Continuing Education Course #388
Desalination Project Design and Delivery

1. Which one of the project activities listed below is a part of the conceptual plant design:
- a. development of preliminary plant site layout
- b. preparation of as-built drawings
- c. installation of equipment
- d. plant facility commissioning and acceptance testing

2. The typical sequence of seawater reverse osmosis (SWRO) desalination plant treatment processes is as follows:
- a. post-treatment, RO membrane separation, source water screening, pre-treatment
- b. seawater water intake, pretreatment, RO membrane separation, post treatment
- c. RO membrane separation, ultraviolet irradiation, dissolved air flotation, coagulation
- d. thermal evaporation, source water screening, pretreatment

3. Brackish water reverse osmosis (BWRO) desalination plants with well intake typically comprise the following treatment processes:
- a. RO membrane separation, source water screening, post treatment, coagulation
- b. granular media filtration, screening, RO membrane separation, post treatment
- c. degassing, pretreatment, re-hardening, desalination, post treatment, distribution
- d. collection & conveyance system, chemical pre-treatment, membrane treatment, chemical post-treatment, degasifier and treatment water storage

4. What is the main purpose of desalination plant pretreatment?
- a. removal of dissolved solids
- b. removal of suspended solids and silt, and minimizing of membrane scaling
- c. disinfection of the desalinated water
- d. adding minerals to the desalinated water

5. How many RO membrane elements are usually installed in a single pressure vessel?
- a. 10 to 16
- b. 9 to 12
- c. 6 to 8
- d. 4 to 6

6. Which of the following pathogen inactivation methods is not suitable for disinfection of desalinated seawater:
- a. disinfection with chlorine gas
- b. disinfection with sodium hypochlorite
- c. ozonation
- d. UV irradiation

7. Which one of the following factors does not impact the selection of desalination equipment?

- ○ a. salinity of the source water
- ○ b. type of the treatment processes and efficiency in terms of energy use
- ○ c. materials from which the equipment is fabricated
- ○ d. size of the plant administration building

8. What is the typical range of the ratio between the capacity of the pilot plant and the final capacity of the full-scale desalination plant:
- ○ a. 1:50 to 1:80
- ○ b. 1: 20,000 to 1:30,000
- ○ c. 1: 5 to 1:10
- ○ d. 1:100 to 1: 2,000

9. Desalination plant footprint in most urbanized coastal centers needs to be compact due to:
- ○ a. complexity of plant operations
- ○ b. limited land availability and high land cost
- ○ c. severe environmental impacts
- ○ d. equipment export limitations

10. What is the typical range of energy use for desalination of Pacific Ocean seawater?
- ○ a. 2.5 to 4.0 kWh/m^3
- ○ b. 0.5 to 2.0 kWh/m^3
- ○ c. 1.5 to 2.0 kWh/m^3
- ○ d. 6.0 - 8.0 kWh/m^3

11. Chemical consumption at desalination plants is mainly influenced by the:
- ○ a. length of the discharge outfall
- ○ b. source water quality
- ○ c. number of RO trains
- ○ d. type of cartridge filters used for pretreatment

12. The typical total length of time in months for implementation of a 100,000 m^3/day desalination plant is in the range of:
- ○ a. 7 to 11 months
- ○ b. 13 to 18 months
- ○ c. 19 to 25 months
- ○ d. 26 to 32 months

13. What is the main benefit of constructing the desalination intake and outfall structures for their ultimate maximum plant production capacity during the first phase of the project, if a project is implemented in multiple stages?
- ○ a. reduction of project construction cost
- ○ b. reduction of environmental impact and public controversy associated with plant expansion
- ○ c. reduction of operation and maintenance expenditures
- ○ d. shorter project construction schedule

14. The economy of scale benefits are very limited for plants larger than what capacity?
- ○ a. 10,000 m^3/day
- ○ b. 50,000 m^3/day
- ○ c. 200,000 m^3/day
- ○ d. 800,000 m^3/day

15. The most cost-attractive concentrate disposal method for small desalination plants is:

○ a. discharge to the wastewater collection system
○ b. offshore discharge via ocean outfall
○ c. discharge to evaporation ponds
○ d. zero liquid discharge

16. Cost of power is typically what percentage of the total expenditure for production of desalinated water?
○ a. 5 to 10%
○ b. 5 to 20%
○ c. 15 to 25%
○ d. 35 to 50%

17. What type of risk may occur when a desalination plant uses an existing wastewater treatment plant (WWTP) outfall and the wastewater treatment plant owner decides to expand WWTP capacity and use a larger portion of the outfall capacity?
○ a. Construction risk
○ b. Regulatory risk
○ c. Desalinated water demand risk
○ d. Entitlement risk

18. When the use of new technology may not be beneficial for reduction of the overall project costs?
○ a. when the technology is selected by independent third party
○ b. when the equipment needed to implement the technology has to be imported
○ c. when the technology is patented
○ d. when the technology lacks full-scale track record of actual availability (downtime)

19. Which of the following factors will not create financial risk is:
○ a. political stability in the country where the desalination project is located
○ b. significant fluctuations in the currency of the country where the plant is located
○ c. inability of the project proponent to meet repayment of debt and equity obligations
○ d. size of the desalination plant administration building

20. What is the main advantage of the Design-Bid-Build (DBB) method of desalination project delivery for the owner of the desalination plant?
○ a. the construction contractor is incentivized to use proven desalination technology only
○ b. the owner retains complete control over the plant ownership
○ c. the owner will not have the opportunity to operate the desalination plant
○ d. the contractors can complete their work without the need of owner’s supervision

21. What is the main advantage of the Design-Build-Operate (DBO) method of desalination project delivery for the owner of the desalination plant?
○ a. DBO allows early coordination of facility planning and design which reduces the life-cycle water production costs
○ b. the DBO contractor transfers all the project risks to the owner
○ c. the owner is not responsible for project funding
○ d. the DBO contractor is not responsible for plant operations

22. What is the main advantage of the Build-Own-Operate-Transfer (BOOT) method of desalination project delivery for the purchaser of the desalinated water?
○ a. The ownership of the desalination plant is transferred to the purchaser of the desalinated water at the end of the contract term.
○ b. the water purchaser can generate revenue from desalination plant operations

○ c. the water purchaser owns all project assets
○ d. the water purchaser transfers to the private sector the risks associated with the number of variables affecting the cost of desalinated water

23. Which of the methods of project delivery listed below has resulted in the lowest cost of production of desalinated water to date:
○ a. Build Own Operate Transfer (BOOT)
○ b. Design Build Operate (DBO)
○ c. Design Bid Build (DBB)
○ d. Water Purchase Agreement (WPA)

24. What portion of the total project capital cost delivered by BOOT method is usually funded by equity?
○ a. 0 - 1%
○ b. 60 to 100%
○ c. 10 to 30%
○ d. > 60%