with the Cease and Desist Order #R7-2009-0049 and the NPDES permit.

5.4 Provide a statement that the discharger's existing and planned pollution strategies do not constitute cross media pollution prevention transfers, unless clear environmental benefits of such an approach are identified to the satisfaction of the SWRCB, RWQCB or the POTW, and the information that supports that statement.

The planned strategies that are under consideration will not cause cross media pollution transfers. The RO based waste water treatment system with disposal to an evaporation pond will remove the target metals from the waterways. The evaporation pond material that will need to be disposed of periodically will be sent to the appropriate hazardous waste landfill and thereby avoid reintroducing this material to the environment. The alternative strategy under consideration, deep well injection, will stop all effluent discharge from the site and remove target metals from the waterways. The water will be injected into EPA class 1 disposal well which will prevent the target metals from contaminating potential sources of underground drinking water or the environment.