FIRST CORE DESALINATION GROUP MEETING IN ATHENS, 11-12 June 2012

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Session II

Reflections & Comments on Technical Aspects of Desalination BAT Using RES

DESALINATION BATs INCLUDING ADVANTAGES & DISADVANTAGES OF EACH

1. Multi-Stage Flash (MSF)
2. Multi-Effect Distillation (MED)
3. Mechanical Vapour Compression (MVC)
4. Reverse Osmosis (RO) with all its new developments.
5. Electro-dialysis (ED)
6. Membrane distillation (MD)
7. Thermo-Ionic™ Desalination
8. Forward Osmosis (FO)
9. Solar Stills
10. Humidification/Dehumidification (HDH)

TABLE 1 ON PAGE 33 OF THE REPORT

Renewable energy technologies for desalination BATs

- **SOLAR:** The relative sophistication of CSP plants make them less suitable for autonomous desalination units in remote and rural areas.
- **WIND:**
- **Geothermal:** It is believed by some investigators that geothermal energy is one the most promising options for renewable energy desalination [16]. Geothermal reservoirs provide a continuous supply of thermal energy at fixed conditions throughout the day and year
- **Waste heat:** An example of such a set-up is the 5000 l/d MD plant in the island of Pantelleria, Italy, which derives 80% of its required power from the waste heat of a diesel power plant, and the remaining 20% from solar collectors.

COMBINATIONS OF RES & DESALINATION

A wide variety of combinations is possible.

1. Solar thermal-MED
2. Solar thermal-HDH in the range of 2-5 €/m^3
3. PV-RO in the range of 3.5 –7 €/m^3 for brackish and 9 –12 €/m^3 for seawater RO units
4. PV-ED
5. Wind-RO in the range of 1000-2500 m^3/day, the estimated cost is in the range of 1.50–3 €/m^3
6. Wind-MVC
7. Geothermal MED cost was reported to be 1.6€/m^3
8. Geothermal HDH and other thermal processes.

QUESTIONS TO BE ANSWERED

1. Are the listed desalination BAT and compatible RES comprehensive? Are you aware of more technological developments that can be added to the report?
2. Knowing the region specificities and the listed BATs with their relative advantages and disadvantages, what in your opinion the BAT that should be given special focus?
3. How can we further elaborate and use the table of comparison as a very brief guide or flier for decision makers?
4. Is there a need to further elaborate on the compatibility of desalination BAT and appropriate RESs to give options and alternatives to decision makers?
5. What sort of capacity development is needed to orient water engineers and administrators on the available mature desalination BAT and their compatible RESs?

SESSION III

ASSESSING COMMUNITY NEEDS FOR DESALINATION

OBJECTIVES OF THE SESSION

To agree on the factors to be considered for determining the feasibility & assess the real needs of a remote community to desalination

I- Geographical & physical considerations

1. Physical geography of the location which influences the type of soil and terrain, surface topography, geothermal reservoir activity, and other geologic factors.
2. Local hydrology of the site. This includes the movement, distribution and quality of water at the location, water resources available and other aspects of the total hydrological profile.
3. Water balance of the region, with its three main components: precipitation, runoff, and evapo-transpiration.
4. The possible cultural, historical and archaeological heritage of a site to avoid damage caused by construction and other civil works.
5. Aesthetical damage that can be caused by unsightly plant installations. Wind turbines and wind farms to be objectionable especially so for historical sites.
6. Locations of wildlife habitat to protect them and potential impacts on bio-diversity.

II- Demographic & socio-cultural considerations

1. **The Socio-technical-institutional interdependence:** Interaction between 3 elements: people, technologies & organizations must be fully understood & accounted for.
2. **Involvement of beneficiaries:** The people affected by the project must be included at all stages, & their input must be taken into account.
3. **Learning:** Opportunities for learning, raising awareness, and training need to be provided from the earliest stages of a project to maximize benefits.
4. **Independence & autonomy:** Technological solutions, however cleaver & innovative they might be in the eyes of the decision-makers, must not be imposed on a community that finds them objectionable.
5. **Flexibility & Process orientation:** The general conditions for water supply in rural areas can change relatively quickly, and are generally very site-specific.
6. **Sustainability:** Average income per family, poverty levels, affordability, willingness to pay for the water produced by the desalination plant & government subsidies, play a major role in sustainability.
7. **Realism:** Project plans, objectives and expectations must be realistic & feasible. Unrealistic or excessively demanding plans are bound to result in failure.

III- Cultural, religious & gender related issues

- Often a new technology introduced into a community for the first time is perceived as an alien intrusion that is incompatible with long-standing traditions, social structures and responsibilities of the community.
- Despite the important role women play, men take charge of decision-making & women are often left out.

IV- Raw water resource quality & availability

- Detailed water chemical analyses of raw water are required for the design of desalination systems to avoid scaling and/or fouling.
- In case of using well water as raw water source for desalination, detailed hydrological study/tests shall be conducted to ensure the draw down in the well, sustainability of the well for the current capacity plant throughout the period of operation of desalination plant.

V- Pricing structures & financing schemes (Affordability)

- A successful desalination project in area should manage to recover its running costs & depreciation. This necessitates that the water pricing reflects the real costs of water supply. On the other hand, access to safe drinking should be available & affordable for all.
- The main challenges facing desalination in rural communities are:
  1. The low income of the rural population.
  2. Limited financial resources within rural communities.
  3. High investment costs required for such projects.
- In response to these difficulties, a number of support mechanisms that do not distort the market function are possible, such as:
  1. Direct financing of the infrastructure.
  2. Providing financial incentives for the operators.
  3. Encouraging private sector involvement.
  4. Adopting the “life-line rate”, where a variable pricing structure is applied based on the volume of water used. Progressive pricing.

VI- Institutional and regulatory factors

Three levels Institutions:

1. **Decision making level:** This typically includes ministries & other high-level government entities that are involved in setting water policy and planning.
2. **Executive level:** This is usually the role of government organizations that operate under the top-level decision making bodies.
3. **User level:** This can be either government NGO that undertake the actual operation & maintenance of water supply facilities.

Regulations:

1. Specific licenses that can be expected:
2. Borehole drilling and seawater withdrawal.
3. Brine disposal (often in the form of liquid waste disposal regulations).
4. Coastal zone construction.
5. Drinking water quality.
6. Renewable energy installations or electric power supply approval.

Questions to Answer

1. In your opinion, what other factors can be included in assessing community needs and capacity to invest in desalination using RES?
2. What sort of capacity development is needed to gear remote communities towards desalination technologies using RES?
3. In general terms, do you believe that desalination using RES is affordable by rural communities? Financing might be a serious obstacle.
4. Knowing the specificity of rural communities in the region in terms of poverty, unemployment and illiteracy, would desalination become a valid option without integrating it into a local sustainable development plan or package?
5. Do you think there is a need for SWIM-SM to start undertaking technical support activities related to the development of regulatory aspects including licensing for desalination in rural areas such as 1- Technical specifications for bore hole drilling & seawater withdrawal, 2- Brine disposal, 3- RES installation, 4- Coastal zone constructions, 5- Finished water quality, 6- Siting, 7- desalination EIA policies, etc.

SESSION IV

FACTORS TO BE CONSIDERED IN SELECTING THE BAT

OBJECTIVE OF THE SESSION

To review & discuss the factors that should be considered in the selection of a desalination BAT for a rural area using RE

Factor 1: Maturity & level of deployment of the processes

- Novel processes may possess attractive features, open up new possibilities & occasionally introduce remarkable improvements in performance; but difficult to recommend for rural applications.

Factor 2: Pre-treatment requirements

- Desalination processes differ in the level of feed pre-treatment they require for stable operation & long plant life.
- Membrane processes are generally more sensitive than thermal processes, and among the membrane processes RO tends to be the most sensitive to feed quality requiring thorough pre-treatment systems, typically consisting of chemical dosing & filtration.

Factor 3: Operational skill level required

- A somewhat related issue to technology maturity & pre-treatment requirements that is important factor in selecting & recommending a technology is the relative ease of plant operation compared to the level of skill available in rural communities.

Factor 4: Energy storage options

- Desalination plants are almost invariably designed to operate at fixed or slowly (seasonally) changing operating points, drawing fixed energy input at fixed rates.
- This contrasts sharply with the nature of many RESs, such as solar & wind, which are marked by instantaneous, diurnal, & seasonal variation. This introduces the need for energy storage & buffering.

Factor 5: Brine disposal

In inland desalination plants brine can be disposed by any one following techniques:

1. Zero Liquid discharge techniques by Thermal Method. Very high cost
2. VSEP Treatment. Huge investment and need special skills
3. Brine injection: Might destroy aquifers.
4. Evaporation pond. Favored option
5. Using brine to produce agriculture & aquaculture products. Create jobs,
6. Evaporation pond using enhanced Evaporation Mechanisms. Spray evaporation, air flow, turbulent flow, etc.

Factor 6- Other practical site characteristics

- Land topography & access, the availability & quality of roads & transportation considerations, and other infrastructure are all factors that need to be considered.

Factor 7- Capital and operating costs of the total proposed solution

- After all other factors are duly considered & appropriately weighed-in, the ultimate deciding factor for selecting the best solution out of a number of equally acceptable technical solutions is the total cost.

FACTORS TO BE CONSIDERED IN SELECTING THE BAT

1. What other factors you might consider as important in selecting the appropriate desalination technology for rural areas?
2. How can we support water officials assess the maturity of the processes & evaluate the technical capacities available in rural areas that are adequate for technically operate & maintain selected desalination & RES options?
3. Should we consider developing capacities on hydro-geological investigation for brine injection?
4. Should SWIM consider capacity development activities for water practitioners on desalination technologies for rural areas including pretreatment of various desalination technologies?
5. Is there a need for further development for energy storage for desalination?
6. How can we ensure regular monitoring, inspection, compliance & enforcement of brine water disposal regulations?

SESSION V

Guidelines to Screen and Assess Desalination BAT Using RES

Step 1- Evaluation of available water resources & demand characteristics

- A comprehensive evaluation of the available water resources, as well as an evaluation of the water demand characteristics at the proposed site is the first step.

1. Do we need a detailed opportunity cost analysis before deciding on desalination?
2. What are the factors to be considered in the opportunity cost analysis (alternative waters, production cost of desalination at the point of use, environmental externalities, reallocation of water from irrigation with its socio-economic impacts, etc.)
3. Should SWIM explore the development of a chapter in the suggested guiding manual on opportunity cost analysis for desalination?
4. Should we propose a capacity building program to train water officials on the principles of opportunity cost analysis for desalination?
5. Should virtual water concepts be considered in the process?

Step 2 - Evaluation of available renewable energy sources & grid connectivity

- The next major step in the process is to carry out an extensive study of the available energy resources, particularly focusing on renewable energy sources, if electric power supply is not available.
- A thorough understanding of the available RESs, their qualitative & quantitative characteristics is required.

- Do we need a capacity development program to train water officials on various RES for desalination, their current state of development, economics, technical aspects, advantages, limitations, etc.?

Step 3: Short listing of candidate desalination processes based on available RES

- The previous steps of identifying, characterizing and selecting the RES should allow the elimination of all desalination processes that are not suited to the type of energy source chosen.

QUESTIONS

1. Do we need to amend the structure or content of the proposed preliminary guideline?
2. Do we need a chapter in the guiding manual on the methodology for the identification of the best combination of RES and desalination technology using optimization techniques?
3. Do we need a training program to introduce the methodology and train water officials on the methodology using various scenarios with case studies exhibiting some of the best practices and factors to consider for replication?
4. Out of the proposed guideline, do we need to develop a guiding manual to support water officials in PCs in deciding on: a- The necessity for desalination in rural areas, b- what desalination technology they can select and by using which RES?
5. Do we need a capacity building programs to train water officials on different aspects of desalination and on policy formulation?

VISION FOR DESALINATION

Open discussions on the need for the development & suggested scope of a regional vision & strategic plan for desalination in SMCs.

Issues for Discussion

1. Is there a genuine need for a regional desalination vision and/or a strategy for the region?
2. What approach can be used to formulate a vision & develop a strategy? Participatory, ownership, etc.
3. Who might be the partners? What would be the structure & functions of the organizing entity?

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Thank you
for your attention

Merci pour
votre attention

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