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Sensitive Ecnomic Analysis of Nuclear Desalination by Using DEEP

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Introduction

Nowadays only 1/2000 of overall fresh water resource can be used in the world, 1.1 billion people in the world are short of safety drinkable water, so the supply of freshwater is one of the major problems facing to the world in 21st century. The desalination of sea water is a very important way to find new fresh water resource and sea water is inexhaustible.

Evaluation method and software

In order to promote nuclear technology in electricity production or portable water production, The IAEA has developed its economic evaluation model and established the Desalination Economic Evaluation Program (DEEP) by using levelized discounted costs method.

Assumption and data Prepartion

Overview of nuclear seawater desalination plant

Nuclear seawater desalination plant consists of a seawater desalination pool shell type reactor (abbreviation SDPSR) and sevseal low temperature multi effect distilling facilities and their correlated systems.

Overview of nuclear seawater desalination plant

SDPSR is a low temperature, normal pressure (atmosphere pressure at the surface of the pool) nuclear reactor which uses the same fuel as that of commercial nuclear power plant. This kind of reactor operates under low temperature and normal pressure.

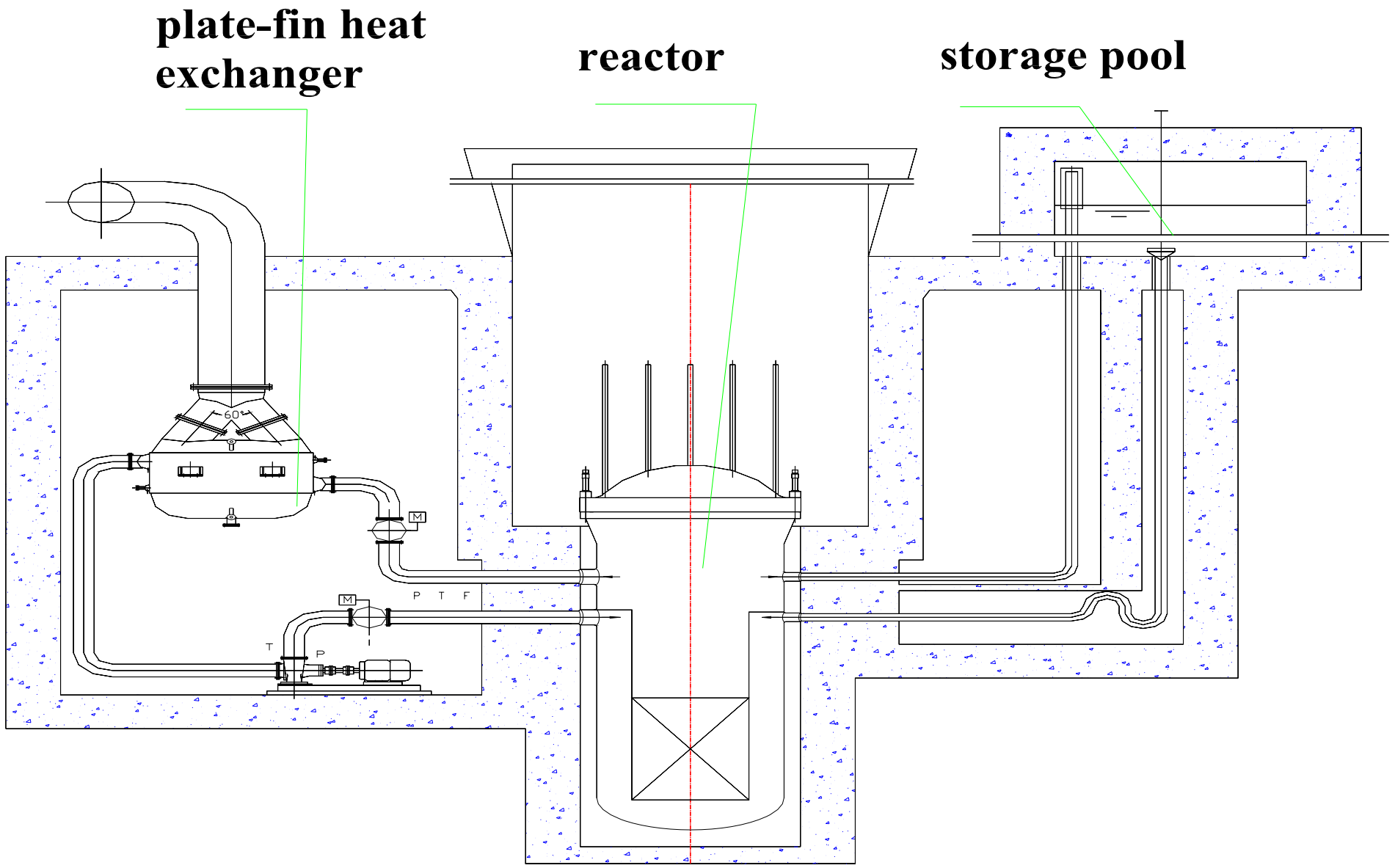
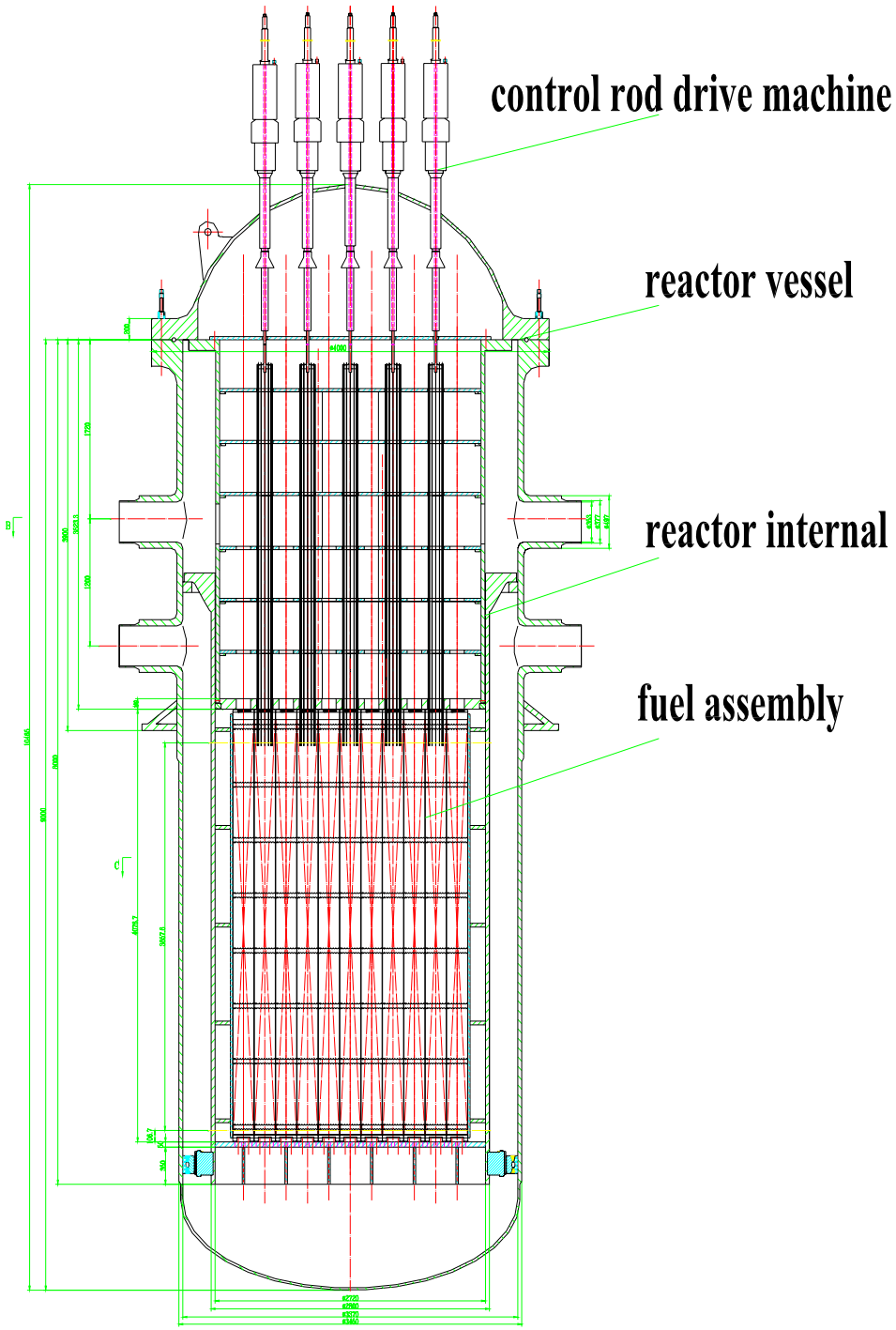


Figure.1 Principal layout of the nuclear heat supply



Main characteristic of the reactor vessel can be found as following:
design pressure 0.6MPa，
design temperature 150℃，
internal diameter Φ3370mm，
total height 12100mm，
maximum diameter 3916mm，
total weightiness 55ton，

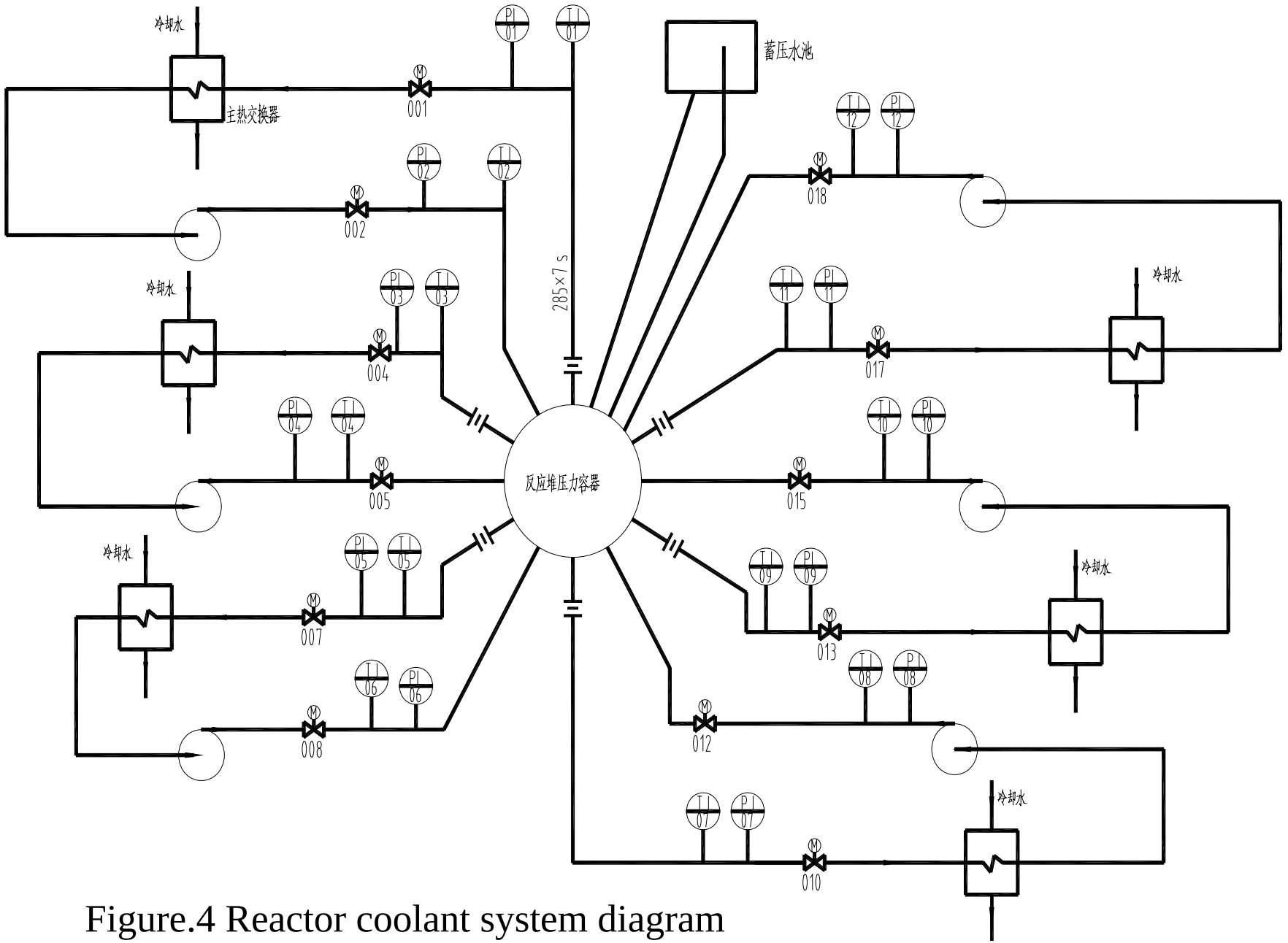


Figure.4 Reactor coolant system diagram

结构 CONSTRUCTION

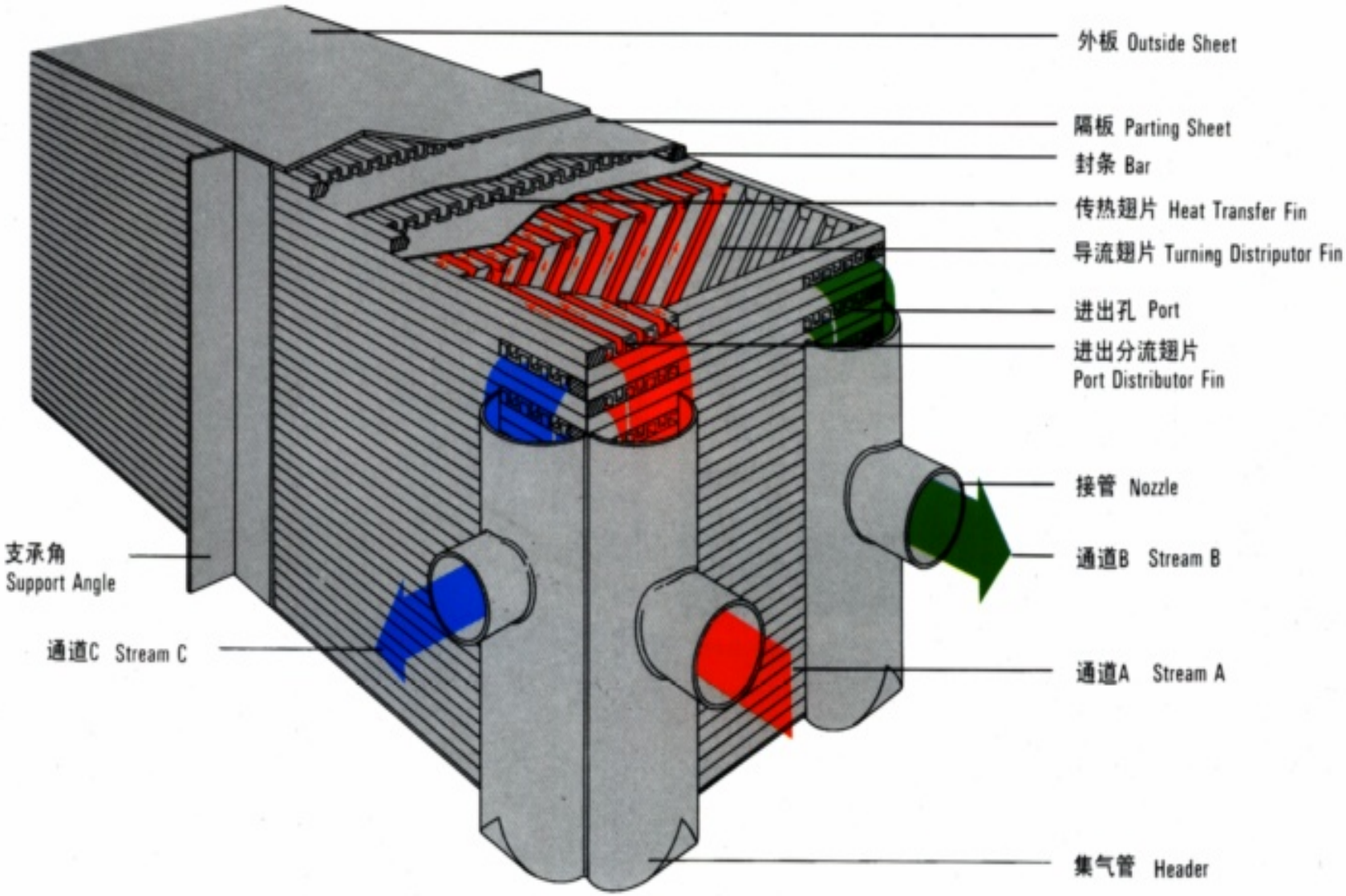


Figure.3 Plate-fin heat exchanger

Research area suggestion and different scenarios assumption

Table 1 Input data for water cost calculation

Region		1	2	3
Sea water temperature ℃		20	25	30
TDS	(ppm)	38000	41000	45000
Person cost ($/year)	Management	160000	60000	60000
	Labour	80000	30000	30000
Discount rate (%)	Sn	5	8	8
	Sf	8	10	10

Table 2 Input data for water cost calculation

IAEAs Desalination Economic Evaluation Programme DEEP Version 3.04 - July 2005 Technical parameters input data			
Average annual cooling water temperature	° C	Tsw	20 to 30
Seawater total dissolved solids (TDS)	ppm	TDS	38 to 45
Electric motor efficiency		Eem	0.96
Temperature difference for heat transfer	° C	DTht	34
Outlet temperature of gas turbine	° C	Togt	NA
Factor auxiliary load		Fal	NA
Turbine mechanical efficiency		Etm	NA
Generator efficiency		Eg	NA

Caculation result

The economic comparison of fresh water production by SDPSR, other kind of nuclear reactors and fossil plant (Sn and Sf are the same meaning and value in table 1) in different regions are shown in Diagram 1, 2 and 3 respectively.

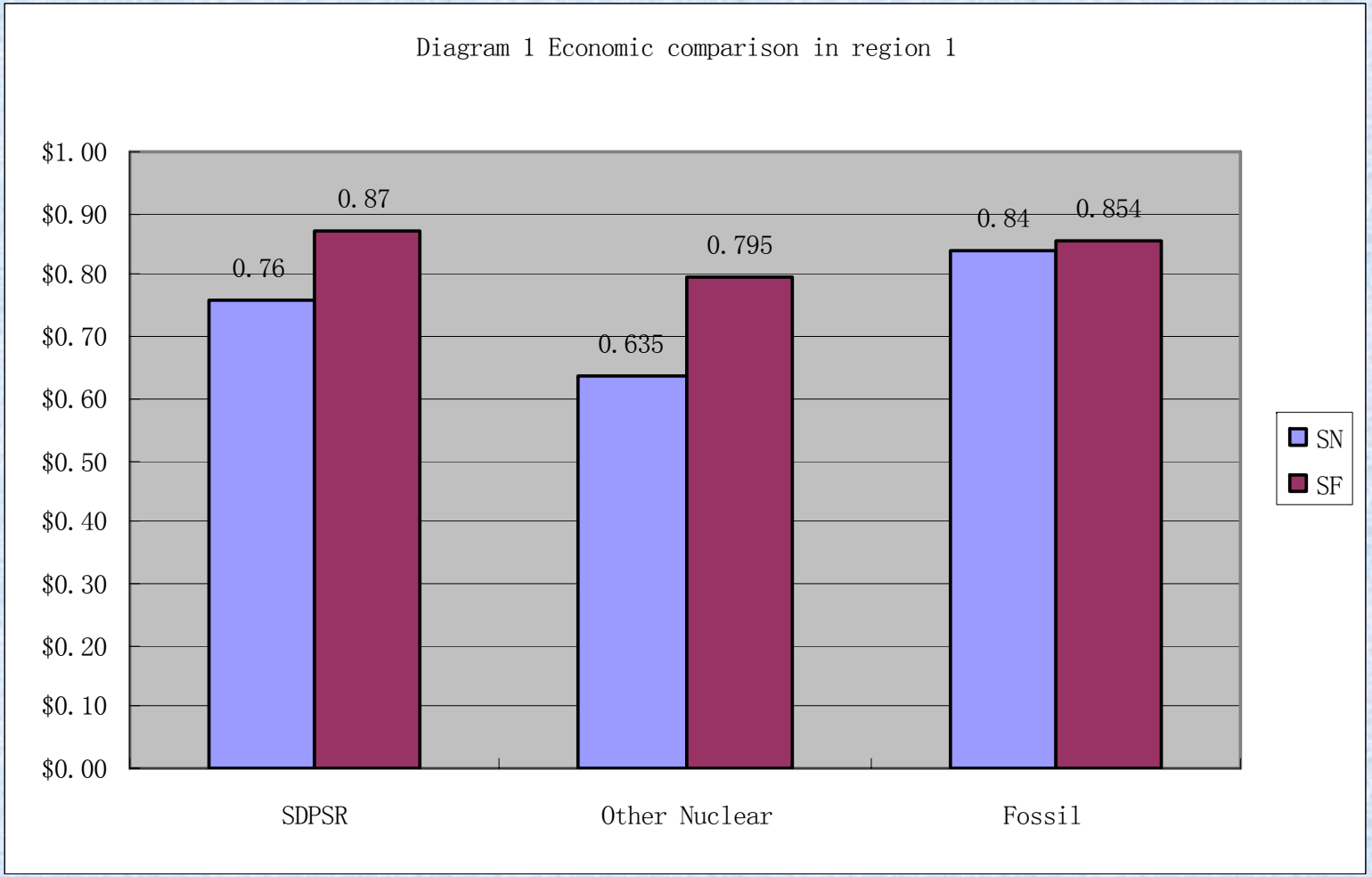


Diagram 1 Economic comparison in region 1
$1.00
$0.90
$0.80
$0.70
$0.60
$0.50
$0.40
$0.30
$0.20
$0.10
$0.00
0.76
0.87
0.635
0.795
0.84
0.854
SDPSR
Other Nuclear
Fossil
SN
SF

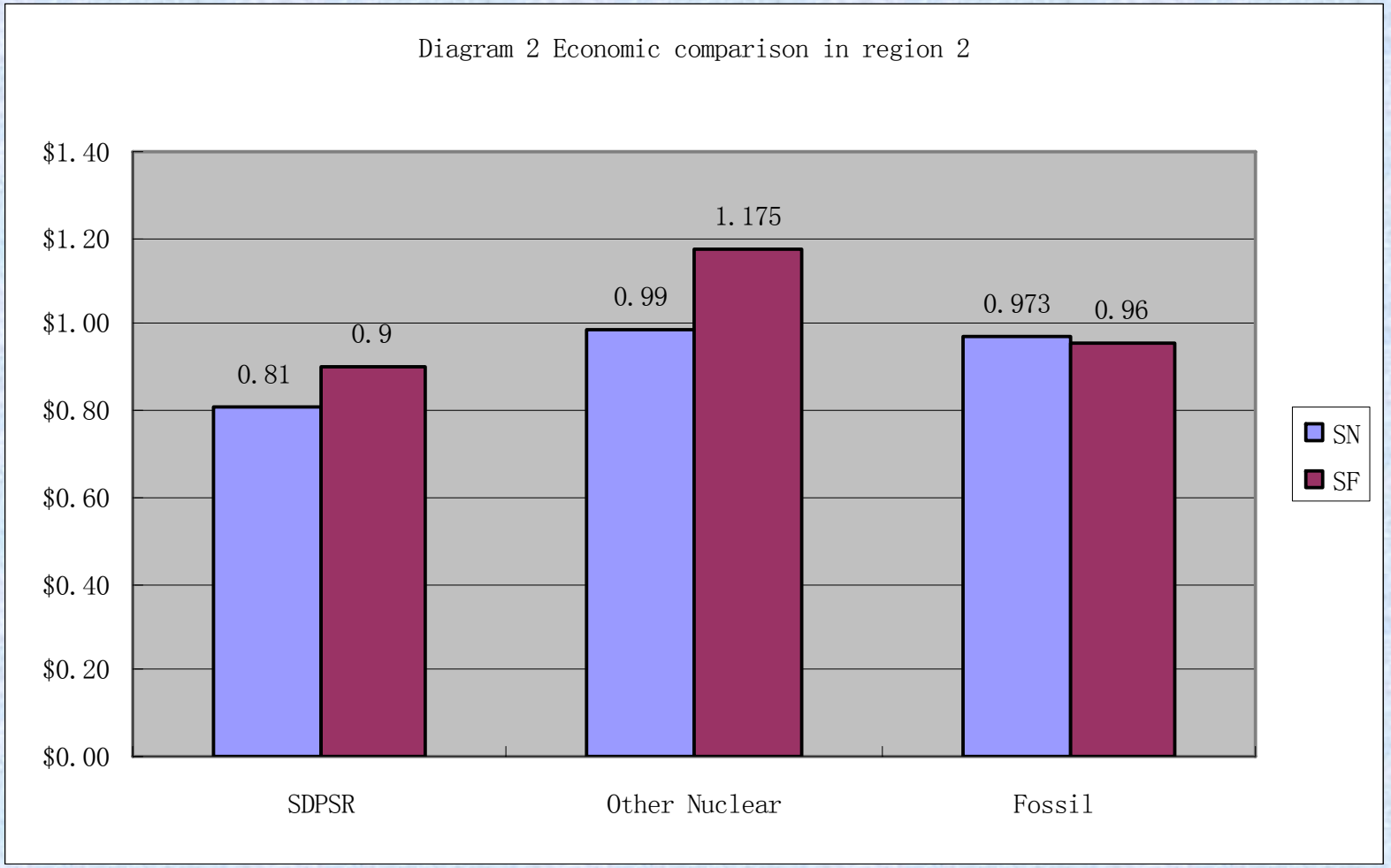


Diagram 2 Economic comparison in region 2
$1.40
$1.20
$1.00
$0.80
$0.60
$0.40
$0.20
$0.00
0.81
0.9
0.99
1.175
0.973
0.96
SDPSR
Other Nuclear
Fossil
SN
SF

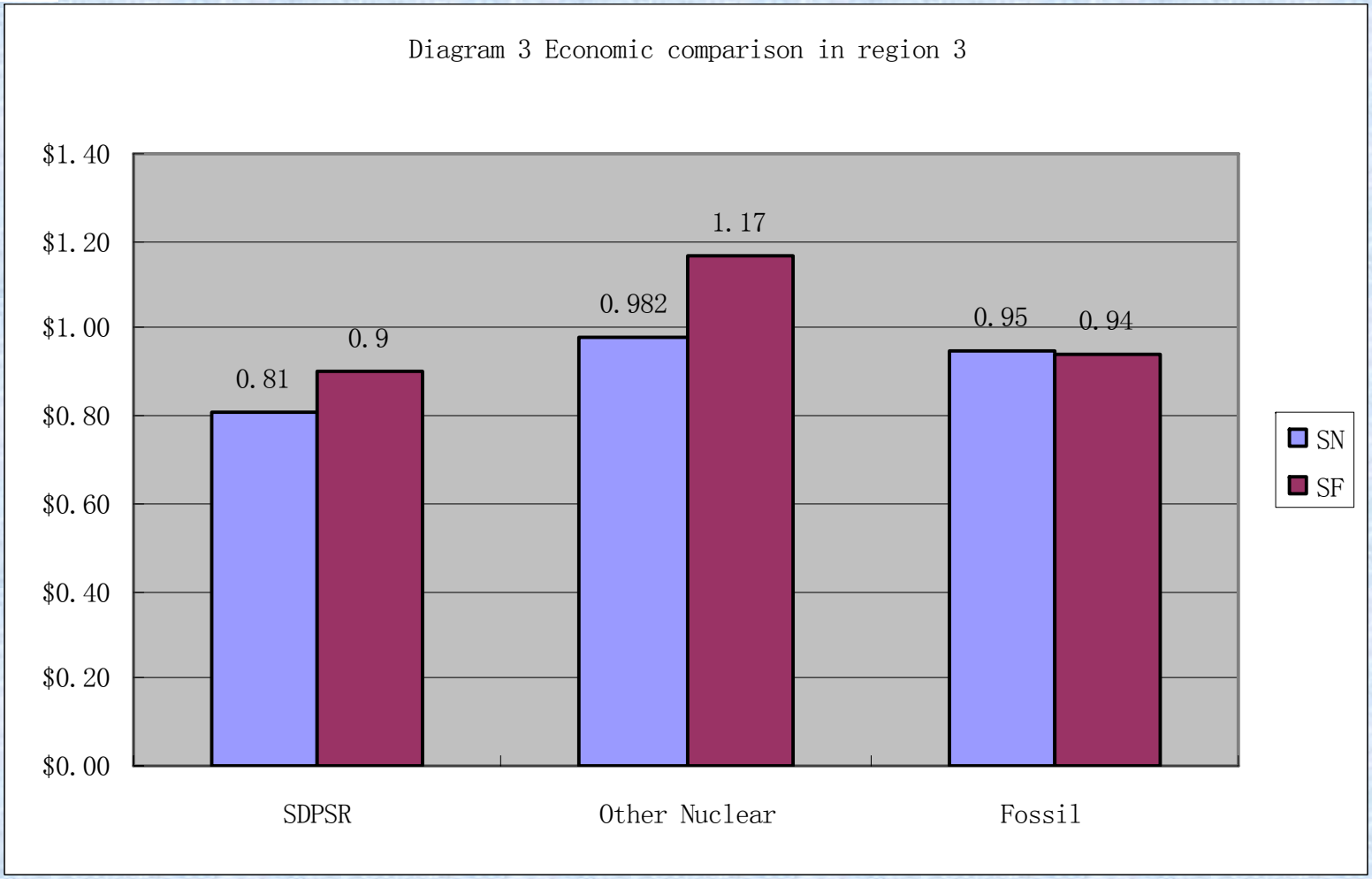


Diagram 3 Economic comparison in region 3
$1.40
$1.20
$1.00
$0.80
$0.60
$0.40
$0.20
$0.00
0.81
0.9
0.982
1.17
0.95
0.94
SDPSR
Other Nuclear
Fossil
SN
SF

Conclusion

From the comparison and analyses above, we can conclude:

Discount rate is a very sensitive factor to water price;

TDS is not a very sensitive factor to water price;

Person cost is almost no affect to water price;

Conclusion

SDPSR is competitive with other nuclear technology and fossil plant in water production in Region 1 and Region 2;

In Region 1, SDPSR is competitive with fossil plant and in water production.

Thanks!