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The Abu Qir Fertilizer Experience in Conservation and Recycling of the Water In Two Sites: - A - Cooling Water System. B - Production of Demineralized Water for Steam Generation

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Abu Qir Fertilizers Company est un des plus grands complexes de productions d'engrais azotés au Moyen Orient. Elle a été constituée en 1975 comme société à capital commun. Cette société compte trois unités produisant journellement 6 000 t. Les données de chacune des unités sont résumées au tableau 1. Abu Qir Fertilizer domine le marché domestique avec 70% de part de marché et, en plus, a un vaste potentiel d'exportation sur le marché international.

Tableau 1
Unités d'Abu Qir I, II, III

Unité I Abu Qir	
Unité d'ammoniac	1 100 t/j
Unité d'urée	1 550 t/j
Sites d'implantation et utilités	
Licence de procédé	Ammoniac Krupp Uhde Stamicarbon – Urée
Produit	Urée prillée 46.5% N
Date de démarrage	1979
Unité II Abu Qir	
Unité d'ammoniac	1 000 t/j
Unité d'acide nitrique	1 800 t/j
Nitrate d'ammonium	2 400 t/j
Licence de procédé	Krupp Uhde Hydro Agri
Produit	Formule d'engrais AN 33.5% N
Date de démarrage	Juillet 1991
Unité III Abu Qir	
Unité d'ammoniac	1 200 t/j
Unité d'urée	2 000 t/j
Licence de procédé	Krupp Uhde Stamicarbon Hydro Agri
Produit	Urée granulée 46.5% N
Date de démarrage	Janvier 1999

Le traitement de l'eau a un rôle important pour approvisionner les unités en eau de refroidissement et pour alimenter les chaudières par la génération de vapeur.

Dans cet exposé on présentera l'expérience d'Abu Qir dans le recyclage, le réemploi et la conservation de l'eau dans 2 sites.

Introduction

The Abu Qir Fertilizers Company has one of the largest nitrogen fertilizer production complexes in the Middle East. It was established in 1975 as a joint stock company.The Company comprises of three plants producing a total daily output of 6.000 mt. Data for each of the process plants are summarized in Table 1. Abu Qir Fertilizer dominates the domestic market with a share of 70% and in addition has vast export potential to international markets .

Table 1
***Abu Qir* plants : I, II and III**

Abu Qir Plant I	
Ammonia output	1,100 mtpd
Urea output	1,550 mtpd
Offsites and Utilities	
Process licensors	Krupp Uhde-Ammonia Stamicarbon – Urea
Product	Prilled urea , 46.5 % N
Date onstream	1979
Abu Qir Plant II	
Ammonia ouput	1,000 mtpd
Nitric acid output	1,800 mtpd
Ammonium nitrate	2,400 mtpd
Process licensors	Krupp Uhde Hydro Agri
Product	Fertilizer grade AN , 33.5 % N
Date onstream	July 1991
Abu Qir Plant III	
Ammonia plant output	1,200 mtpd
Urea plant output	2,000 mtpd
Process licensors	Krupp Uhde Stamicarbon Hydro Agri
Product	Granulated urea , 46.5 % N
Date onstream	January 1999

The water treatment has an important role for supplying the process units with cooling water and boiler feed water for steam generation .
In this paper we will explain Abu Qir's experience in recycling, reusing and conservation of the water in two sites :

1st) The cooling system
2nd) The production of demineralized water for steam generation

Water Treatment at Abu Qir 1 Plant

The System:

1 - Feed water system for steam generation

The total high purity water consumption is about 320 M^3/hr, of which 50% is polished turbine condensate return and the other 50% demineralized water from water treatment unit. As the total dissolved solids (TDS) increases, the cost production of demineralized water increases. In 1993, the modernization project was implemented when a new EDR unit was built, after economic and technical studies were carried out with respect to environmental issues.

2 - The cooling water system

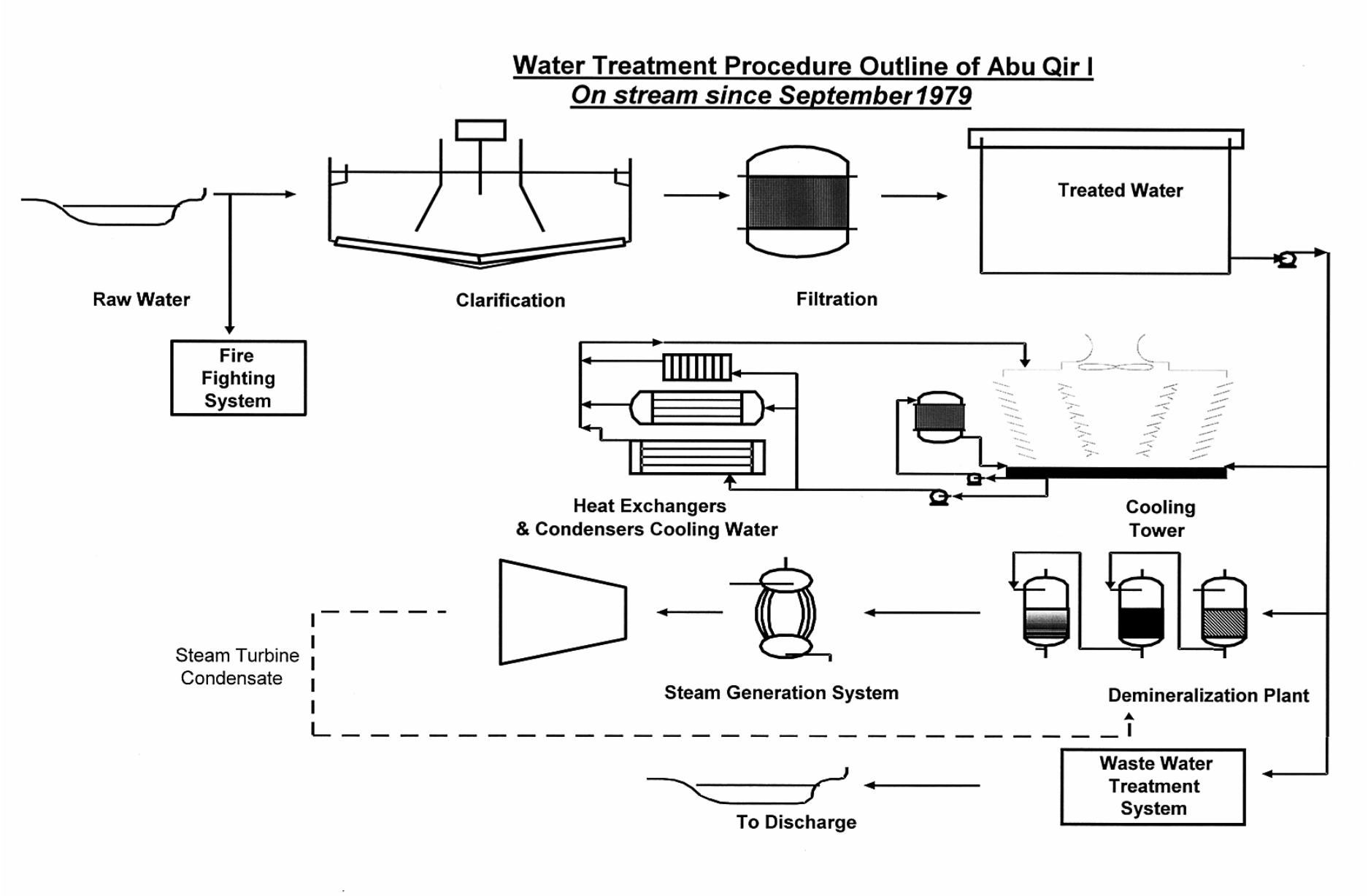
The cooling water system is subdivided into three sections for supplying both ammonia and urea plant by cooling water :
A) Induced-draught cross flow cooling tower of wood and pump station.
B) Side stream filtration.
C) Chemical treatment.

Design data for cooling tower:

Circulation rate	20000 M^3/hr
Make up water	650 M^3/hr
Blow down	350 M^3/hr
Conc. Factor	1.5 - 2 max cl^- 110 mg/l
Temp. diff. " Δt "	10 °C

Ion-exchange operating cost before and after using of E.D.R. unit at TDS 450 ppm :

Items	Consumption of demin. unit	
	Before E.D.R.	After E.D.R.
1 - HCl 30% Conc. t/y	3693	1575
2 - NaOH 50% Conc. t/y	2209.2	925.5
3 - Productivity of demin. Unit M^3/y	1663389	1533033
3 - Productivity of demin. Unit M^3/hr	192	177
4 - Operating hours / cycle	Max 18	Max 50
5 - Quantity of reg. Water M^3/y	280320	148920
6 - Saving cost %	Cost decreased by 50 %	
7 - Saving of quantity of reg. %	Reg. Qty. decreased by 46 %	
8 - Operating hours %	Increased by 177 %	


Water Treatment Procedure Outline of Abu Qir I
On stream since September 1979
Raw Water
Clarification
Filtration
Treated Water
Fire Fighting System
Heat Exchangers & Condensers Cooling Water
Cooling Tower
Steam Turbine Condensate
Steam Generation System
Demineralization Plant
Waste Water Treatment System
To Discharge

Water treatment at Abu Qir 2 Plant

1 - Feed water system for steam generation

The demineralization unit is designed to produce 300 M^3/hr demineralized water for steam generation.

The production of demineralized water is based on

1st) Turbine condensate 60 %.
2nd) Process condensate from NH_3 (I + II) plants 20 %.
3rd) Treated water 20 %.

The steam and turbine condensates are purified in cartridge filters, the process condensate after stripping unit is purified in activated carbon filters and the raw water which treated in the clarifier by using $Ca(OH)_2$, $Al_2(SO_4)_3$, $KMnO_4$ and P.E and filtered in the gravel filters.All streams A, B and C are mixed and fed to the cation and anion and then to the mixed bed exchangers for fine treatment which operated in a counter current flow with fluidized bed design.

Saving Gain

By reuse of process and turbine condensates:
1 - minimize the treated water used.
2 - economic cost of the production of demineralized water.

2 - The cooling water system

The cooling water system consists of two separate cooling towers (cross flow designed):
a) The first supplies the nitric acid and ammonium nitrate plants by cooling water.
b) The second supplies the ammonia plant by the cooling water.

For normal operation both cooling towers operated together at different concentration:
* Conc. factor of nitric acid cooling tower = 1.5 " max. Cl^- 120 mg/l ".
* Conc. factor of NH_3 cooling tower = 3.5 at " max. Cl^- 300 mg/l ".

Each cooling tower system is subdivided into the following three sections:
1 - Induced-draught cross flow cooling tower with pump station.
2 - Side stream filtration.
3 - Chemical treatment.

Saving gain:

1 - Minimize the treated water used by using blow down from Tower I as a makeup water for Tower II.
2 - Economic cost for the cooling water treatment.

Design data for cooling towers:

Item	HNO_3 & AN Plant	NH_3 Plant
Circulation rate	12700 M^3/hr	13700 M^3/hr
Make up water	515 M^3/hr	318 M^3/hr
Blow down	315 M^3/hr	115 M^3/hr
Conc. Factor	1.5	2.5 - 3
Temp. diff. "Δt"	10 ° C	10 ° C
Mat. Of Construction 1- Heat Exchanger	1) St. St. 2) Carbon St. ST. 35.8	1) St. St. 1.4593 & 1.4539 2) Titanium
2 - Piping Material	Carbon St. ST. 35.8	Carbon St. ST. 35.8

Cooling Water System for ABU QIR 2
The Makeup Water M^3/year during 2 Cases and % Saving :

1 - When using the blow down water from first cooling tower as makeup water to the second cooling tower beside treated water.
2 - When using only treated water as makeup.

	Makeup Water M^3/hr		Treated Water
	Treated Water	Blow Down	M^3/year
Case I	500	300	3960000
Case II	750	-	5940000
Saving	250	-	1980000

	% Saving
Treated Water	33.3
Chemical Cost	35.7

Demineralization Unit for ABU QIR 2
The Demineralized Water M^3/year during 2 Cases and % Saving:

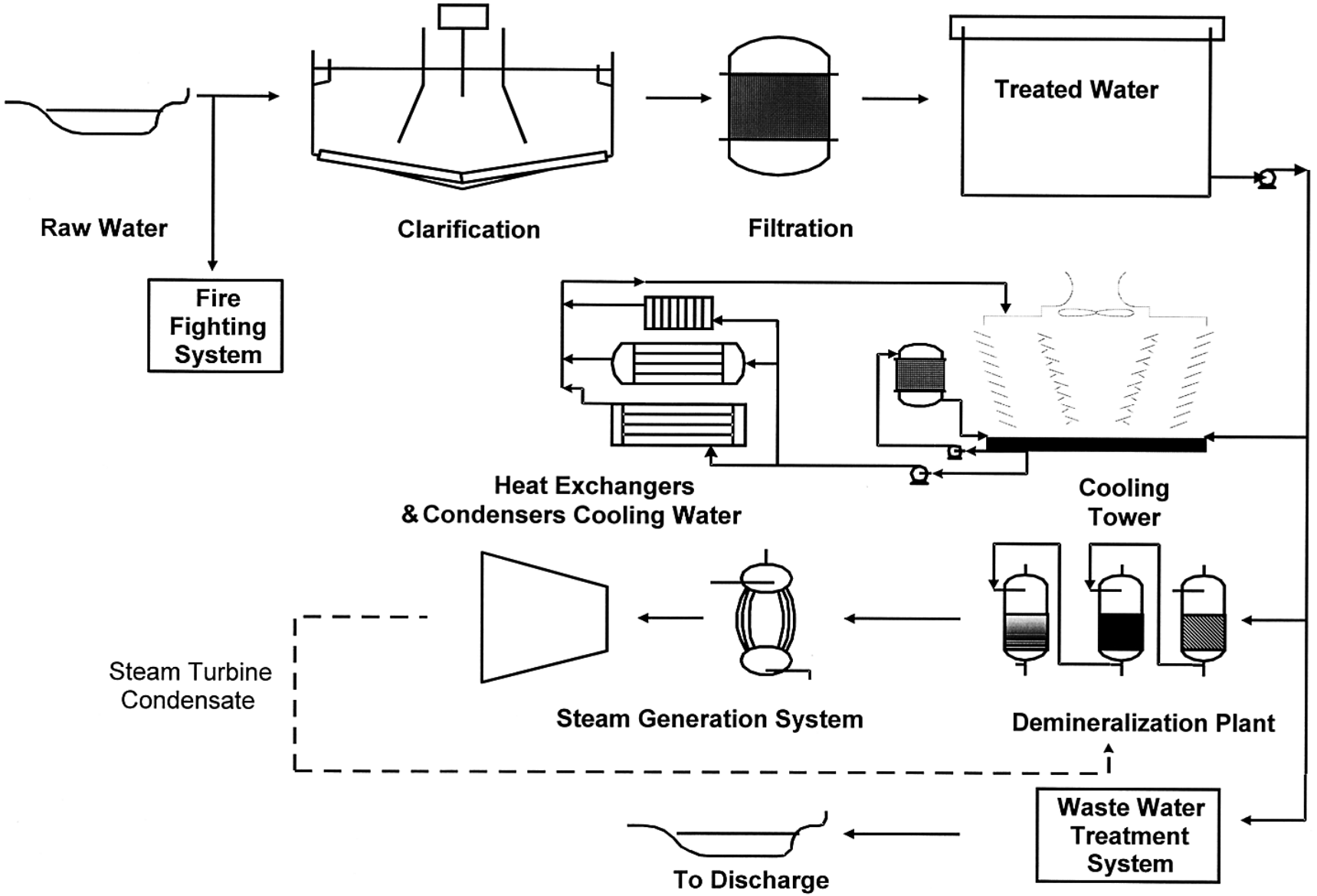
1 - Production of demineralized water from {(turbine cond. + process cond.) + treated water}.
2 - Production of demineralized water from (turbine cond. + treated water).

	Turbine	Process	Treated	Total	Treated Water
	M^3/hr	M^3/hr	M^3/hr	M^3/hr	M^3/year
Case I	176	40	90	306	712800
Case II	176	-	130	306	1029600
Saving	-	-	40	-	316800

	% Saving
Treated Water	30.8
Chemical Cost	8.4

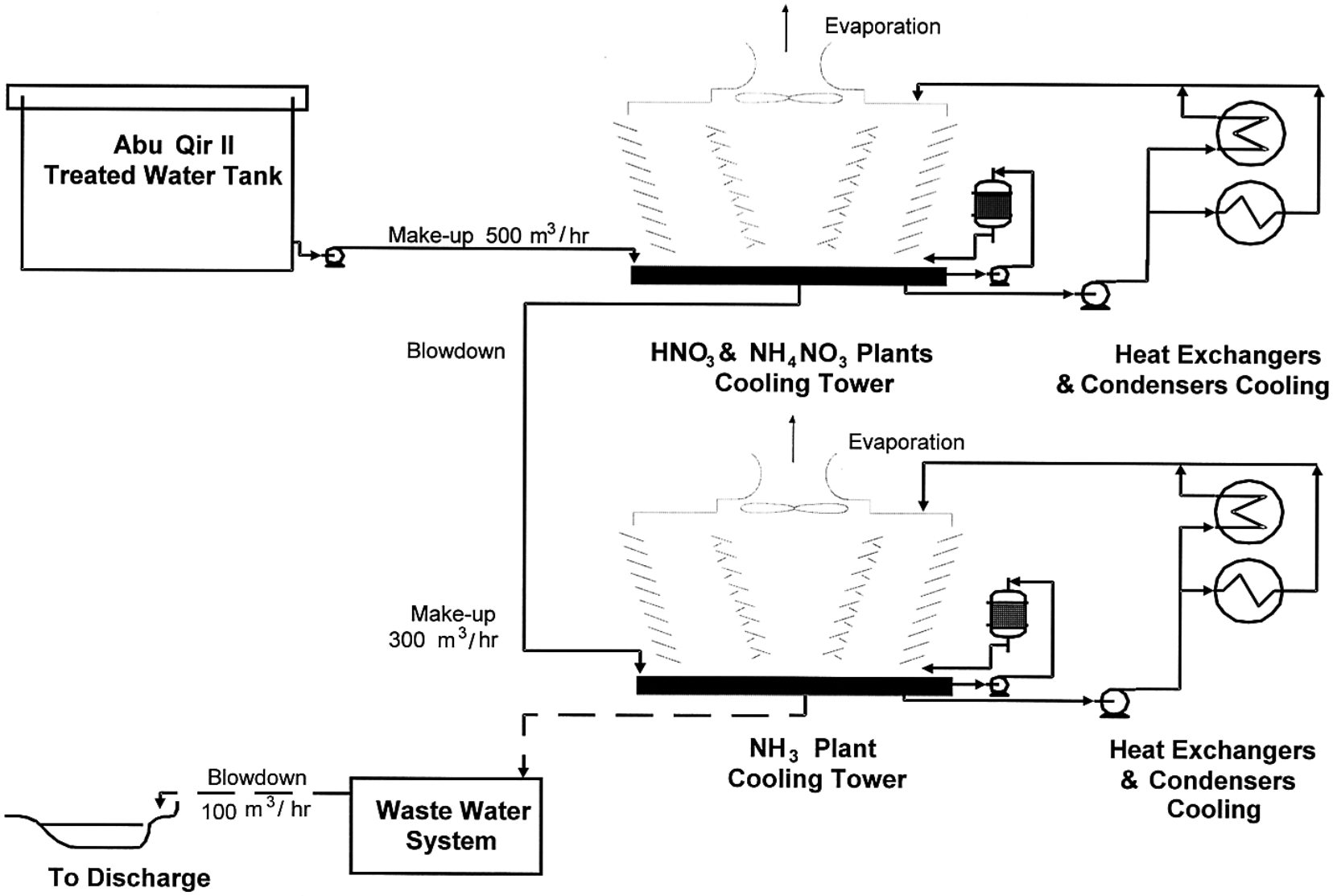
Water Treatment Procedure Outline of Abu Qir II

On stream since July 1991



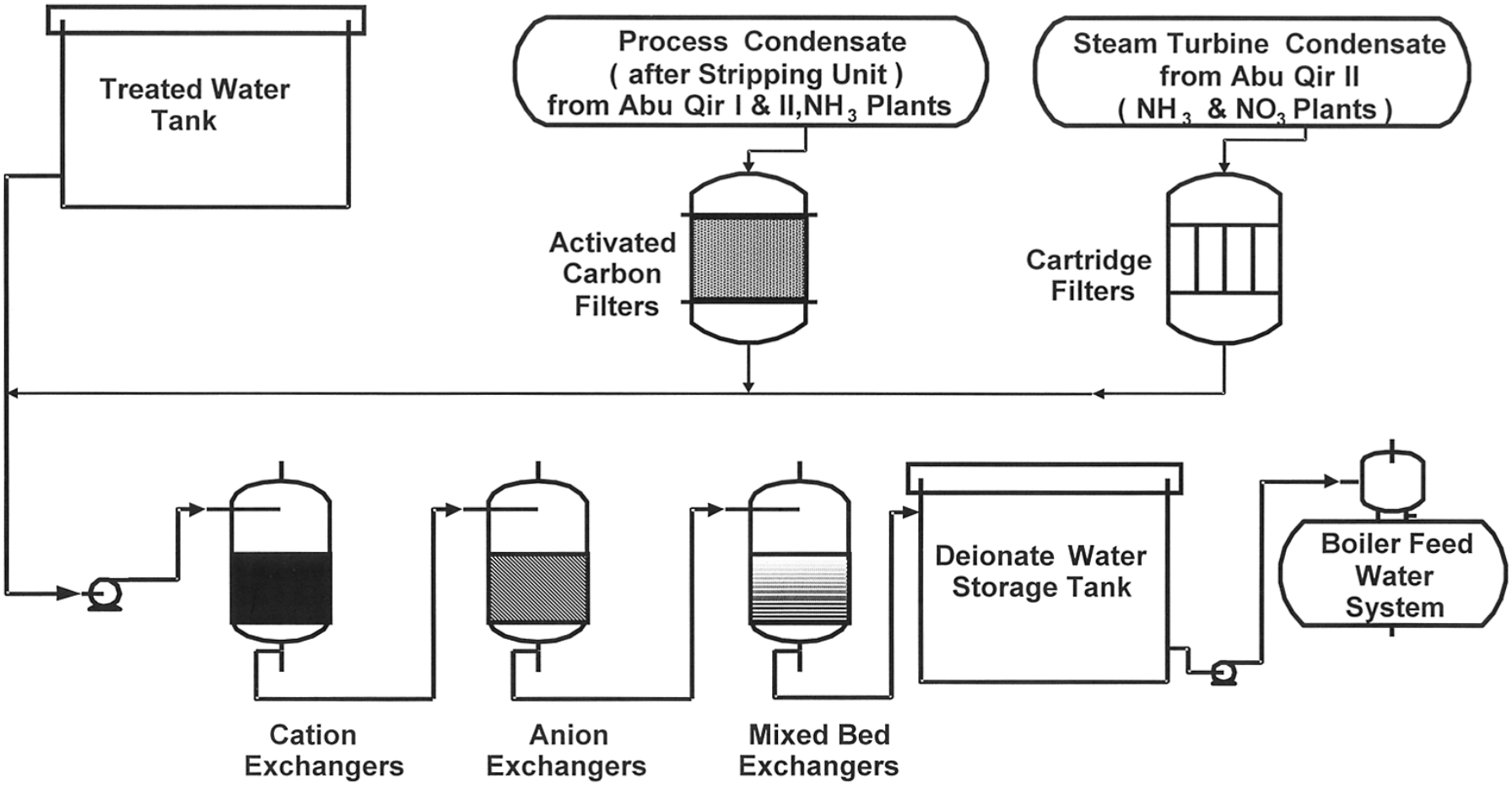
Cooling Water Procedure Outline of AbuQir II

On Stream Since July 1991



Demineralization Unit Procedure Outline of Abu Qir II

On Stream Since July,1991



Water treatment at Abu Qir 3 Plant

1 - Feed water system for steam generation

The demineralization unit is designed to produce 340 M^3/hr demineralized water for steam generation.

The production of demineralized water is based on
a) Turbine condensate 51.4 %.
b) Process condensate from NH_3 (I + III) 33.8 %.
c) Treated water 14.7 %.

The operation and the process units of demineralization plant similar to Abu Qir II.

2 - The cooling water system

The cooling water system consists of two separate cooling towers:
a) The first supplies the urea plant by the cooling water.
b) The second supplies the NH_3 plant by the cooling water.

Each cooling tower system is subdivided into the following three sections:
1 - Induced - draught cross flow cooling tower with pump station.
2 - Side stream filtration.
3 - Chemical treatment.

Saving gain

1 - Minimize the treated water used as a makeup water by using a different source of reused water as a makeup " Total Makeup = 475 M^3/hr ".
a) The reuse of urea process condensate after treatment by urea hydrolyzer as a makeup to the urea cooling tower " 75 M^3/hr ".
b) The reuse of blow down from urea cooling tower as a makeup to the NH_3 cooling tower " 100M^3/hr ".
c) The reuse of blow down from Abu Qir I cooling tower as a makeup to the NH_3 cooling tower " 300 M^3/hr ".

2 - Economic cost for the cooling water treatment.

Cooling Water System for ABU QIR 3
The Makeup Water M^3/year during 2 Cases and % Saving :

1 - When using different sources as makeup water [Blow down & treated urea process condensate] beside treated water.
2 - When using only treated water as makeup.

	Makeup Water M^3/hr		Treated Water
	Treated Water	Blow Down + urea cond.	M^3/year
Case I	110	475	871200
Case II	585	-	4633200
Saving	475	-	3762000

	% Saving
Treated Water	81.2
Chemical Cost	50.1

Demineralization Unit for ABU QIR 3
The Demineralized Water M^3/year during 2 Cases and % Saving:

1 - Production of demineralized water from {(turbine cond. + process cond.) + treated water}.
2 - Production of demineralized water from (turbine cond. + treated water).

	Turbine	Process	Treat. Wat.	Tot. Prod.	Treated Water
	M^3/hr	M^3/hr	M^3/hr	M^3/hr	M^3/year
Case I	175	115	50	340	396000
Case II	175	-	165	340	1306800
Saving	-	-	115	-	910800

	% Saving
Treated Water	69.7
Chemical Cost	48.6

The final evaluation of the optimum water resources and chemical consumption Abu Qir complex

	Abu Qir I Prilled urea 46.5% N	Abu Qir II Granulated AN 33.5% N	Abu Qir III Granulated urea 46.5% N
Date on stream	September, 1979	July, 1991	January, 1999
production	536000 ton/year	800000 ton/year	600000 ton/year
The uses of treated water I - as a makeup II - for demin unit	 650 M^3/hr 170 M^3/hr	 500 M^3/hr 90 M^3/hr	 110 M^3/hr 50 M^3/hr
Total treated water consumption	820 M^3/hr 6494400 M^3/year	590 M^3/hr 4672800 M^3/year	160 M^3/hr 1967200 M^3/year
% of saving I - treated water II - chemical cost	 - -	 27.6 % 18.6 %	 80 % 51.8 %

Conclusion:

The development process in the three plants in Abu Qir complex, as opposed to traditional techniques of choosing the optimal process for reusing each source of water to meet process need, depends on reuse and recycling of the cooling water blow down and process condensate.

This led to:

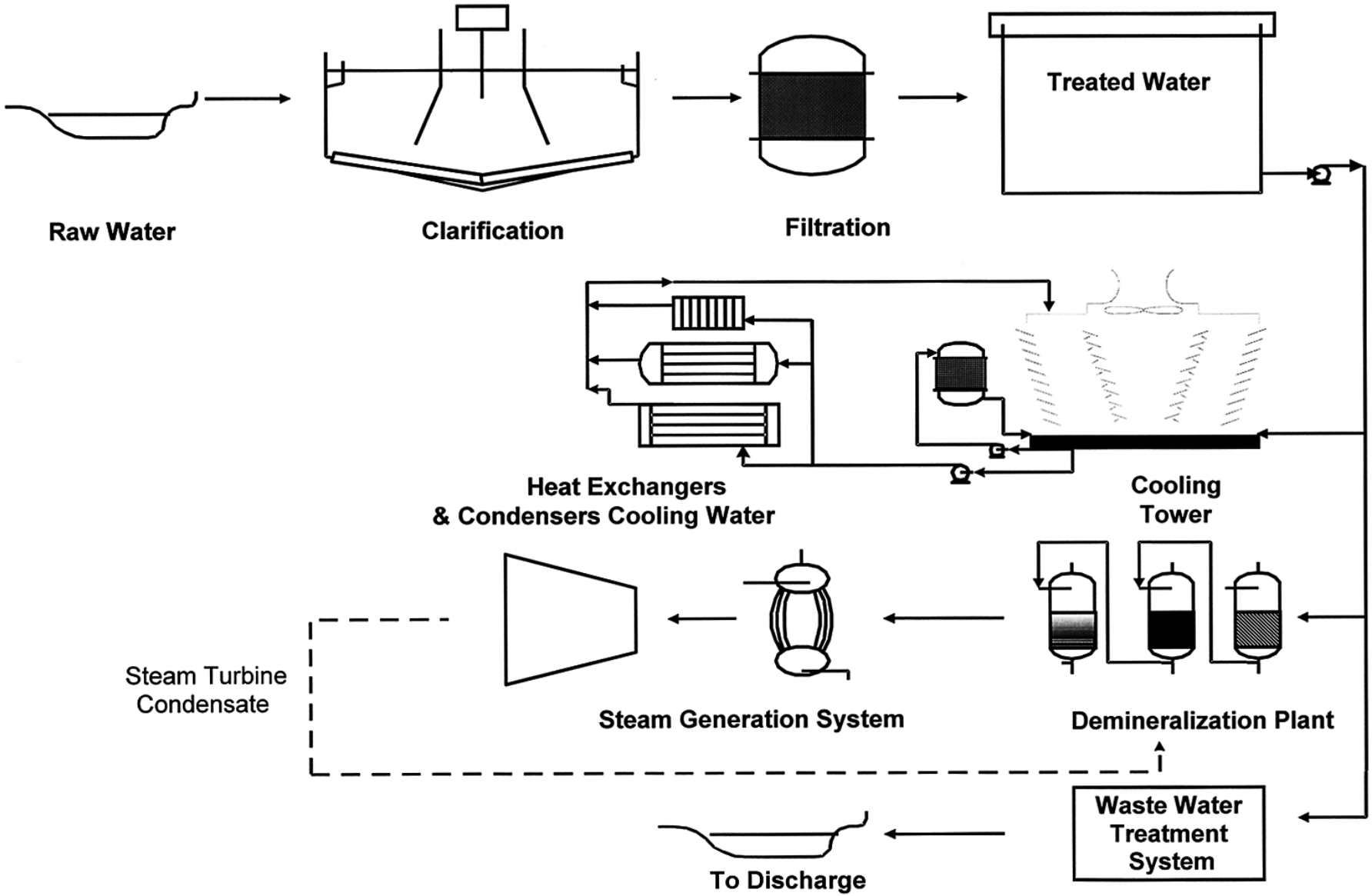
1 - Minimize the fresh water quantity used:
- by 27.6 % at Abu Qir II.
- by 80.0 % at Abu Qir III.

2 - Decreasing the chemical consumption which will minimize the total cost of cubic meter of water:
- by 18.6 % at Abu Qir II
- by 51.8 % at Abu Qir III.

3 - Providing an improvement in environment profile by eliminating the potential contamination

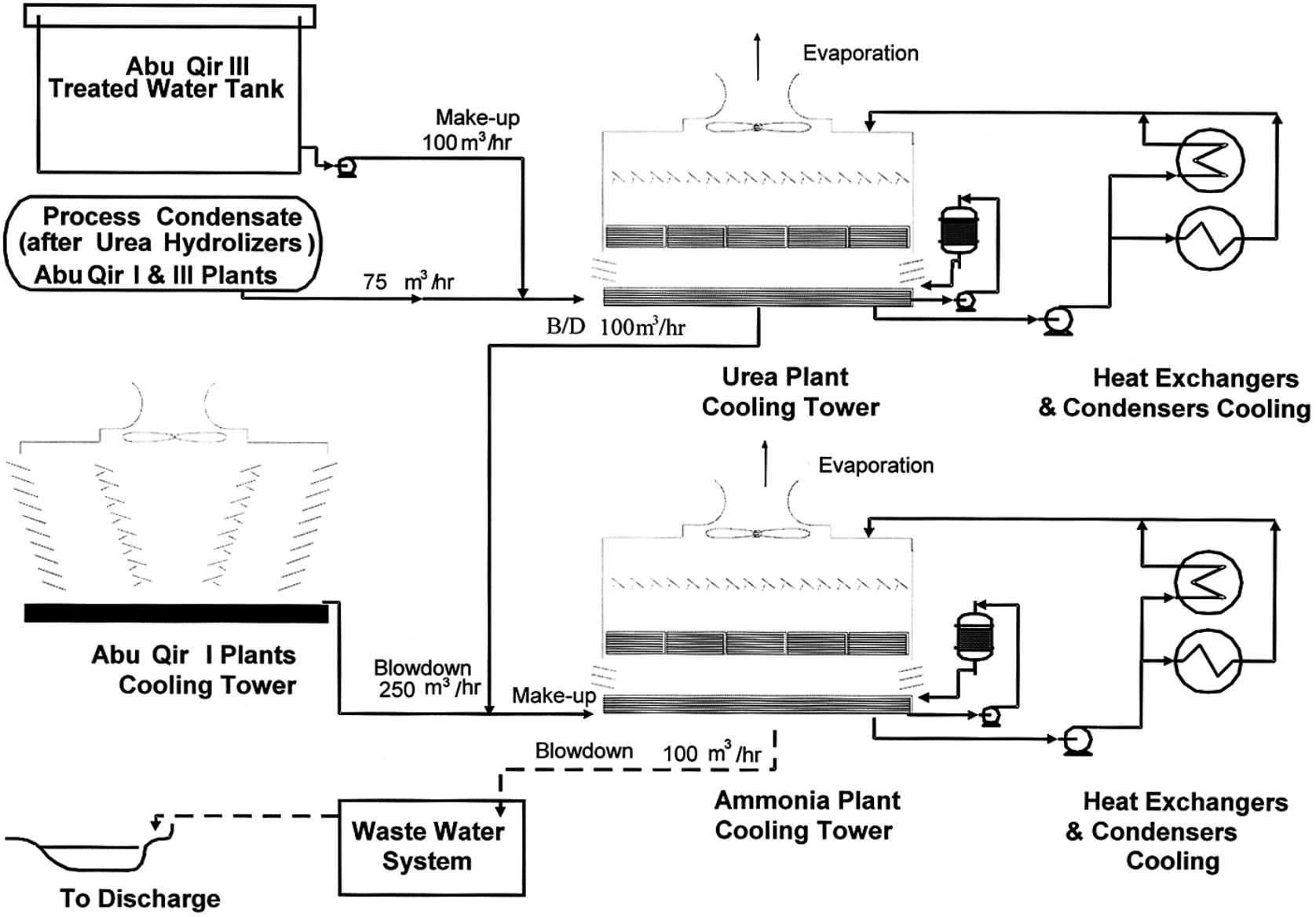
Water Treatment Procedure Outline of Abu Qir III

On stream since January1999.



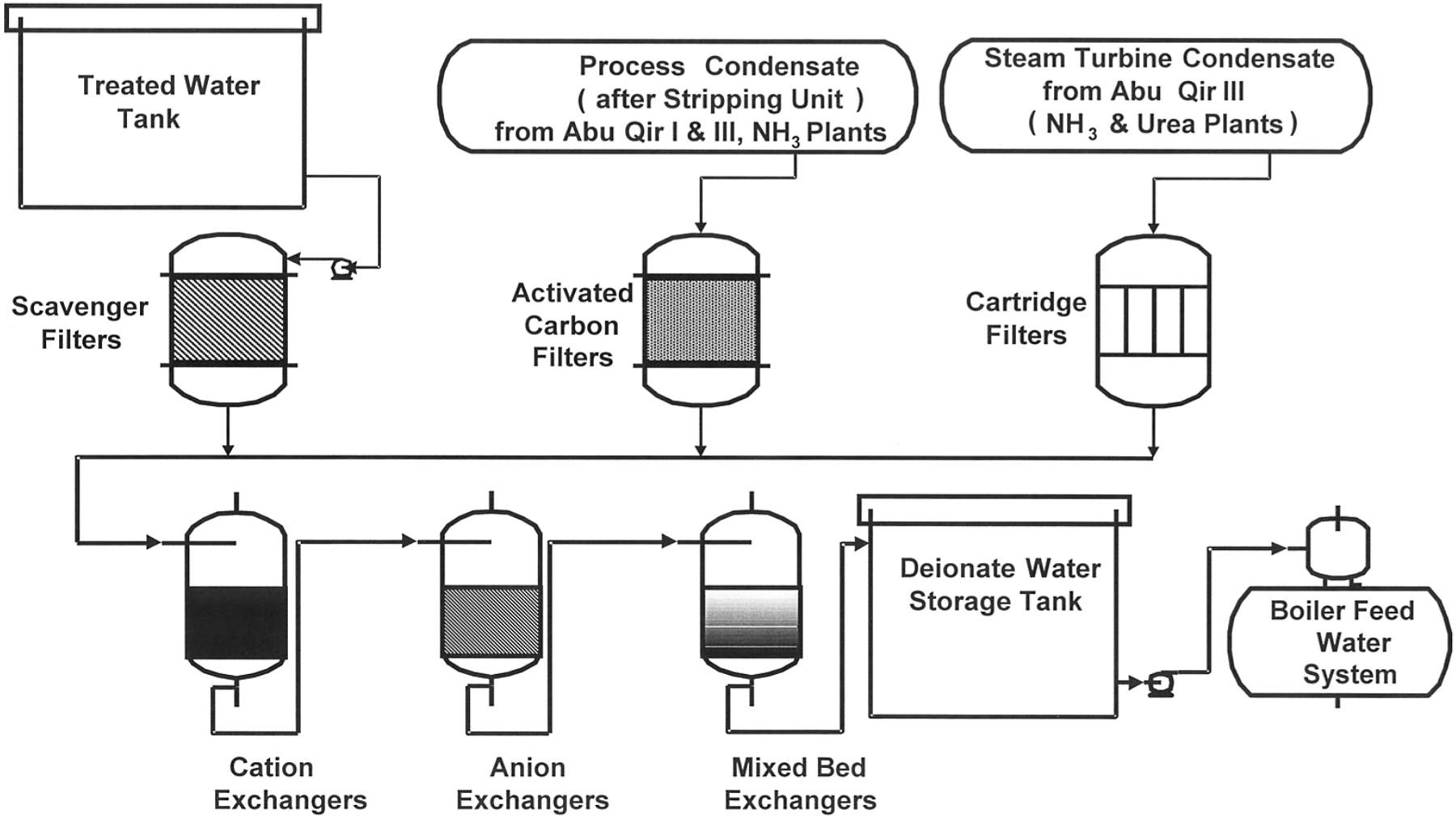
Cooling Water Procedure Outline of Abu Qir III

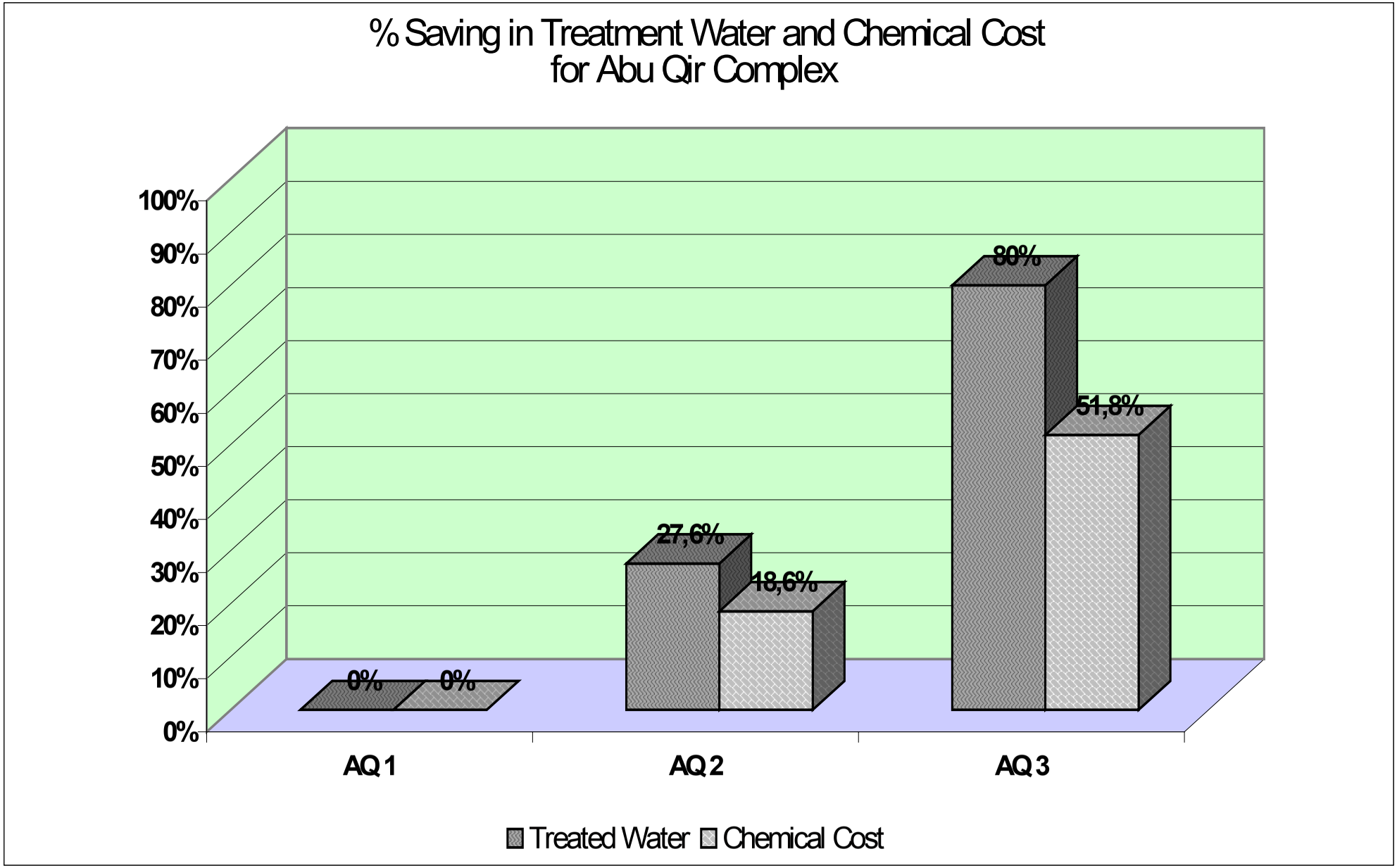
On Stream Since January 1999



Demineralization Unit Procedure Outline of Abu Qir III

On Stream Since January,1999




% Saving in Treatment Water and Chemical Cost for Abu Qir Complex
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
0%
0%
27,6%
18,6%
80%
51,8%
AQ1
AQ2
AQ3
Treated Water
Chemical Cost