Water and Environment Centre

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Environmental Impact Assessment of DESALINATION

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CONTENTS

DESAL. TECH. and its application

EIA classification and steps: ,

EMP: Design Phase:(Air, Water,Land)

Construction Phase: (Air, noize and vibration, safety, hydrology,water, sludge and solidwaste,ecosystem (flora and fauna)

Operation Phase: (air, noise and vibration, hydrology, aquifer, Energy use, water, loss of marine species, sludge and solid waste, brine, temp, turbidity, oxygen)

Consultation and Training:

EMP:CONSTRUCTION AND OPERATION

Desalination

- Desalination is the process of producing water suitable for human consumption **(with 500ppm TDS)** from saline waters such as sea water (with **35000 ppm TDS**) or brackish water **(with 2000 ppm TDS) .**

Desalination technologies:

Process group (phase change)	Process	Process Energy
Distillation or Evaporation based Tech.: (Liquid-→ vabour)	**MSF** (Multi Stage Flash Distillation) Evaporation processes in combination with power plants.	Heat
	MED (Multi Effect Desalination)	Heat
	TVC (Thermal Vapour Compression)	Heat
	MVC (Mechanical vapour Compression)	Electrical Energy
Membrane based Tech.: (No phase change)	**RO** (Reverse Osmosis) A membrane separates 2 solutions .	Electrical Energy
	Electrodialysis A bundle of membranes	Electrical Energy

Desal. Tech. Vs application

Desal. Technologies	Application	comments
Thermal Desalination	seawater and rarely to brackish water	they are energy intensive
Membrane Desalination	seawater and brackish water	pretreatment, scaling, fouling)
multiple membrane systems (RO)		
MF-RO	wastewater reclamation	MF removes the major foulants from the secondary effluent, followed by RO to remove the salts, organics, and microbes.
UF-RO	for brackish water	UF pretreatment, followed by RO to remove salts

Advantages of RO plants over distillation:

- no heating=> no thermal impacts.
- fewer problems with corrosion
- Require lower energy
- High recovery rate 45% for seawater.
- Remove trihalomethane-precursors, Pesticides and bacteria.
- Require less surface area

Criteria for tech. selection

- Sea water quality, pollution situation, trends, and the extraction situation.
- Process design and efficiency
- Construction material and extent of automation.
- Energy, labor and consumable requirements.
- Layout and space requirements
- Environmental Aspects

Cost Considerations

- Design Parameters
  - Salinity
  - Composition
  - Temperature
- Equipment cost
- Energy Import
- O & M Costs
- Service Life of Membranes (RO)
- Site-Related Costs

Positive Environmental Impacts

- Improvements of Quality and Sanitation
- Softening of Water
- Agriculture
  - Soil
  - Drainage
  - Groundwater
- Becoming LessExpensive

Negative Environmental Impacts

- Coastal Land Use
- Aquifer Impact
- Marine Environment Impact
- Noise Pollution
- Intensive Energy Requirements

- Power plant/Desalination plant Combination
  - Dilution of Brine
  - Energy Source
  - One site
- Long Discharge Pipes
- Leak Recording Equipment

- EIA Classification according to WB:
  - A: high impact needs intensive strict mitigation measures
  - B: Medium impact needs medium mitigation mesures
  - C:No impact needs no EIA
- THIS STUDY IS CONSIDERED AS CLASS B

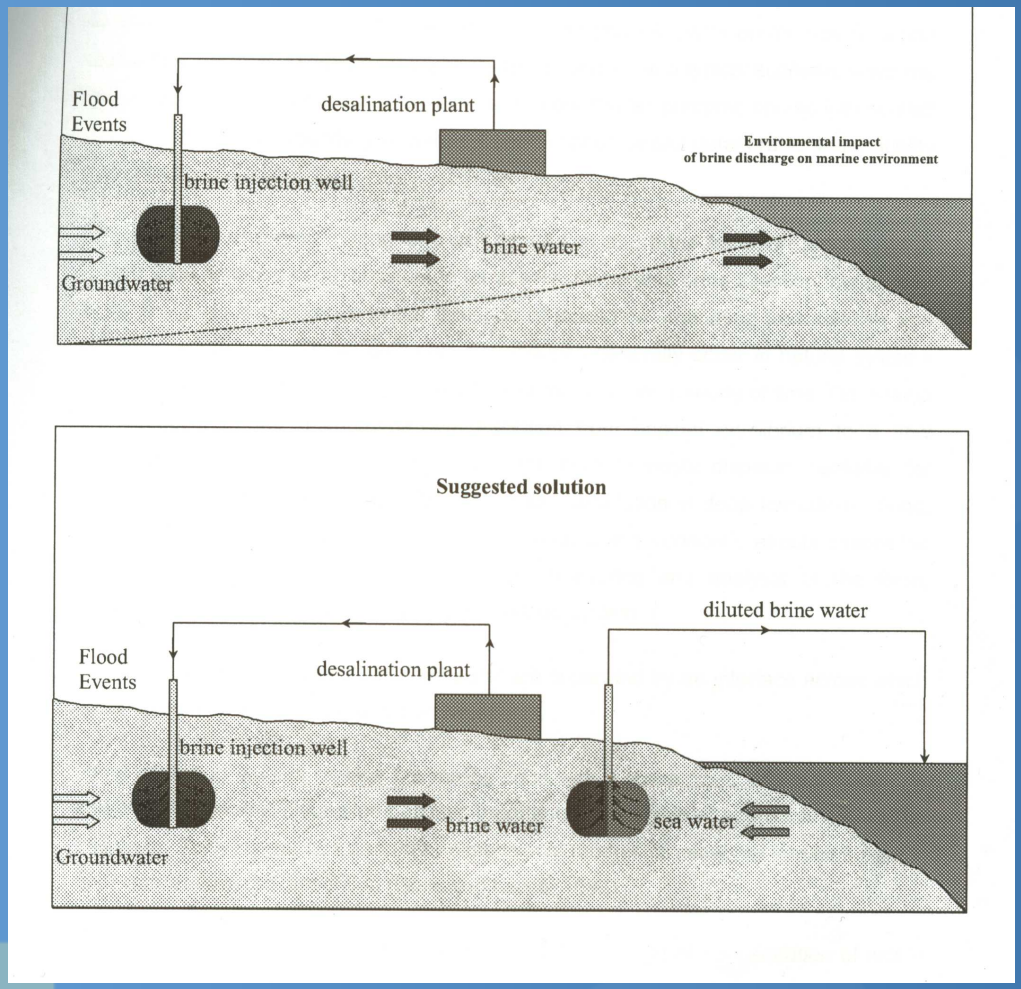
Environmental Management plan (EMP) for Desalination project

Item	Potential Negative Impact	Mitigation Measure
Design Phase		
Air	Offensive noise and vibrations.	Install Desalination plant : far from recreational tourist area at isolated (remote area) from the population (direction of prevailing wind, and future urban development). Optimize the system applied (desulphurization techniques).
	use of energy => worming environment	
	Air pollution (when power plant is applied)	

EMP for Desalination project-II

Item	Potential Negative Impact	Mitigation Measure
Design Phase		
Water (seawater and groundwater)	Disposal of brine and sludge causing pollution of sea water /groundwater.	Adopt beach wells or infiltration galleries Adopt injection well-dilution well (see Figs. 1 and 2)
	Insufficient treatment capacity.	Design the sizes based on the following criteria: -20 years design period.

Possible solution for diminishing the negative impact of concentrated brine



EMP for Desalination project-III

Item	Potential Negative Impact	Mitigation Measure
Design Phase		
Land use	Disputes, privately owned land, touristic interest, disturbing wildlife etc.	get approval or purchase land, or change to communal owned land or to land with less expected conflicts . Consider drop of sub-project if problems are not resolved .
Land resources	Groundwater pollution from brine .	Groundwater testing at regular intervals. Soil/ site inspection before brine injection. Adoption of two well-system to dilute the brine. (Fig.2)

EMP for Desalination project IV

Item	Potential Negative Impact	Mitigation Measure
Construction Phase		
Air	Dust during construction and transportation machinery Exhaust emission from construction machinery such as bulldozers, excavators, and tractors.	Protect with proper shielding scaffolds. Spraying water. Workers wear protective masks Periodic maintenance and repair.

EMP for Desalination project-V

Item	Potential Negative Impact	Mitigation Measure
Construction Phase		
Noise and vibration	traffic noise and vibration by Equipments (excavators, pile driver, cranes, steamrollers and dredgers)	Chose isolated plant site Inform nearby houses. Avoid work during night hours. Provide workers with protection Noise dampening technologies

Item	Potential Negative Impact	Mitigation Measure
Construction Phase		
Safety	possibility of accidents	Protect work zones with portable scaffold sheets. Provide proper support for trench sides to protect against their collapse . Improve the readiness of health facilities in the region to deal with emergency cases . Provide workers with protective clothing
Hydrology	intake, drainage and conveyance pipeline =>affect flow regime and substrate agitation.	Installation of stop flow facilities is necessary to deal with direct runoff sedimentation.

EMP for Desalination project -VII

Item	Potential Negative Impact	Mitigation Measure
Construction Phase		
Water	waste discharge (People and machinery) increase in suspended solids and turbidity around intake and drainage pipe and the tillage of the industrial pipes and the industrial building site.	Groundwater quality testing at regular intervals. Soil/ site inspection before plant construction. Install wastewater treatment Proper management for collection and treatment

Item	Potential Negative Impact	Mitigation Measure
Construction Phase		
Water	Tillage process=> dust and debris either directly fallen into the water or has been bleared along by surface runoff. Domestic sewage and solid waste from construction personnel on water quality include increase in BOD, oil, turbidity suspended solids, and intestinal germs and bacteria	Groundwater quality testing at regular intervals. Soil/ site inspection before plant construction. Install wastewater treatment Proper management for collection and treatment

EMP for Desalination project - IX

Safety	possibility of accidents	Protect site from trespassers. Improve the readiness of health facilities to deal with emergency cases. Provide workers with protective clothing.
Sludge and solidwaste from desalinati on	Led to environmental pollution	Proper on-site management and reliable treatment by contractor

EMP for Desalination project -X

Ecosystem: (flora and fauna ecosystem)	Effect on plant life ecology Eradication of vegetation=>affect animal ecology. Noise => affect local bird population.	Avoid valuable plant ecosystems site. survey before construction to determine if site contains rare or endangered species. Noise dampening

EMP for Desalination project -XI

Ecosystem: (Marine ecosystem)	Intake and drainage: Increase in ss and turbidity=>affects the growth, reproduction rate of photosynthesis of phytoplankton, the nourishment and respiration of plankton, destroy part of the benthonic habitat	Shorten the construction phase

EMP for desalination Project-XII

Item	Potential Negative Impact	Mitigation Measure
Operation Phase		
Air	Suspended particles, SO_2 (combustion of coal, fuel or heavy oil) CO_2 production, Heat to atmosphere, Heat to sea	Dust collection and smoke emission desulphurization techniques.
Noise and vibration	High pressure pumps (RO)	Pumps located indoors, or supplied with soundproof or sheaths to absorb noise.
Hydrology	Effect of intake and drainage	Proper management => rapid dilution of discharged alkaline (brine) within the surrounding seawater.

EMP for desalination Project- XIII

Item	Potential Negative Impact	Mitigation Measure
Operation Phase		
Aquifer:	Salt water intrusion (seawater conc. Around 35000ppm, while brine water conc. 46000-80000ppm	Beach wells or infiltration galleries. Adopt injection well –dilution well (See fig 1 and 2)
Intensive use of energy associated with desalination plants	Worming environment	Optimize the system applied

EMP for desalination Project -XIV

Item	Potential Negative Impact	Mitigation Measure
Operation Phase		
Energy use	Location of the plant, Energy efficiency	The plant must be sited in an appropriate location, Energy efficiency and renewable energy generation should be pursued inorder to reduce the plant's overall environmental footprints

EMP for desalination Project -XV

Item	Potential Negative Impact	Mitigation Measure
Operation Phase		
Water	Biological and chemical composition of the brine (depends on technology applied) MED (Multi Effect Desalination: High temp, salinity, anti scalling, and metal ions stripped from the pipe line (copper, nickel, lead, etc….). High temp. may lead to the scaling and corrosion of the heat exchanger.	Addition of anti-scaling or acid medication=> suppresses fouling. Prevent scaling of the brine by appropriate drainage system (rapid diffusion of the alkaline jet into the surrounding seawater)

Item	Potential Negative Impact	Mitigation Measure
Operation Phase		
Water	corrosion and high temp=> led into increase in the metal ion of alkaline. RO alkaline emissions: High salinity (but less amount of chemical medication, no high temp.	Addition of anti-scaling or acid medication=> suppresses fouling. Prevent scaling of the brine by appropriate drainage system (rapid diffusion of the alkaline jet into the surrounding seawater).
Loss of marine species at intake	Impingement (on the screen) or entrainment (on the plant)	Avoid as much as possible by adopting technologies at intake

Table 2-5. Environmental Management plan for Desalination project (cont.)

Sludge and solid waste from desalination	Pre-treatment (remove suspended solids, protect the reverse osmosis membranes from fouling). The sludge produced from this process is silt, seaweed, and algae. While If chemical pre-treatment process is used, the sludge will also contain coagulation chemicals.	Sludge is dried (i.e. using belt filter) Disposal in conventional landfills.

Environmental Management plant for Desalination project (cont.)

Marine ecosystem High **salt** High **temp** High **turbidity** Low **Oxygen** conc.	Primary effects: short and long term effects of lethal stress short term sublethal stress (i.e. migration) long term sublethal stress (i.e.bioaccumulation)	Power plant cooling water is being used to dilute brine. Power plant reduce the cost of bringing power to the desalination plant Allow for rapid diffusion, mixtu and dilute into the surrounding sea water.

Environmental Management plant for Desalination project (cont.)

Low Oxygen conc. Due to deaeration for distillation to prevent corrosion Chemicals from pre-treatment (coagulant, antiscale) Chemicals use in flushing the pipe line and cleaning the membrane	Secondary effects: Destruction of Habitat, Breakage of food chain and changes in ecosystem Increase in competition, predation, disease. Lethal stress of biological food sources. DO, T, and Salinity are considered the three most important determinants for the growth and survival of marine life.	Brine must be blended and dispose of in a way that does not negatively impact the ecosystem. Brine water: blended with another water source, and then disposed in a way that enables mixing and dispersal

Environmental Management plant for Desalination project (cont.)

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Chemicals used to preserve the RO membrane High **organics and metals** contained in the feed water. Metals that are picked up by the **brine** in contact with plant components and pipelines.	**Low** level of **DO** => **death** caused by the inability to metabolize. **Temp** >34oC suppresses the rate of phytoplankton **photosynthesis** =>disrupt the survival and normal metabolism of plankton. It may result in the large-scale **destruction of algae.** Change in **salinity** disturb the **equilibrium** between the osmotic pressure of body fluid and the surrounding sea water. Salinity and temp may affect the **migration** of different **species**, avoid high food places and exposure to predators.	Brine must be blended and dispose of in a way that does not negatively impact the ecosystem. Brine water: blended with another water source, and then disposed in a way that enables mixing and dispersal

EMP for Desalination project (cont.)

CONSULTATION AND TRAINING COMPONENTS		
Capacity building	The possibility of failure due to low capacity in O&M, administrative or financial management of the project .	Support training of local authority, local NGOs and members of the community on O&M of the system. Support training on the administrative and financial management of the project

Environmental Monitoring Program for Desalination projects

Phase	When	What	Who	How
Construction works	monthly	Health and safety measures: •Protective clothes •Site protection •Treatment and disposal of solid waste and wastewater •Readiness of health facilities for emergencies •Normal working hours (not more than 8hours / day)	Environmental specialist; And Design engineer.	Site inspection checklists and photos
		Noise and dust levels •Ear protection and dust masks for workers •No work at night time •Spray water		
		Traffic diversion and work progress in stretches.		

Environmental Monitoring Program for Desalination projects

Phase	When	What	Who	How
Operation works	Semi-annually (for one year after the start of operation)	Proper operation of the plant Soil test for salinity Groundwater test for salinity and pH Brine quality test for: •pH •Sanlintiy •Temp Health and safety of workers and farmers Capacity building programs. Training of members of community or local NGOs on health & Hygiene awareness	Environmental specialist	Monitoring checklists Visual inspection at the Samples collected of the brine. Checks on courseware qualities for capacity building programs (Administrative, financial and O&M) Interviews with awareness teams

Thank you