EES

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Environmental Impacts associated with the construction and operation of an enhanced evaporation system to control salinity of the salton sea.

History:

In a Study of the Feasibility of a Solar Salt Pond Generating facility in the State of California Ormat Turbines first proposed this idea in 1980. An updated proposal was submitted in the Salton Sea Project, Preliminary Study in March 1989. This alternative was included in Meyer Resources Inc. in the Summary Analysis of Authorities and Responsibilities Associated with the Salton Sea (1988) IID and the County of Imperial discussed this approach in the Salton Sea Mitigation Plan Phase in 1988. These proposals were for a complete solar electrical generation system which would be composed of 4 modules (2.0 x 1.2 miles each) and would be composed of 612 acres of EES, 4 and up to 8 1.0MW Ormat Energy converters, 4 and up to 8 40 acre ponds solar ponds, a 75 acre crystallization pond and possibly one deep injection well. Four of these modules would evaporate 225,000 AF per year. These proposals included the following cost figures in 1996 dollars.

	4 modules	9 modules
Construction	186 million	418.5 million
annual OME&R	6 million	13.5 million

These costs did not include disposal costs for evaporated salts from the EES beds and periodic adjustment of the EES

Assuming a 10 year life for the lining under the Solar pond and EES system, replacement costs would total over 48.6 million every ten years . As the OME&R costs exceeded the 10 million annual threshold this alternative was deleted from consideration in the September 1997 Alternative Evaluation.

Current Plans

The Bureau of Reclamation is evaluating the feasibility of constructing two enhanced evaporation systems without the Solar pond electrical system having a total surface area of 19.6 sq miles. Water would be pumped from the Salton Sea to a filtering system and then to (up to) 145 foot towers into hoses with multiple nozzles suspended between the towers. The water would be sprayed through nozzles allowing evaporation of the water and deposition of saline brines below the towers. This would probably be a two pass system to concentrate the brine which would then be sent to evaporation ponds to evaporate to completion. The EES ponds would be in the range of 60,000 to 350,000 ppm. This would result in an extensive wall of water droplets in the region.

Description of the EES system

The system is sized to process 225-250,000 AF/yr. The total EES area is approximately 12.5 sq. mi. (7.5 sq. mi. on the west near Bombay Beach and 5 sq. mi. on the west near the Salton sea test base.
In addition an evaporation pond area of approximately 7.1 sq. mi. (4.3 sq. mi. on the east and 2.8 sq. mi. on the west) . The design would e composed of basic modules which would evaporate 25,000 AF/yr per module (10 modules for 250,000 AF/yr. Each of these modules would be approximately 1.25 sq. miles with two 312 acre EES ponds and one 75 acre crystallization pond plus a smaller sand filter pond. The concentrated brine out of the EES system is approximately 35% wt, TDS. It is unclear how many towers will be utilized in each module however, the preliminary study results for the Pilot test system speak of two towers in a 10-20 acre pond which would translate to 32-64 145 foot towers per full scale module. This design would result in a total of 320-640 towers for the final site.

Currently, a pilot test system is envisioned for the southwest side of the sea at the Salton Sea Test Base which will utilize adjustable towers (85-150 ft) and a ten to twenty acre clay lined pond constructed on shore under the EES.

Current assumptions are that the full scale system will be shut down at wind speeds above 14 mph to ensure no environmental

impact from drift. The current model assumes 18/hr day average operation at the Salton Sea.

Each module would treat 25,000 AF/yr. which would result in the deposition of 320 x 10 third metric tons per year salt in the EES pond and 1.11 metric tons per year salt in the evaporation ponds which would result in a total annual salt deposit of 14.3x 10 to the 6? in unlined and uncovered pans.

Construction of the ponds possibly would not be as extensive as required for the evaporation only ponds but would have similar environmental effects.

Other EES Systems

Currently to our knowledge there is only one system in full operation. This South African Mine system is thought to be a specialized system composed of a single pond with five towers which is used to concentrate acid solutions for platinum recovery. It is unknown whether this is a saline water system but appears to be a acid mine water metals concentration system for the recovery of platinum. If this is correct there are major differences between this system and a saline water system.

Previously, there was a system in Israel which was a small scale EES and solar electrical system which was shut down due to wind drift problems into surrounding agricultural lands.

Another small system was developed in El Paso Texas as an evaporation pond (3355 m sq. solar electrical production system which operated and attempted to utilize a small enhanced evaporation net system to increase the evaporation rate without increasing pond size. Ormat designed two fifty meter sq. nets . Brine was pumped through an irrigation type drip tube at the top of the nets which were 2 meters high. Initially the system performed well evaporating 25% of the water in the brine on a single pass. Later, a automatic shutdown system for high winds or piping failure had to be installed. Debris frequently clogged the system and the nets deteriorated badly in one year. Another net was tested which was more successful but due to clogging and unscheduled shutdowns the enhanced evaporation scheme was abandoned and an additional

1600 meter evaporation was built.(Swift,A.H.P. and Golding,Peter(1992).
It appears that this system has been in operation only on a very small scale since being proposed in 1980 and is an unproved technology on the scale required for the lowering of the salinity of the Salton Sea.

Potential Environmental Impacts

Impacts identified during a workshop held at San Diego State University on June 17 and attended by
Harry Remmers Bureau of Reclamation
Laslo J. Stijj Cal Poly Pomona
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Dean Sarto ARB

Construction:

Development of ponds and road sites will involve extensive modification of the region and would have similar impacts as mentioned in the development of the evaporation ponds by Doyle(1999)

Cultural Resources:

There is an extensive history of cultural resources near Bombay Beach and near the Test Base. Tetra Tech is reviewing this information

Presence of wetlands or permanent streams.

The presence of any wetlands or permanent streams in the area should be determined and mitigation may be required if damage is done to these resources. Tetra Tech is reviewing the available information

Intake Systems:

Previous systems according to the current information available were situated in areas of acid mine waters or oligotrophic

saline waters. There is no reference to location of these systems in areas of hypereuthrophic systems. The requirements of the drip system may require an extensive filter system which can successfully remove the organics present as well as some of the salts which are close to supersaturation. This residue from the filter system may have toxic elements and may need to be considered as hazardous waste and treated as such. Literature searches were unable to find any references to organics effects in evaporation systems.

Spray

depending on the pretreatment system the spray may offer environmental problems in several areas. There is a question brought forth by John Faukner of Scripps as to whether a system of this size will form its own microclimate and perhaps form a cloud system which would move downwind. Consultations with the Cloud group at Scripps did not shed any light on this possibility.

The extensive spray systems would act as a curtain with the possibility of exposure of birds flying into the spray and being exposed to flash evaporation of salts on their feathers. Salt encrustation from rapid cooling of a lake resulting in supersaturation and flash crystallization of the salt have been reported(Wobeser,G., Howard J.(1987)

Evaporation pans would have the same problems as Doyle(1999) discussed.

Winds

Winds have a large affect on the utilization on the EES system. Review of the CD Rom of the Wildlife Refuge data gave the following results.

Wind Records : 1953 winds to 70 mph Jan Feb. march April Spring 53 windiest and coolest since records kept in the valley. On 14 days May winds av. 15 mph or better for entire 24 hour day with frequent gusts to 25 mph The communities of Brawley and Westmoreland were covered with towering walls of dust.

Cot 18th wind gusts to 38mph, DEC 5 48 mph with tons of wind blown dust from western deserts.
1954-Feb.13,14,26 winds to 50 mph March 10 days exceeding 40 mph with gusts to 50 mph. April winds every day with closing of highway 99. March 29 strong persistent winds checked the westward flow of the New River and silt deposits closed the outlet.
1954 winds of 65 mph and wind borne clouds to 16,000 feet. Days of >25mph at Sealey May 10, June 13, July 6 Aug. 5
1955 winds over 25 mph Jan 0, Feb. 9 Mar 14 APR 20 May 16, June 16, July 11 Aug. 10
1956-Jan 8, Feb. 5, Mar 13, APR 13, May 19, June 12 >25 mph
1957 Jan 8, Feb. 5, Mar 13, APR, 13 May 19, June 12>mph
1957 May 17, June 14, Sept. 7, Oct. 11, Nov. 9, DEC 3 >25mph

Flooding -

There is data on the CD database of extensive flooding due to storms which may have significant impacts on the pond system depending on the water flow patterns of the area.

1950 a 1/2 inch downpour caused flooding which blocked highway 99 with deep mud. There was storm damage to IID.
1951 Aug. 26 2" rainfall canals carrying a normal load of some 4000 ft/sec received runoff until dirt banks toppled and holes ripped into system. Hwy 90 west of Westmoreland and highway 80 near Sealy were covered with 3' of water.
1957 high rains 1.13" with hail in Oct.
1959 Jan April the Official Naval weather station Seeley was closed and IID was the only nonoffical source of weather data in the valley
1981 Refuge report on Climatic conditions

The Imperial Valley experienced its third consecutive year of abnormally high rainfall receiving 9.35" this year, three times the 67 year average of 2.87. Only an inch of rain brings farming and other habitat management work to a halt because of the valleys non-porous clay soils which turn into a mud bowl" From Feb. through march 4.43. inches of rain, combined with 30mph winds, completely

eroded 2.5 miles of interior dikes and river levees along the Alamo river into the hazard tract. In early August 3.05" was received.(Refuge records)

Humidity:

1955 reported weeks of high humidity
1964 very high humidity reported.
1967 Weather station installed wildlife refuge. This resulted in the following data:
1967 av. rel hum for year 46.2 with high of 68.7 in Dec.. Evaporation varied from 1.3 in Dec. to 16.12 in June.
Jan 3.20
Feb. 5.32
Mar 8.37
Apr. 11.60
May 14.53
June 16.12
Jul. 15.87
Aug. 14.64
Sept. 9.96
Oct. 8.18
Nov. 3.58
Dec. 1.30

The only data available from 1959 on was supplied by Sarto of the ARB from his RFP proposal which gave occurrences of wind speeds in knots. From the limited data available an EES system with a cutoff wind speed of 14 mph may be shut down by winds for a significant part of the time . In addition the ponds in both regions would be susceptible to flooding and rupture in the storms which have been reported. Humidity would affect the amount of evaporation and the few reports of extensive high humidity would affect the operation of the system.

It is imperative that extensive climatic records be assembled as both proposed areas have extensive reports of high winds and high humidity and flooding occurrences. These factors will greatly

influence the ability of this system to evaporate or retain amount of salts necessary to change the salinity of the sea.

BIRDS:

According to McKenan(1982) there are 3-4 distinct seasons with Spring fall migration.of passerines, winter waterfowl. Night movements are extensive for example 5000 wigeon at Davis Road move in the middle of the night To raft on the sea. In the regions of Bombay Beach and Salton City 70-80,000 birds per hour passed a 1 mi. radar line stationed at Del Rio Golf course and at Mecca spoke to mckenan at museum who has done extensive work on migratory patterns in the sea and has done radar studies from del rio golf course and mecca which looked at birds passing a one mile line at night below 90 meters. found 70,000-80,000 birds passerines? per hour spring fall also 20% movement occurred below 90 meters at night 131-5500/hr, fall 10%below 90 meters. there appears to be significant interference with bird movement and the migratory bird act may be violated by the number of towers and spray utilized in the full scale system.

A review of the literature showed that there was an extensive body of data concerning bird collisions with towers and wires(Avian Collision and Electrocution: An Annotated Bibliography(1995). Weir, R.D. 1976. Annotated bibliography of bird kills at man-made obstacles: a review of the state of the art and solutions. Canadian Wildlife Services, Ontario Region, Ottawa. 85 pp.

Many of these collisions occurred at night in inclement weather or fog. Elkins N. (1988)reported that "Bird mortality caused by inclement weather and collision with power lines and other structures is briefly discussed. "This happens most frequently to nocturnal migrants in dense fog or cloud accompanied by precipitation. The refraction and reflection of light by water droplets increase the sphere of illumination and confuse the migrants. Multiple reports of birds deaths have occurred with fog and changes in weather (Kibbe, D.P. 1975, (Laskey, A.R. 1971)

Migration peaks are also associated with massive bird deaths associated with towers. During 5-8 October 1954, coinciding with an advancing cold front, 25 instances of mortality totaling over 100,000 birds (88 species) were reported from ceilometers, towers, and buildings in the eastern U.S. The most commonly killed species were the ovenbird, magnolia warbler, red-eyed vireo, and chestnut-sided warbler. where an estimated total of 50,000 birds (53 species) died. The massive bird moralities were primarily associated with nocturnal fall migration.(Johnston, D.W. and T.P. Haines. 1957)

A report compiled by NUS Corp(1979 found that the factors found to influence the frequency of collisions include poor visibility due to weather or time of day; weather (winds, rain) which causes birds to fly lower than normal; disturbances and distractions (mating, pursuit of prey); cable size (smaller wires cause greater frequency of collisions than larger ones); age (young birds collide more often than adults); and line location (those below tree tops are less hazardous than more exposed lines). Species with long legs and necks collide more often than those with shorter appendages. High wing loading, as in swans, reduces the ability to maneuver around lines. The report recommends that power lines circumvent wetlands to reduce waterfowl casualties Weir, R.D. 1976.) stated that "Nocturnal bird kills are virtually certain wherever an obstacle extends into the air space where birds are flying in migration. The time of year, sitting, height, lighting and cross-sectional area of the obstacle and weather conditions will determine the magnitude of the kill."

There have been several suggestions that the full sized EES would form it's own microclimate and possibly form clouds which would act as fog. Attempts to discuss this were made with the Cloud group at Scripps but not previous experience with microclimate formation was found.

With the placement of the EES system on the eastern and western edges of the Salton Sea there is a question of interference with bird migration patterns or with the potential of birds losses due to towers, etc. mentioned above. McKernan, R(1984) et all studied the nocturnal and diurnal bird use in the Imperial Valley, Spring and

Fall, 1982. This was one of a number of studies completed on the migration patterns of the Sea. In a study of the Salton Sea KGRA (geothermal resource areas) north of Niland. Radar was utilized to observe nocturnal bird migration for 25 nights during spring and fall. They used the concept of Migration Traffic Rate (MTR)-the number of birds crossing a line 1 km long in 1 hour to express the magnitude of migration.

During 25 nights over 10,000 entries on radar and 976 visual sitting were made. Single nocturnal migrants were songbirds, while flocks were either shorebirds or waterfowl. Single migrants were the most common (92%). During the spring 20% of passerines were flying below 93 meters versus the fall with 10% below 93 meters. Over 40% of the flocks observed in both spring and fall were flying below 100 meters. Fall mean flight tracks were in the southeasterly direction in line with the west coast of Mexico. This study pointed out the extensive nocturnal migration which occurs with most birds passing through by midnight McKernan (1999 phone communication) suggested that use patterns of the sites should be conducted as well as flight patterns of migratory birds.

Other areas requested by Tetra Tech:

Nesting patterns in the southern part of the sea to be addressed by the current contractor

Salt pan use by birds see Doyle discussion

Mono lake Dikes- according to members of the Mono lake committee there were no moats or dikes formed at Mono lake . An attempt was

made to blow up a land bridge which formed with the lowering of the lake which failed. They suggested that any moat would have to be extensive as the water had to get to widths greater than blocks wide before predators would be prevented from swimming there(personal communication 1999"Geoffrey McQuilkin" <geoff@monolake.org>)