DESALINATION CAPABILITIES AND EXPERIENCE

Design and Cost Estimates

Value Engineering and Construction Analysis

Due Diligence and Advisory Services

Studies and Miscellaneous

Water Consultants International, Inc

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AN INTRODUCTION TO WCI

Water Consultants International Inc. (WCI) was founded in January, 1991 by two former senior staff members of DSS Engineers, Inc. (DSS). Since 1968 DSS gained a widely held reputation as an experienced, skilful consulting firm with emphasis on planning, design and implementation of advanced water treatment (AWT), membrane and thermal desalination projects, both domestic and international. With the formation of WCI, these credentials are in effect, continued under the new name.

During their careers, WCI staff and associates have been engaged on water supply planning, feasibility studies, preparation of conceptual designs, specifications, in construction supervision, repair and upgrading of existing facilities, and in operation and maintenance services for water works systems. Professional services were provided for a variety of municipal, industrial, utility and governmental clients, domestic and foreign.

Several hundred separate contracts have been directed and executed by the firm’s principals and associates. This team has special appreciation of the problems associated with design, construction, operation and maintenance of water supply facilities ranging from sophisticated industrial sites to remote water-short areas of the world.

WCI is able to mobilise this experience to provide water supplies –

FOR ANY PURPOSE FROM ANY SOURCE TO ANY SPECIFICATION
CONSULTANCY CAPABILITIES

REQUIREMENTS FOR EFFECTIVE CONSULTING

WCI has all the necessary qualifications to perform knowledgeable, effective and timely consulting services in connection with the highly specialised technologies involved in modern methods of desalination and advanced water treatment such as:

- In-depth knowledge of the marketplace including extensive proprietary databases showing what is being done, where, how and at what cost.
- Market studies; global, regional or product/application based
- Product or technology assessment; technical and market oriented
- Business performance assessment
- Due diligence reviews for technical or fiscal purposes
- Business model development for BOO, BOT, IWPP or simple Water Sales Agreements
- Balanced staff and associate capabilities and experience in all disciplines involved in planning, design construction and operation: mechanical, electrical/I&C, chemical, civil and environmental engineering , water and hydrology;
- Ready access to the design and development experts of all system component suppliers;
- In-house libraries and files of international standards and specifications;
- Computerised design and cost estimating capabilities; performance prediction software for simulating the effects of changing input conditions such as raw water chemistry, pretreatments, process settings and product blend ratios;
- Computer-aided drawing systems for preliminary and final drawings ranging from process schematics to detailed plans

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SELECTED PROJECT EXPERIENCE OF WCI

Following are some selected examples of WCI project references. As a highly specialized consultancy many of WCI’s contracts are subject to Confidentiality or Non-Disclosure Agreements. As such only a limited amount of information can be publicly disclosed for many of our projects and no information at all can be released for others.

Facility Audit 5 x 12.5 MIGD MSF / 37.5 MIGD SWRO Hybrid, UAE

A WCI team reviewed the installation and operation of a large hybrid desalination facility as part of complete review of the hybrid power/water project. The Audit included a basic “fit for purpose” review and assessment of commissioning and operations issues which have arisen.

Design Verification of 5 x 14 MIGD Distillation Facility, UAE

Due to the increased unit capacity of each of these plants, several OEMs awarded WCI independently contract to verify that the plant would meet all performance specifications over a matrix of seasonal and operational conditions. These OEMs had previously never constructed plants of this same design or magnitude. The successful contractor was also directed by the Owner to have a 3rd party evaluation which was also completed by WCI.

Lenders Engineer Services 36 MGD seawater RO plant. Asia

WCI provided extensive services to review the design, costs and O&M plans for the largest seawater reverse osmosis plant in Asia. This plant has several unique features including a requirement to operate with significant level of hydrocarbon in the seawater due to the proximity of major shipping lanes.

Lenders Engineer Services 50 MIGD seawater RO plant. UAE

WCI provided extensive services to review the design, costs and O&M plans for the largest seawater reverse osmosis plant planned for the United Arab Emirates. This project has not yet been awarded.
Preliminary Design and Cost Estimates, Power/Water Facility, Oman

WCI provided extensive engineering services to a BOO consortium to bid on Phase 1 of an 1850 MW, 254,000 m³/d facility at Barka, Sultanate of Oman. Designs were developed for both MSF plant using steam from a combined cycle power plant and an SWRO plant with a separate independent power plant. Up-to-date cost estimates were made on both.

Preliminary Designs and Cost Estimates, Power/Water Facility, Ajman

WCI provided design and cost estimates to a BOO consortium considering MED and SWRO desalting in a bid for supply of 3-6 MIGD to the Emirate of Ajman. The base bid using SWRO was the lowest and the consortium has been negotiating for the project.

Design, Manufacturing, Construction, Start up and Warranty Consulting Services, Cape Verde

Funded by the Government of Belgium and the African Development Bank, a turkey contract was awarded to Tractebel to finish a 2400 m³/d and 750 kW water/power facility at Mindelo, Sao Vicente, Cape Verde. WCI was selected to provide consulting engineering services to the government utility, ELECTRA, E.P., beginning with negotiation of the contract with the Contractor and supervision of design, manufacturing, construction and commissioning.

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Design Verification Study of 6 x 15 MGD Distillation Facility, UAE

Due to the record unit capacity of each of these plants, IRITECNA awarded WCI a contract to verify that the plant would meet all performance specifications over a matrix of seasonal seawater temperature extremes, and low (100°C) and high (112°C) temperature operation.

The study included presentation of the theory and practice involved in calculation of process thermo-hydraulic designs and optimum scale inhibiting, venting and vacuum system requirements. After calibration of procedures by comparison with actual operating data mathematical simulation models were prepared and incorporated into a computer process simulation program.

Design and Specifications – 20 MGD Reverse Osmosis Facility, USA

WCI was engaged by the Principal Consultants to the City of Hollywood, Florida for design studies, detailed design and specification of a 20 MGD membrane water treatment plant. Phase 1 of this plant provides treatment of both brackish and fresh ground water by reverse osmosis consisting of 14 MGD membrane softening and 4 MGD of brackish water reverse osmosis. Product from these two treatments systems will be blended with raw ground water and lime softened water to produce 32 MGD of drinking water, meeting all future regulatory requirements.
Detailed Designs – MED Plants

An extensive development program was undertaken for equipment manufacturers to design, standardise and optimise low temperature Multiple Effect Desalination (MED) plants. Work included research into past designs and testing carried out by the Office of Saline Water followed by development of a computer program to establish the basic designs. Then, to optimise the designs, a cost routine was incorporated into the program and it was set up to run a number of cases with different design parameters. Results can be plotted to determine minimum cost designs. The program can design and cost both cross flow and long flow MED plants with various number of vessels.

Constructibility Analysis and Value Engineering Services, USA

WCI provides water treatment and membrane plant expertise to a team providing constructibility analysis and value engineering services for all County capital improvement projects. Water projects include upgrade of existing lime softening plant and membrane plant expansion to raise WTP #3 capacity from 14.3 to 35 MGD by 2015, WTP #8 from 16 to 24 MGD by 2004 and replacement of old 14 MGD lime plant at WTP #9 with 20 MGD of membrane softening and brackish water RO.

Value Engineering Study, 3.0 MGD SWRO Plant, USA

WCI was retained by E.J.Nichols & Associates, a Value Engineering Services consultant, to review the designs and drawings being produced for rehabilitation of end modifications to the Florida Keys Aqueduct Authority’s SWRO plant at Key West.

This work was originally directed to providing an assured supply of water to the Lower Keys in the event of pipeline failure. The current modifications include the supply of emergency diesel alternators sufficient for about 0.9 MGD.

Commissioning Services, Taweelah ‘B’, UAE

WCI supported Tractebel Energy Engineering in commissioning of the 6 x 15 MGD Italimpianti MSF plants at Taweelah Phase ‘B’, Abu Dhabi, UAE (see reference to Design Verification Study under “Designs and Cost Estimates”). Services were provided by one full time Site Engineer, backed by Senior Consultants from Home Office who made periodic visits to the site.

These services included application of the MSFSIM software, which enables projection of plant performance and additive demands under any combination of process settings, fouling and seawater condition.
**Inspection and Analysis – MSF Units, Virgin Islands**

This 1 MGD plant, manufactured by Westinghouse and started up in 1972 is all titanium tubed, with carbon steel chambers and internals. Unit was acid-treated, with 225°F top temperature, but was changed to HT additive treatment in mid-80’s which caused under venting of CO₂ released in the top stages.

Inspection showed extensive corrosion of carbon steel vent baffles, tube support plates and distillate trays, and consequent damage to tubes no longer properly supported. Both short and long term recommendations included replacement of tubes, internals, support plates and baffles, and re-routing of vent lines to optimise CO₂ venting.

**Damage Assessment – 20 MGD Shuwaikh ‘D’ MSF Plants, Kuwait**

WCI was retained to provide pre-bid inspection services supporting lump pricing for their repair and rehabilitation. Although several stage condensers were damaged by artillery fire, the three units may have suffered most by injudicious use of mild steel for tube support plates, whose heavy corrosion mitigated against the possibility of retubing in situ.

A novel alternative approach to temporarily regaining capacity and steam economy was advanced: i.e. by judicious raising of top temperature from design level of 90°C.

**Performance and Acceptance Testing – Multiple Effect Distillation Plants**

Services covered the development of criteria for and operating supervision of desalination plants during final acceptance tests. Plants are 2 x 1 MGD MED type plants constructed at the U.S. Naval Station, Guantanamo Bay, Cuba. Final external and internal inspections were made, criteria for operation to demonstrate performance acceptance developed and operation during final testing supervised. A detailed report was prepared on acceptance testing results. Completed August, 1991.

**Materials in Desalination – Consulting Services**

WCI is retained by the Nicel Development Institute (NiDI) to provide consulting services on all aspects of materials application in desalination in the Americas and Caribbean, present and future. Topics of material investigations have included:

- Membrane pressure vessels
- Membrane process supply well casings
- Distillation plant tubing, tube sheets, tube support plates and distillate trays
- Membrane process concentrate disposal wells
Project awarded by IFFWSAT in 1993 to develop and refine a steady-state operational simulator for MSF plants. Program developed displays process flow diagram, operating levels and graphs of performance through a range of operating conditions. The simulator is written in FORTRAN with the interface in Lotus 1-2-3 for windows.

Allocations of Production Costs in Dual Purpose Facility

In 1993, WCI developed a procedure for allocating power and water production costs for the combined cycle dual purpose plants of Virgin Islands Water and Power Authority (VIWAPA). Complete documentation of the alternate allocation methods was developed along with the cost flow diagrams and cost allocation comparisons. A computer program was developed to accurately allocate monthly all production costs on both St. Thomas and St. Croix.

Evaluation of Independent Power and Water B.O.O. Proposal, Bahrain

WCI participated in the Project Team selected to evaluate a B.O.O. proposal to produce 350 MW electricity and 15 MIGD water for the State of Bahrain. Technical, financial and legal issues were reviewed in detail by the Project Team during a 15 day period in Bahrain. A complete detailed report was issued in two weeks following this.

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Replacement of Old Plants with 20 MIGD ROMED Dual Cycle System, UAE

A technical and economic study was made and a conceptual design developed for a 20/23 MIGD Desalination facility to replace 6 x 2 MIGD MSF plants at Abu Dhabi town station in the U.A.E.. The existing overall power and water system was analysed and existing site facilities evaluated. A desalination system was then developed to utilise existing site facilities and be compatible with the overall power and water production system. The conceptual design developed includes 7 MIGD of Multiple Effect Distillation (MED) with 12 effects and no vapour compression, 3 MIGD of MED, 6 effect units with mechanical vapour compression and 13 MIGD of Reverse Osmosis.

Technical/Economic Study - Single Purpose Desalination Plants for California

Study work included the development of conceptual designs of single purpose desalination facilities as follows:

- Sea Water Reserve Osmosis (SWRO)
- Multiple Effect Distillation with Thermal Vapour Compression (MED-TVC)
- Multiple Effect Distillation with Mechanical Vapour Compression (MED-MVC)
- Combined ROMED-TVC
- Combined ROMED-MVC

The economic analysis revealed that the ROMED-TVC would produce the lowest cost of water – about 15% lower than SWRO alone.