Winter

AIR - CONDITIONING &
REFRIGERATION L.L.C.

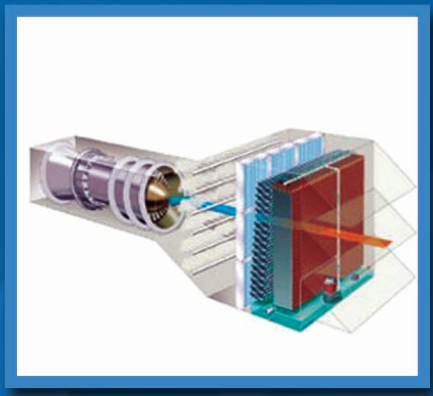
“We are specialists in Refrigeration, Process Cooling & Air-Conditioning Packaging using Screw Compressors technology”

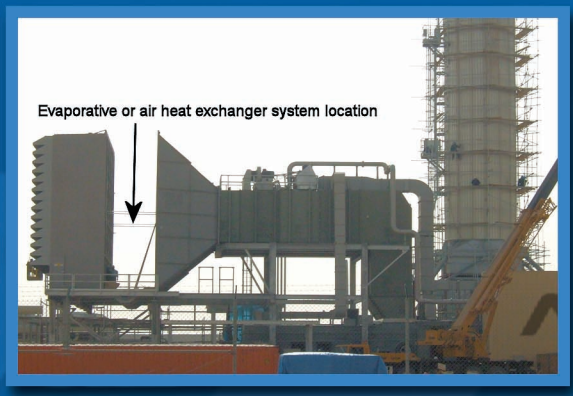
Introduction

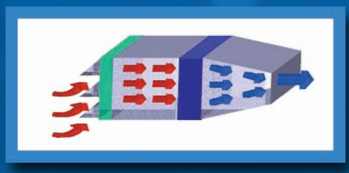
With an increase in ambient temperature, depending on the location, efficiency of gas turbine and combined cycle drops between 0.6% and 0.8% and 0.27%per degree centigrade, respectively.

Mechanical Refrigeration Cooling
+
Chilled Water Thermal Energy Storage

- No makeup water and suitable for Iran geology conditions
- Air-cooled
- Gas turbine inlet cooling could prevent the efficiency drop up to 30%.
- Reduction in operating cost per kWh
- Climate independent and predictable turbine output
- Guaranteed ISO conditions performance
- The latest peak shaving technology in the world







It has been estimated that about 20% (13,800 MW) of gas turbine capacity in Iran is lost during the summer months as there are more than 68,000 MW power generation facility within Iran with a total capacity of around 55,000 MW. However, the power output of the units is about 80 per cent of their rated capacity in the summer.

This means that around 13,800 MW is lost during the hot season.
With the growing demand of electricity and the gas turbine power degradation in summer, one solution is to enhance the gas turbine power output using inlet air cooling systems.

Turbine Inlet Cooling can contribute to the power plants success by:

- Reducing Operating Costs Per kWh

If there is an increase in ambient temperature & were looking to make up for the lost capacity of the plant, there is only one option and that is to install and bring online another power plant to make up for the lost capacity, when averaging the cost of installing a new power plant Vs Turbine Inlet Cooling System the structure of a power plant is more expensive than Turbine Inlet Cooling System for the baseline power plant.

- Increasing Generator Capacity

When the plant is in a naturally warm to hot climatic region or where ambient temperature rises above 40°C in other regions, This scenario is ideal for Turbine Inlet Cooling System due to the fact that it allows plant owners to Reduce or even prevent loss of the power plant output, using Turbine Inlet Cooling System allows the plant to increase its power output by cooling the inlet air at ISO rating 15°C or even below.

- Increased Fuel Efficiency

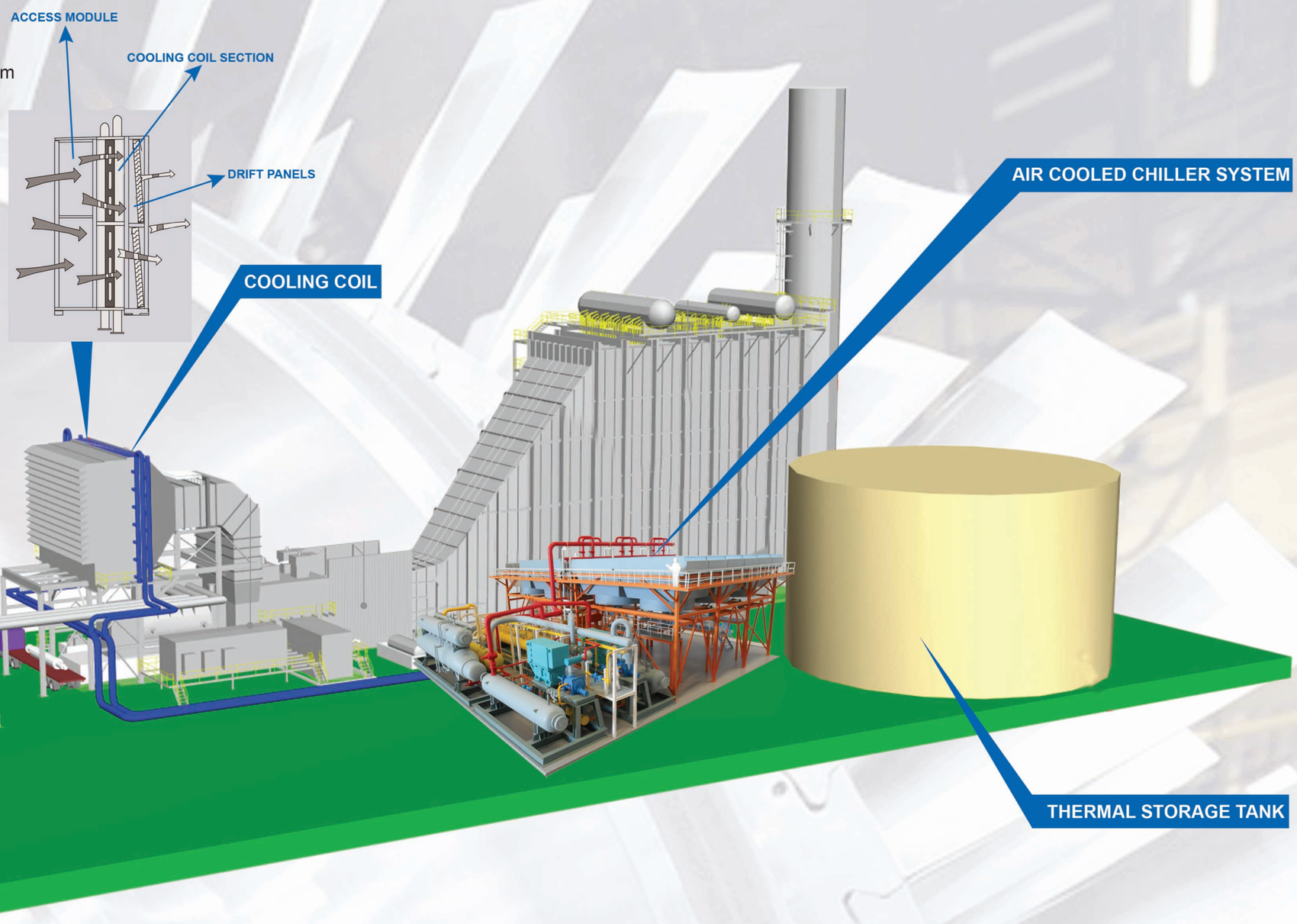
Another important benefit of using the Turbine Inlet Cooling System, it reduces/prevents a decrease in fuel efficiency of the power plant (increases in heart rate)

• Increased Steam Output in Cogeneration and Power Output of Steam Turbine Output in Combined-Cycle Systems

Taking into mind that the power output of a power plant decreases as ambient temp increases because the mass flow rate of the inlet air decreases, Turbine Inlet Cooling System reduces/Prevents loss of steam produced in co-generation systems and loss of power output of steam turbines in combined-cycle systems.

• Improved predictability of power output by eliminating the weather variable

With implementing Turbine Inlet Cooling System technologies, allows power plant operations to be set to any desired temperature the pant chooses to as low as 5ºC, regardless of the weather conditions, in turn these technologies assist a more predictable power output at all times and hence discards the weather as a variable in predicting plants that use power plants output.



Site conditions:

Location	:	Assalouyeh
Installed Units	:	6xSiemens V94.2 gas turbines
Rated Power	:	159 MW.
Peak Temp	:	June-October
Decrease per 1°C	:	0.98%
ISO Conditions	:	15°C
Max Temp DB	:	45.2°C
Min Temp DB	:	28.7 °C
Average Temp DB	:	37.3°C
Max Temp WB	:	30.7°C
Min Temp WB	:	24.9°C
Average Temp WB	:	28.0°C

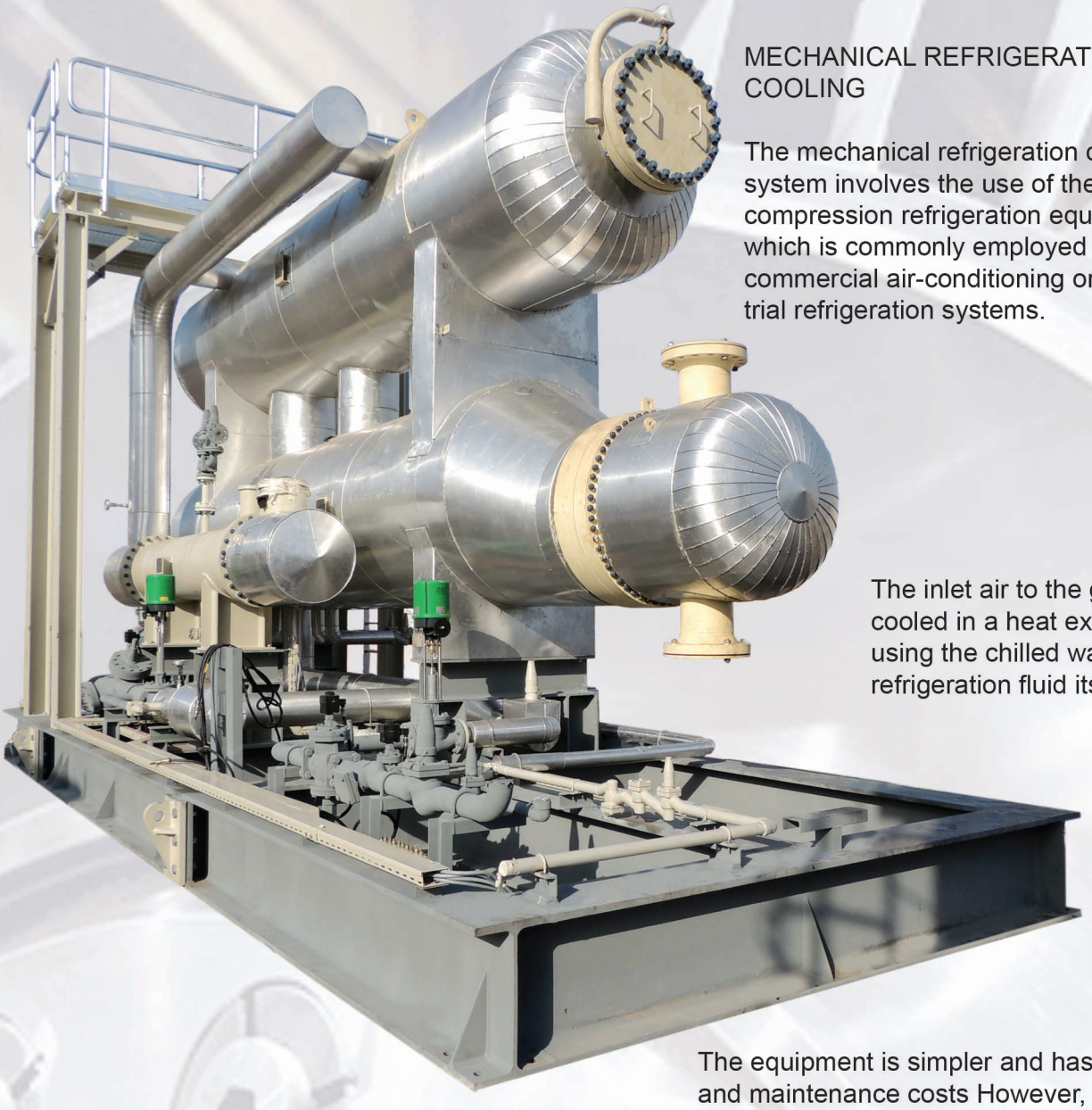
Evaporative cooling

These systems use the vaporization latent heat of water in an adiabatic air saturation process to reduce the dry bulb temperature to the wet bulb temperature. Therefore, their success in reducing the high air temperature depends on the relative humidity of the ambient air. Although these types of systems are economical, they are suitable for hot dry climates rather than hot humid conditions.

Total Capital Cost	:	1,890,000€
Annual O&M	:	71,800€
Annual fuel consumption increased costs	:	2,350€
Annual benefits	:	487,500€
Capital cost per maximum increased kilowatt (€/kW)	:	276 €
Cost of electricity (c/kWh)	:	1.75
Payback period(years)	:	4.6
Rate of return(%)	:	21.4

MECHANICAL REFRIGERATION COOLING

The mechanical refrigeration cooling system involves the use of the vapor compression refrigeration equipment, which is commonly employed in the commercial air-conditioning or industrial refrigeration systems.



The inlet air to the gas turbine is cooled in a heat exchanger using the chilled water or the refrigeration fluid itself.

The equipment is simpler and has less operation and maintenance costs However, its capital cost is still relatively high as the parasitic power needed for the operation of the refrigeration system during off-peak hours which its ambient temperature gets cooler and COP (Coefficient Of Performance)

TES (THERMAL ENERGY SYSTEM)

Chilled water storage systems use the sensible heat capacity of water to store the cooling energy. Water is cooled by a chiller and stored in a tank for later use to meet the cooling needs. This system is used during the peak loads when power is highly valued (5 to 7 hours per day). Chillers are sized to run during non-peak demand times (perhaps 17 to 19 hours per day).

Total Capital Cost	:	33,500,000€
Annual O&M:721,750€		
Annual fuel consumption increased costs	:	181,350€
Annual benefits: 7,450,000€		
Capital cost per maximum increased kilowatt (€/kW)	:	0.013 €
COP Coefficients of Performance of Inlet Cooling	:	0.25
Payback period(years)	:	4.6
Rate of return(%)	:	21.6

Pioneer in Refrigeration, Process Cooling
&
Air conditioning Technology

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