

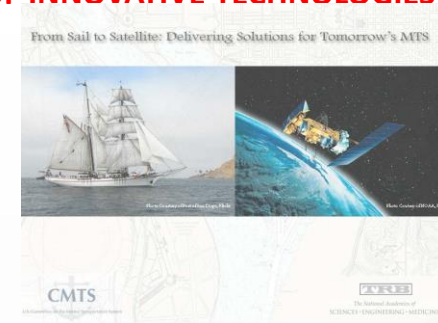
A STUDY OF ABSORPTION CHILLER/HEATER APPLICATION IN MARINE ENGINEERING

Yongjian Gu, Ph.D., P.E.

Department of Marine Engineering
US Merchant Marine Academy
(516)716-5719, guy@usmma.edu



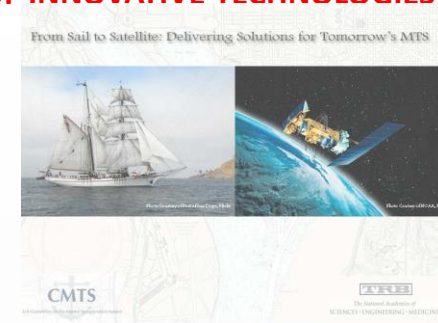
Yongjian Gu, Ph.D., P.E.
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US Merchant Marine Academy
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OUTLINE

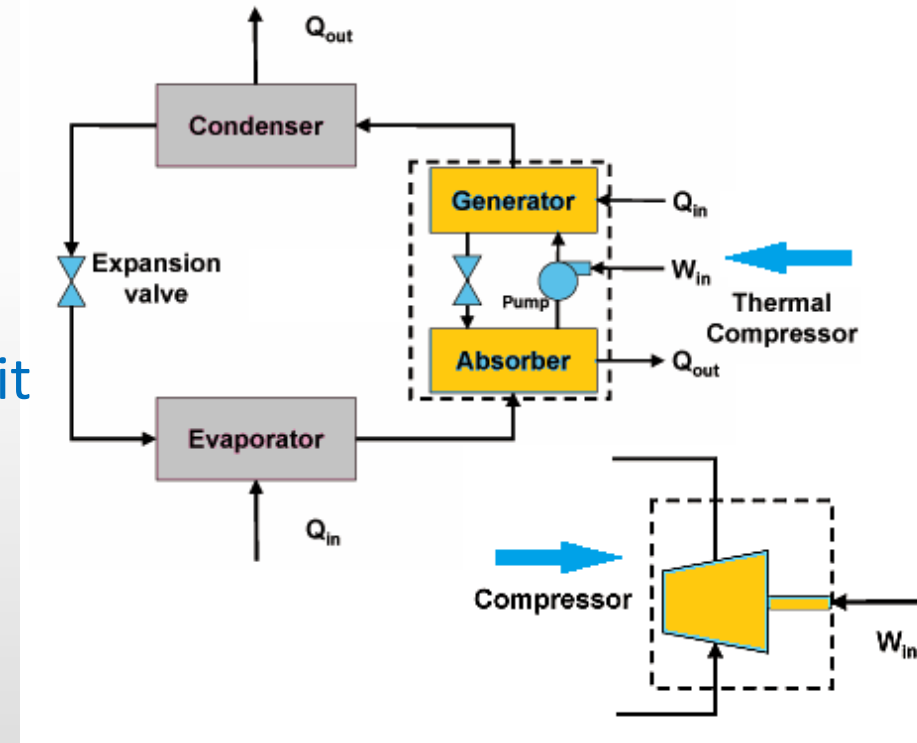
- ❑ Advantages of Applying Absorption Chiller/Heater
- ❑ Working Principle of Absorption Cycle
- ❑ Types of Absorption Chiller/Heater
- ❑ Operation Mode of Absorption Chiller/Heater
- ❑ Design Consideration of Absorption Chiller/Heater Application in Marine Engineering
- ❑ An Example of HVAC with Absorption Chiller Applicable in Marine Engineering
- ❑ Summary





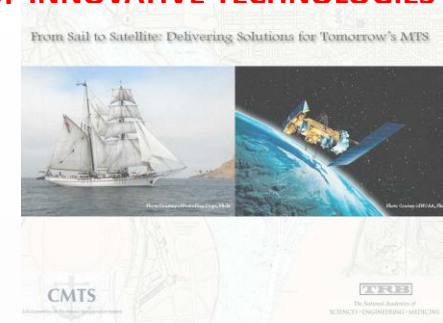
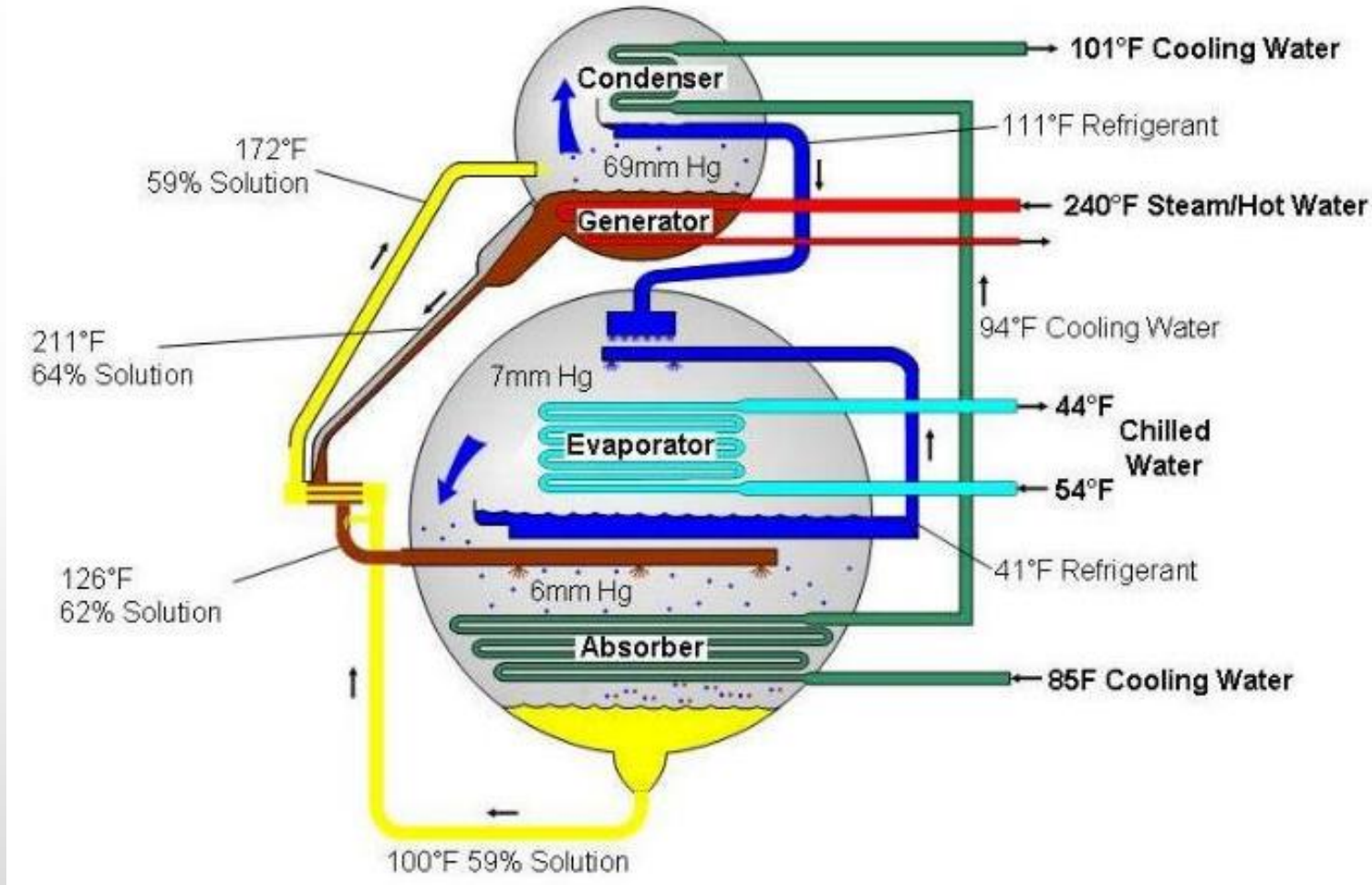
ADVANTAGES OF USING ABSORPTION CHILLER/HEATER (COMPARING TO ELECTRICAL COMPRESSION CHILLER)

- ❑ Diversity of Heating Energy
- ❑ Recovery of Waste/Exhaust Heat
- ❑ Large Reduction in Power Input
- ❑ Providing Cooling and Heating from One Integrated Unit
- ❑ Reducing Emissions
- ❑ Improving Efficiency of Entire Thermodynamic System

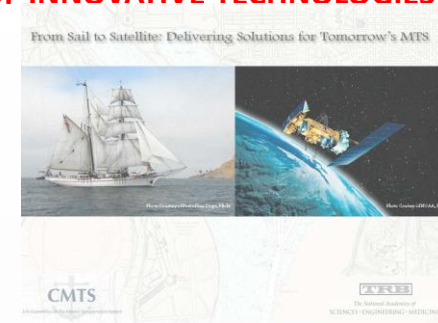


Yongjian Gu, Ph.D., P.E.
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US Merchant Marine Academy
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WORKING PRINCIPLE OF ABSORPTION CYCLE



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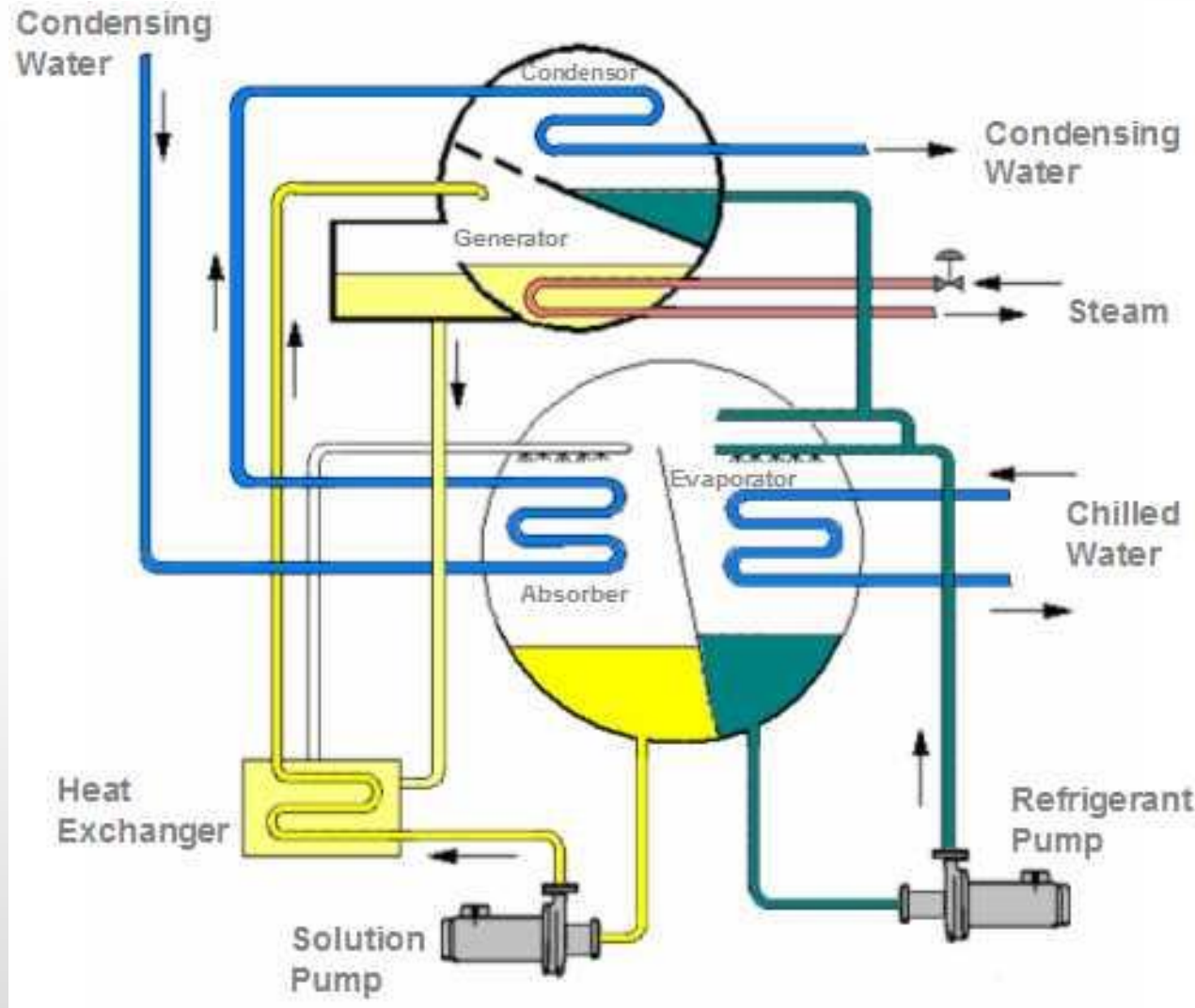
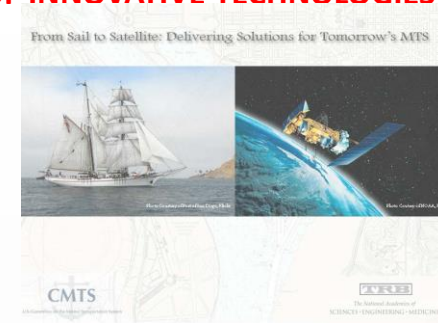


TYPES OF ABSORPTION CHILLER/HEATER

- ❑ Refrigerant
 - ❖ Water/Ammonia ($\text{H}_2\text{O}-\text{NH}_3$): Ammonia
 - ❖ Lithium-Bromide/Water ($\text{LiBr}-\text{H}_2\text{O}$): Water
- ❑ Configuration
 - ❖ Single-Effect
 - ❖ Double-Effect
- ❑ Heating Source
 - ❖ Direct-Fired: Gas or Fuel Oil burner
 - ❖ Indirect-Fired: Steam or Hot Water Produced by Exhaust Gas or Solar Panels
 - ❖ Hybrid: Fuel and Exhaust Gas



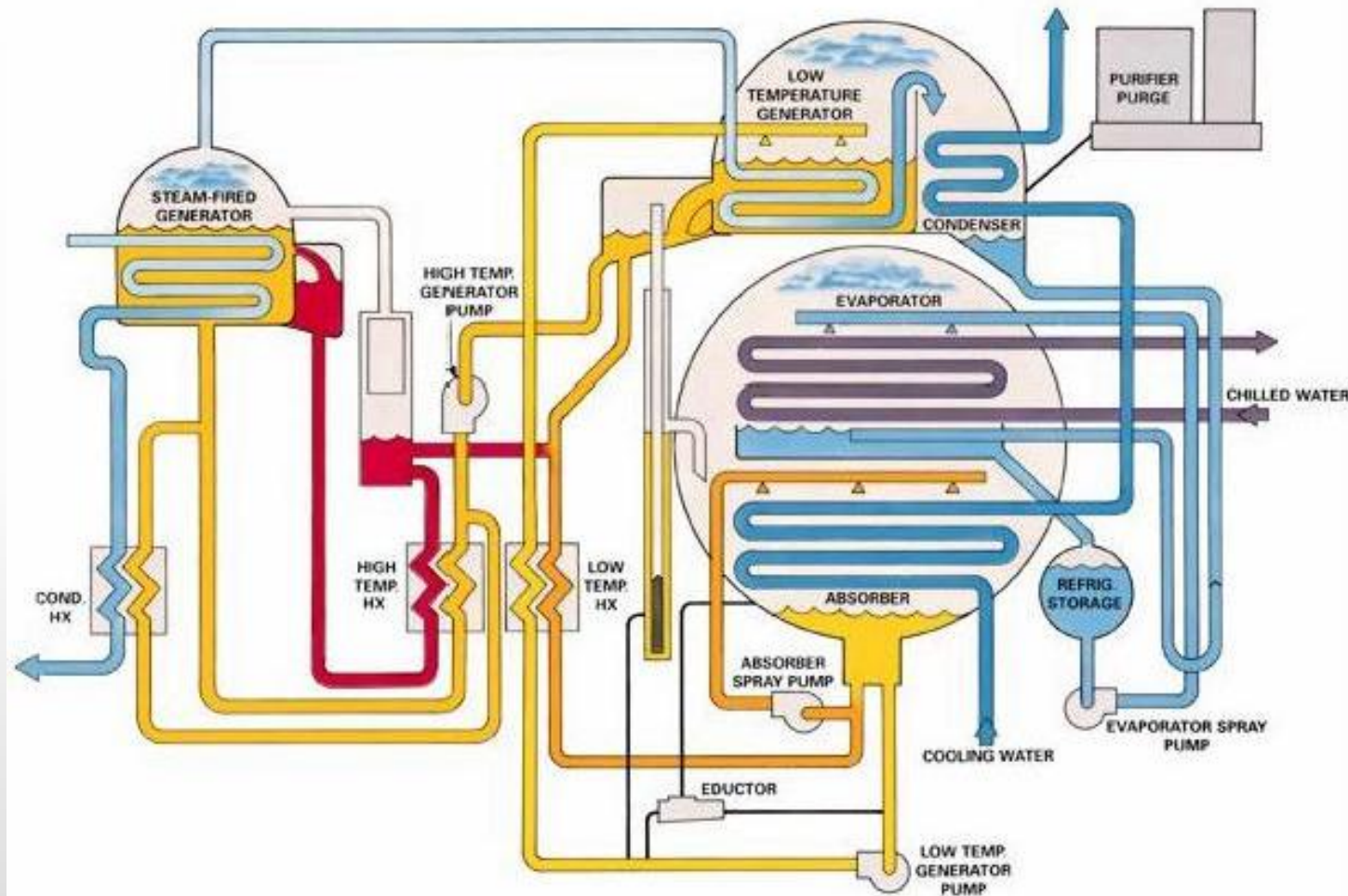
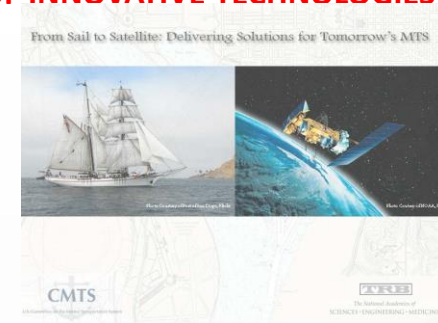
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**SINGLE-EFFECT
INDIRECT FIRED**



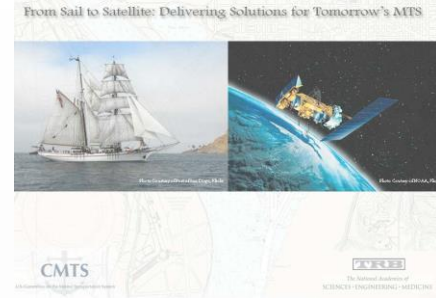
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Department of Marine Engineering
US Merchant Marine Academy
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**DOUBLE-EFFECT
INDIRECT FIRED**

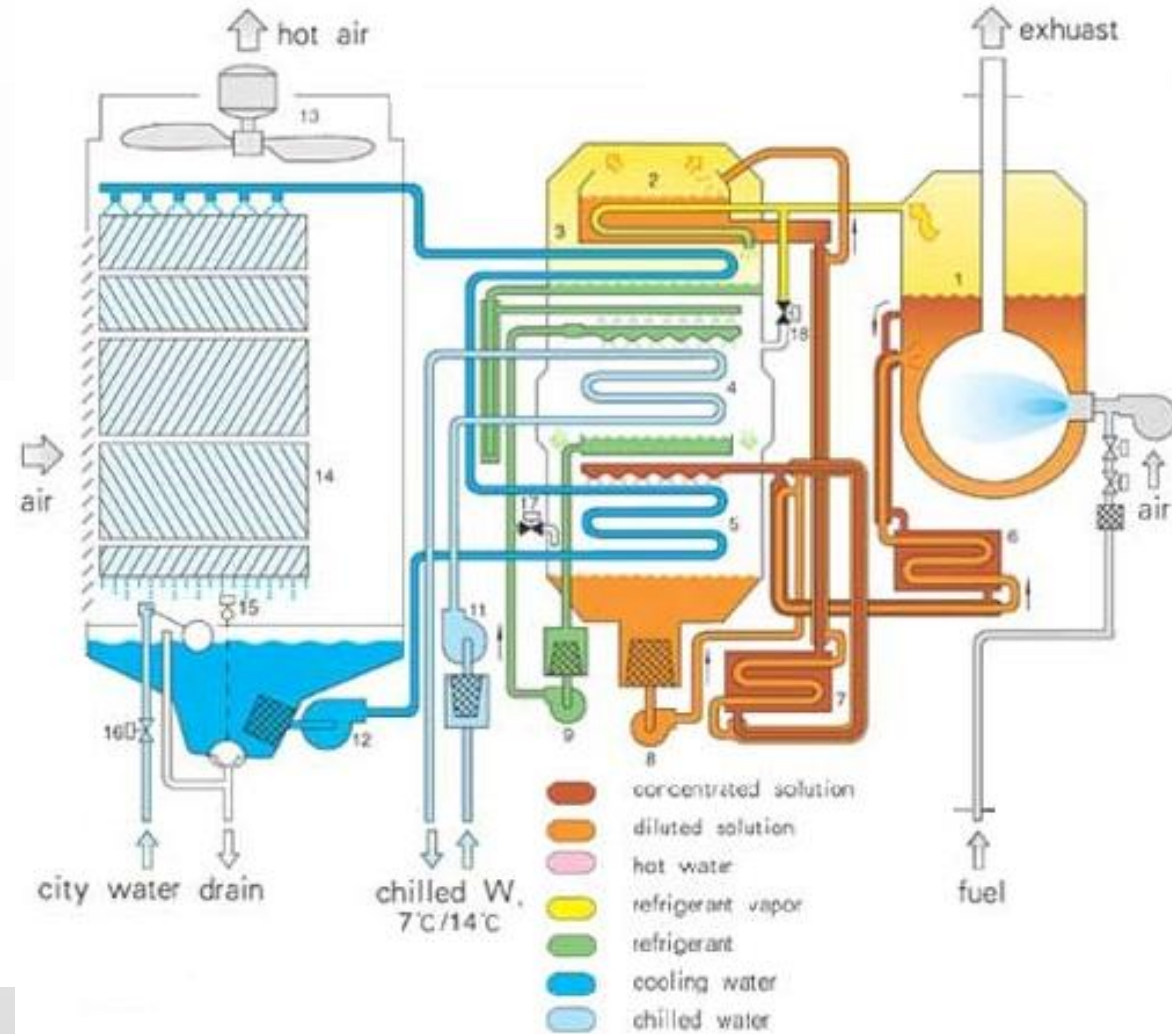
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Department of Marine Engineering
US Merchant Marine Academy
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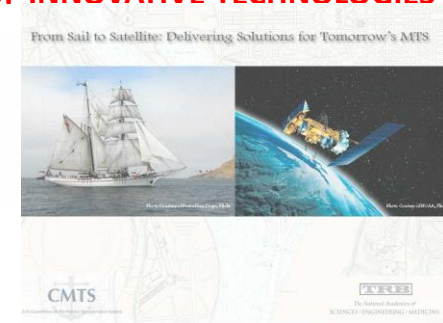
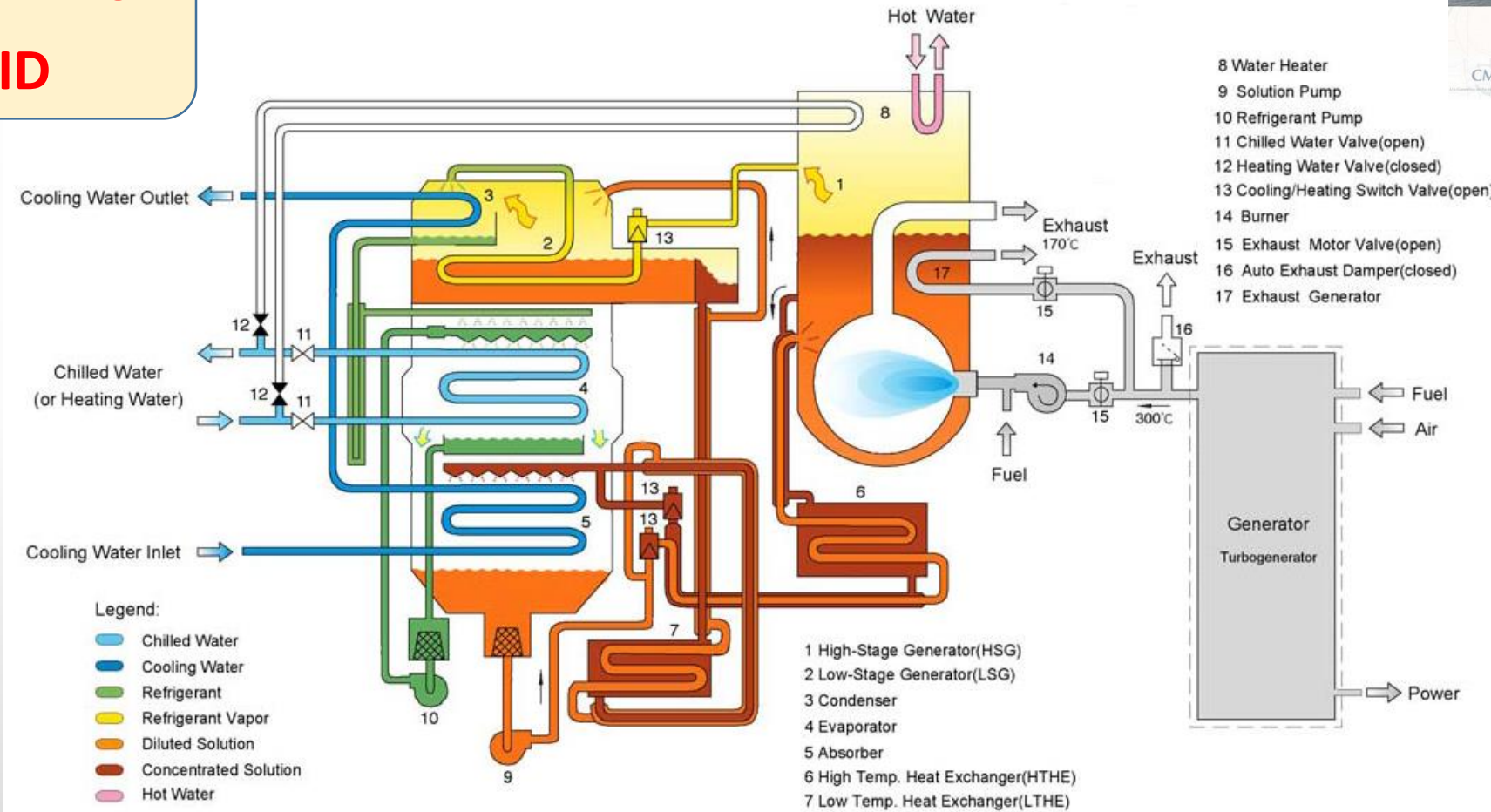
DOUBLE-EFFECT DIRECT FIRED

1. High stage generator (HSG)
2. low stage generator (LSG)
3. condenser
4. evaporator
5. absorber
6. high temp. heat exchanger (HTHE)
7. low temp. heat exchanger (LTHE)
8. solution pump
9. refrigerant pump
10. burner
11. chilled W. pump
12. cooling W. pump
13. cooling fan
14. cooling tower
15. discharge switch (close)
16. water make-up solenoid valve (open)
17. refrigerant by-pass solenoid valve (close)
18. cooling/heating switch solenoid valve (close)



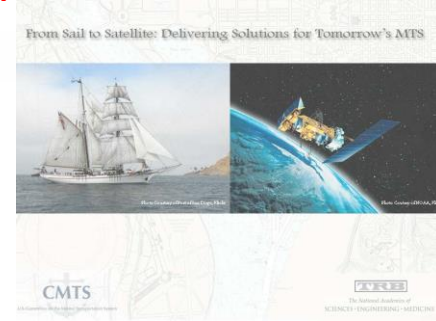
Yongjian Gu, Ph.D., P.E.
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DOUBLE-EFFECT HYBRID



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US Merchant Marine Academy
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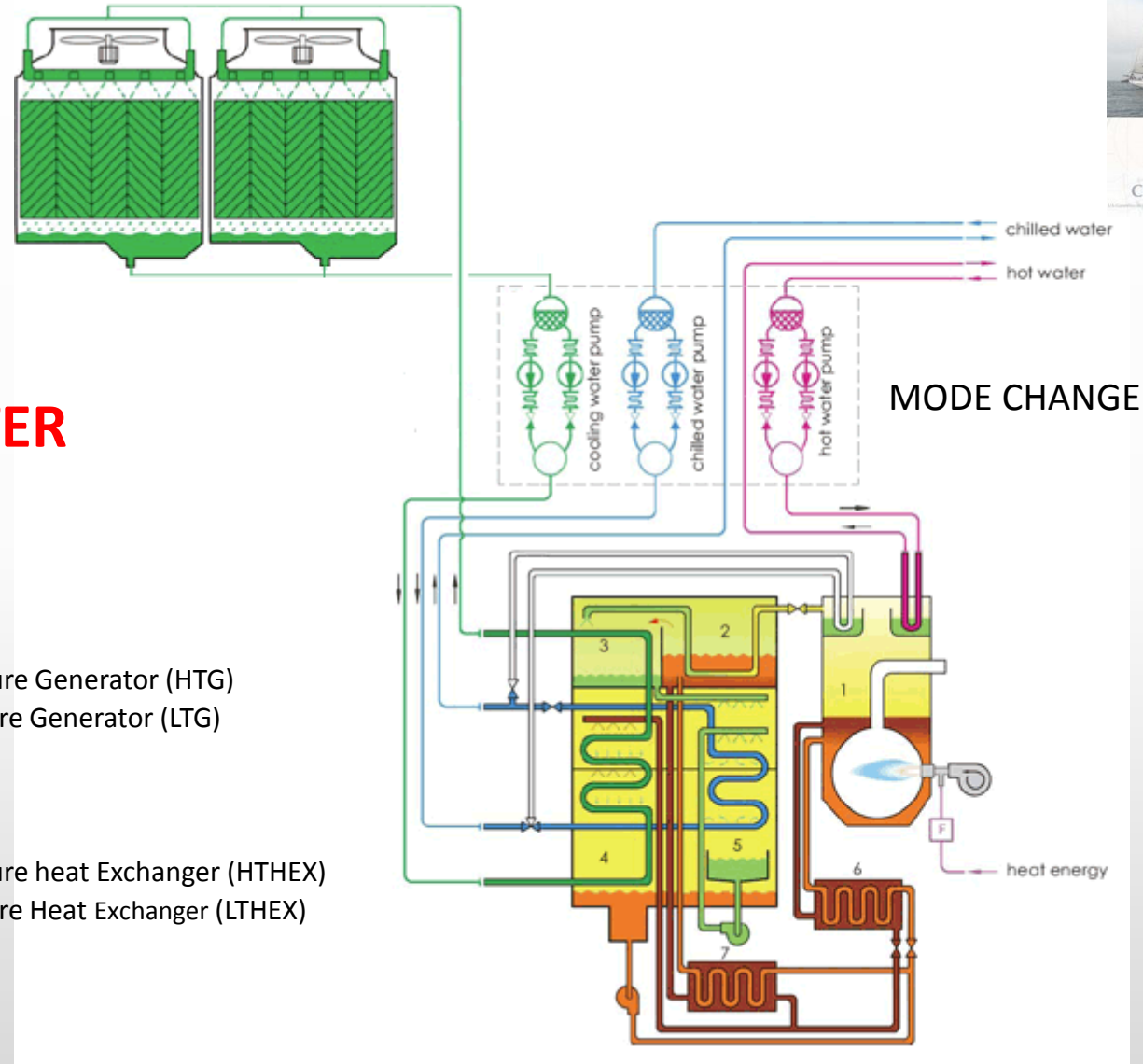


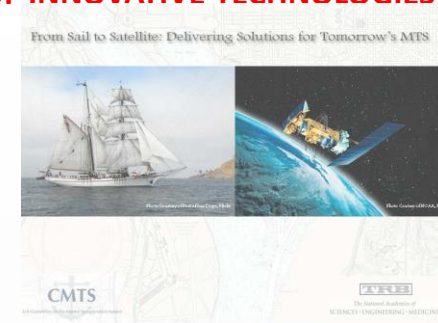


OPERATION MODE OF ABSORPTION CHILLER/HEATER

- ❑ Cooling Mode
- ❑ Heating Mode

1. High Temperature Generator (HTG)
2. Low Temperature Generator (LTG)
3. Condenser
4. Absorber
5. Evaporator
6. High Temperature heat Exchanger (HTHEX)
7. Low Temperature Heat Exchanger (LTHEX)





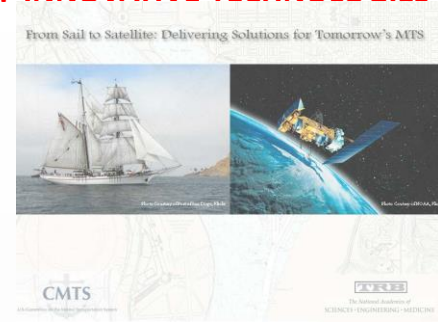
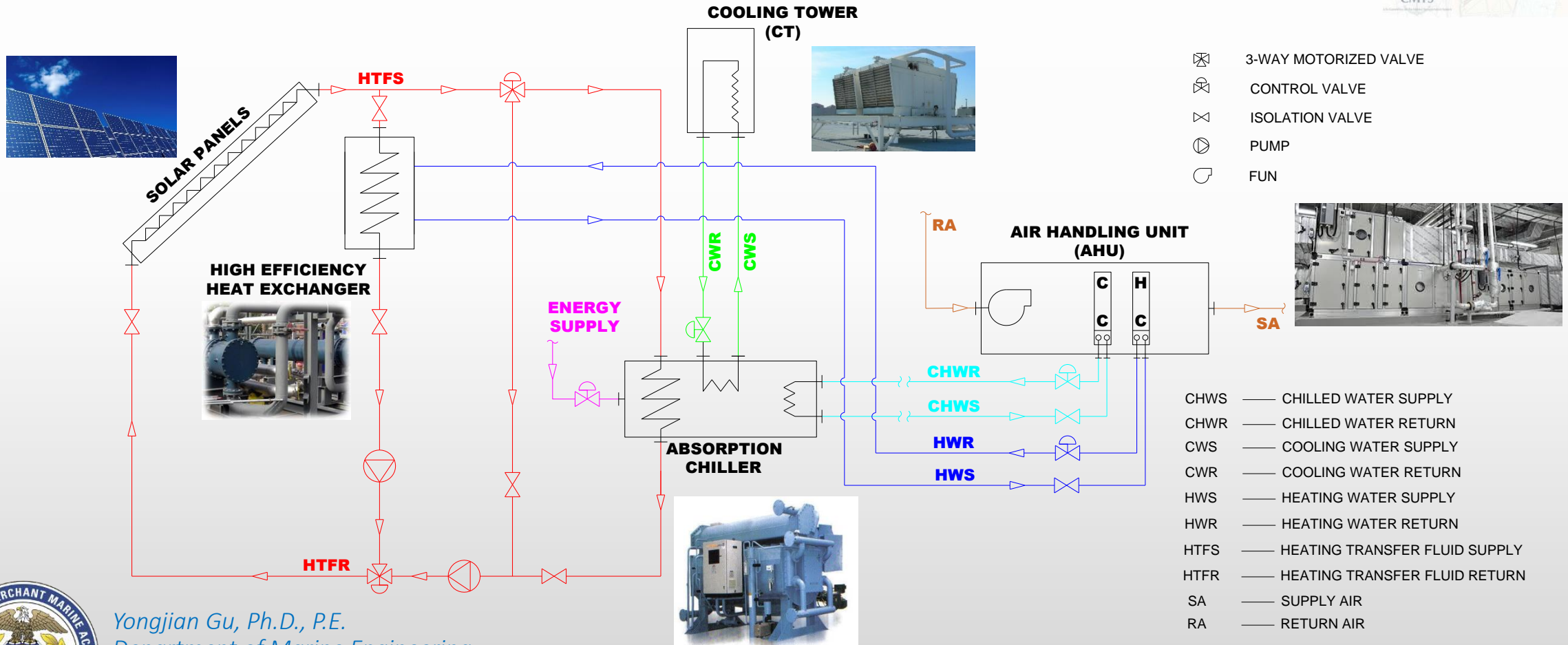
DESIGN CONSIDERATION OF ABSORPTION CHILLER/HEATER APPLICATION IN MARINE ENGINEERING

- HVAC system
 - ❖ Lithium-Bromide/Water (LiBr-H₂O)
 - ❖ Single-Effect
- Heating Energy
 - ❖ Indirect Fired: Waste/Exhaust Heat Recovered from propulsion engines (Diesel Engine, Gas Turbine)
 - ❖ Direct Fired: Gas or Fuel Oil
 - ❖ Solar Panels



Yongjian Gu, Ph.D., P.E.
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ABSORPTION CHILLER WITH SOLAR PANELS



A STUDY OF ABSORPTION CHILLER/HEATER APPLICATION IN MARINE ENGINEERING

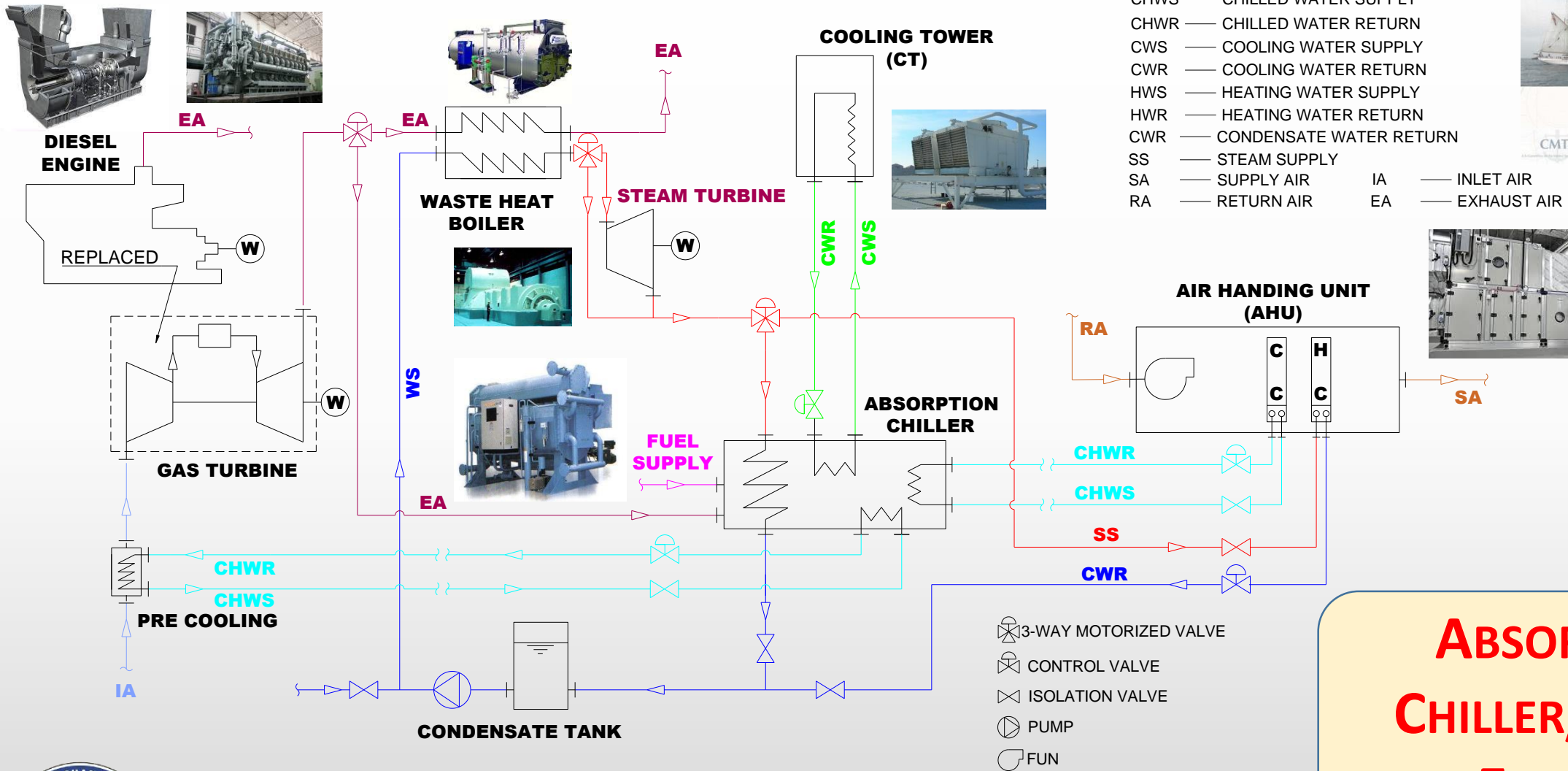
SESSION OF INNOVATIVE TECHNOLOGIES

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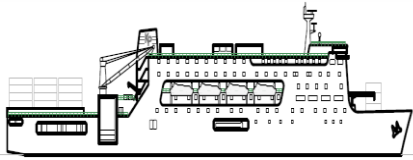
THE OFFICE OF MARINE TRANSPORTATION SYSTEMS RESEARCH & DEVELOPMENT



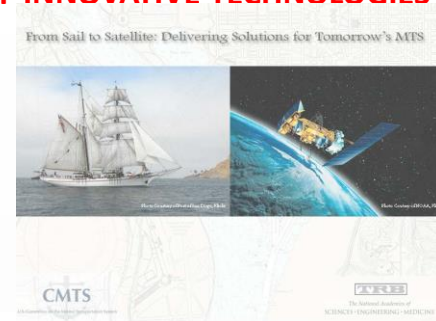
**ABSORPTION
CHILLER/HEATER
WITH EXHAUST HEAT**



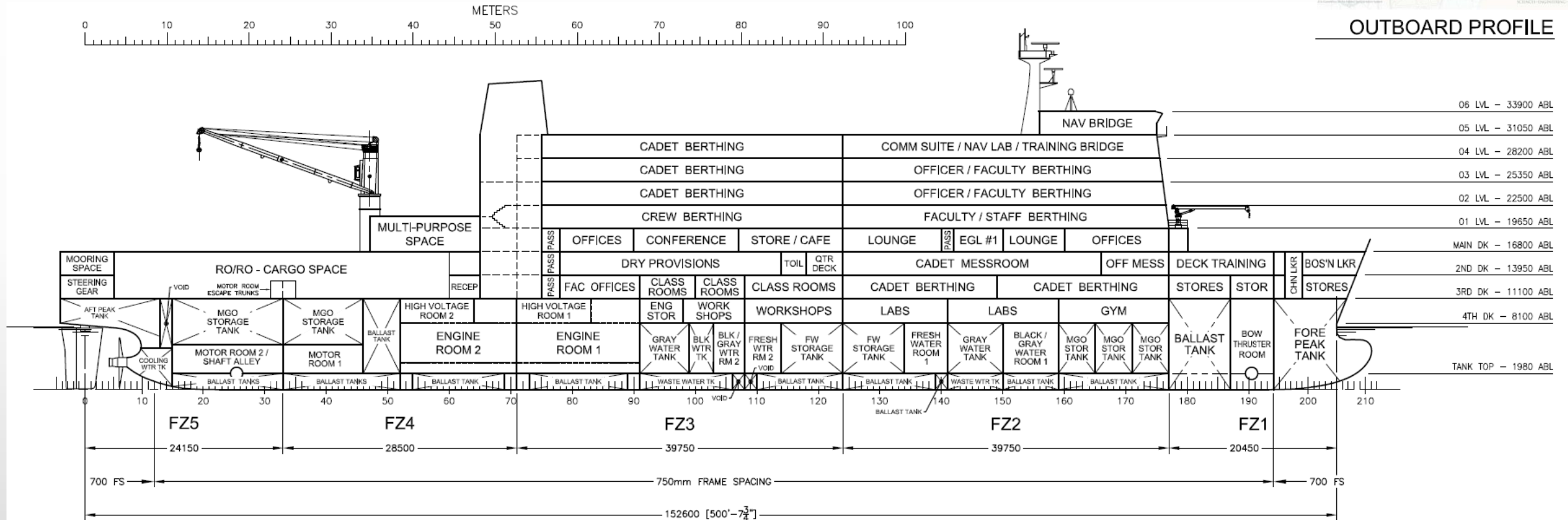
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 US Merchant Marine Academy
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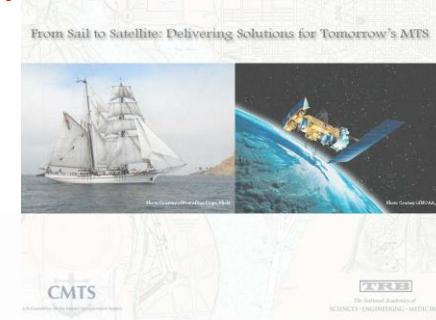
AN EXAMPLE OF HVAC WITH ABSORPTION CHILLER APPLICABLE IN MARINE ENGINEERING



OUTBOARD PROFILE



*Yongjian Gu, Ph.D., P.E.
Department of Marine Engineering
US Merchant Marine Academy
(516)716-5719, guy@usmma.edu*



HVAC SYSTEM MAJOR REQUIREMENTS AND DESIGN SPECIFICATIONS

MAJOR HVAC SYSTEM DESIGN SPECIFICATION	
Description	Value
Room Temperature (deg. C)	70
Room Relative Humidity (%)	50
Environment Temperature DB/WB (deg. C)	95/82

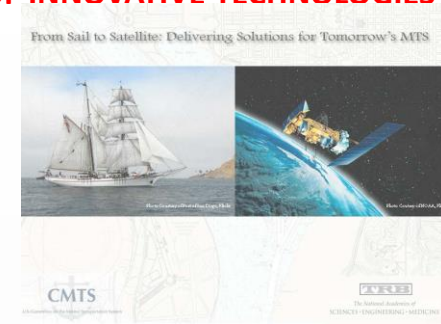
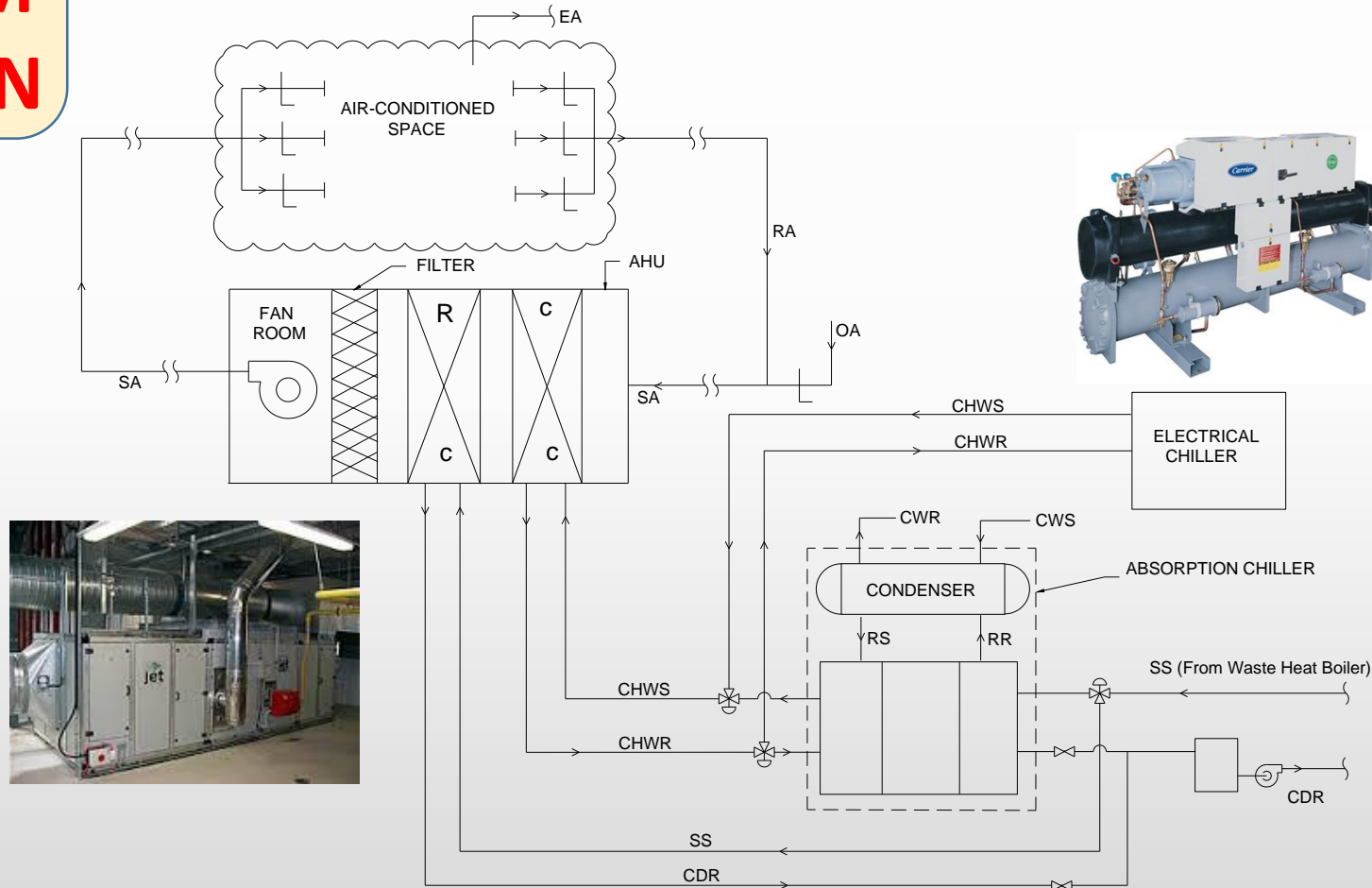
MAJOR HVAC SYSTEM REQUIREMENT	
Description	Value
Minimum No. of People	765
Maximum No. of People	1,000
Total CFM for Main Deck	7,640
Total CFM for 2nd Deck	10,850
Total CFM for 3rd Deck	20,410
Total CFM for 01 Level	8,354
Total CFM for 02 Level	7,809
Total CFM for 03 Level	12,142
Total CFM for 04 Level	9,910
Total CFM for 05 Level	1,489



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ABSORPTION CHILLER SYSTEM CONFIGURATION

LEGEND
RA - RETURN AIR
SA - SUPPLY AIR
OA - OUTSIDE AIR
CHWR - CHILLED WATER RETURN
CHWS - CHILLED WATER SUPPLY
CWR - COOLING WATER RETURN
CWS - COOLING WATER SUPPLY
CDR - CONDENSATE RETURN
SS - STEAM SUPPLY
RH - REHEAT
CC - COOLING COILS
RC - REHEAT COILS
EA - EXHAUST AIR
AHU - AIR HANDLING UNIT



MAJOR EQUIPMENT SPECIFICATIONS



AIR HANDLING UNIT	
Term	Descriptoin
Manufacturer	Carrier
Model	AERO 39 MN, MW03-110
Total Sets	3
Capacity	32,000 CFM
Chiller Water Coils	1/2" OD, Male Thread Conn.
Steam Coils	5/8" OD, 175 psig@400F
Shipping Weight	4,820 lbm
Height X Width X Length	126" X 157" X 290"



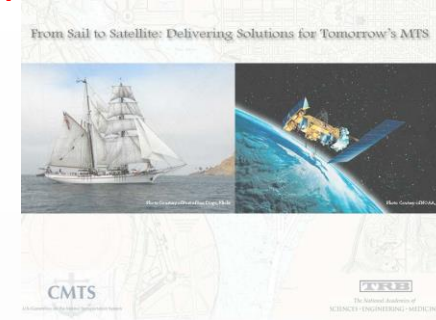
ABSORPTION CHILLER	
Term	Descriptoin
Manufacturer	Thermax
Model	SD 20ACX
Fluid Type	Lithium Bromide/Water
Chiller Water Flow	268 GPM
Cooling Water Flow	489 GPM
Steam Consumptoin	953 lb/hr
Nominal Power Input	2.15kW
Shipping Weight	12,300 lbm
Height X Width X Length	101" X 84" X 116"
Coefficient of Performance	1.43



ELECTRICAL CHILLER	
Term	Descriptoin
Manufacturer	Carrier
Model	30HXC-375
Fluid Type	R-404A
Capacity	350 tons
Chiller Water Flow	268 GPM
Cooling Water Flow	60 L/s
Nominal Power Input	263 kW
Operation Weight	5,721lbm
Height X Width X Length	83" X 40" X 179"
Coefficient of Performance	4.11

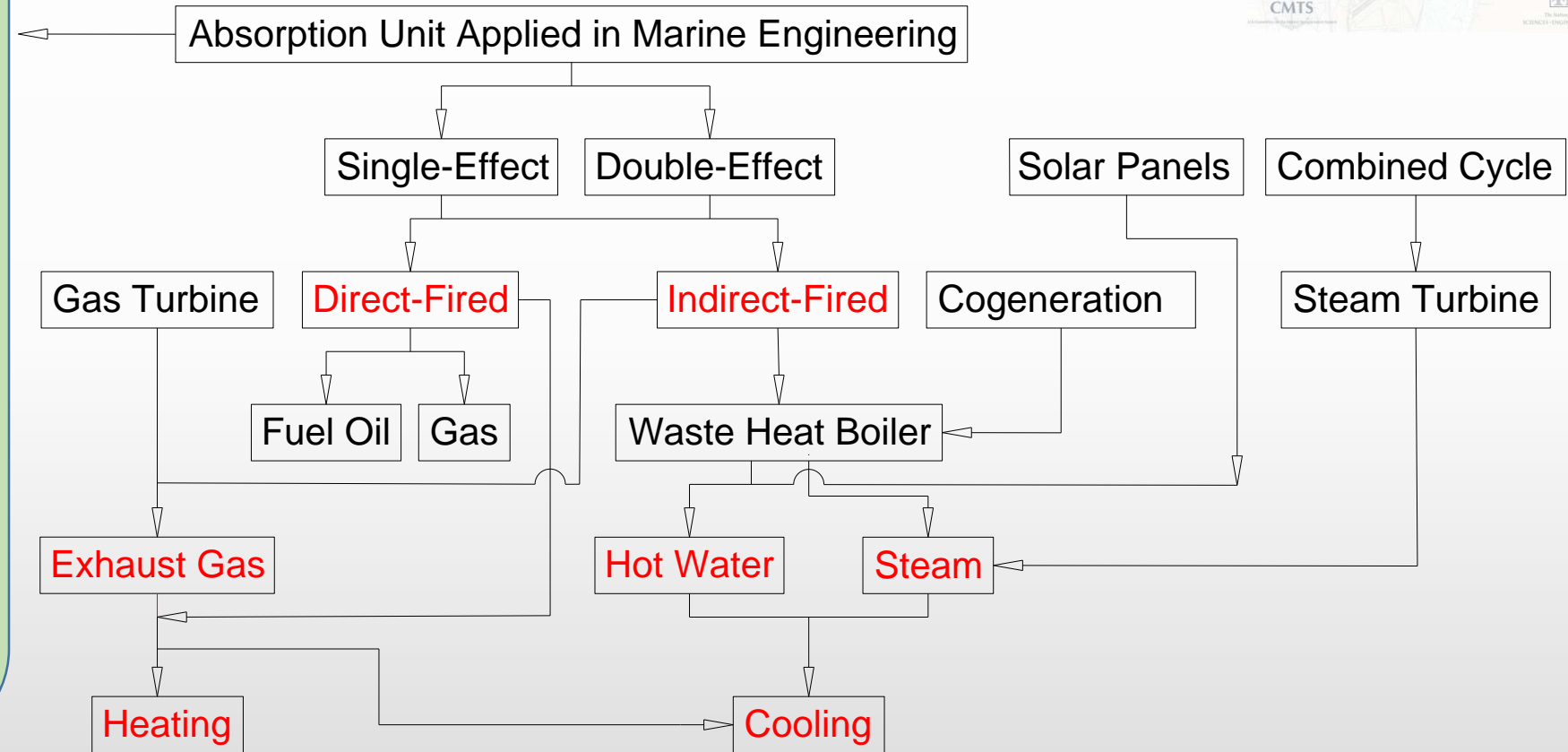


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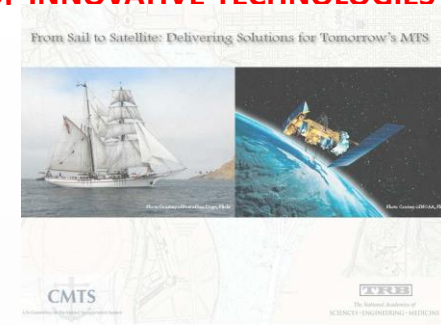


SUMMARY

- ❑ Diversity of heating energy
- ❑ Recovery of wasted heat
- ❑ Large reduction in power input
- ❑ Providing heating and cooling from one integrated unit
- ❑ Reducing emissions
- ❑ Improving efficiency of entire thermodynamic system
- ❑ Large potential in the current development of promoting liquefied natural gas as an alternative maritime fuel



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THANK YOU

QUESTIONS ?



Yongjian Gu, Ph.D., P.E.
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