

الافتتاحية

قال الله سبحانه وتعالى في محكم التنزيل :-

((الذي جعل لكم من الشجر الاخضر نارا فاذا انتم منه توقدون))

صدق الله العظيم

سورة يس

الآية رقم (٨٠)

DEDICATION

To my mother

To my father

To my brothers

To my wife

To Areej and Ahmed with love

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All prayers and thanks are due to ALLAH (soubhanaho WA taala) for bestowing me with health, knowledge and patience to complete this work.

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ABSTRACT

The gas turbine performance is highly sensitive to the Compressor Inlet air temperature. In Sudan the output of gas turbine falls to value that is less than the rated output under high temperature Conditions. The solution of this problem is important because the Peak Demand season in Sudan happens in the summer. As one of the convenient methods of inlet air cooling is evaporative cooling type considered as appropriate for hot and dry climate.

The gas turbine and combined plants in Sudan installed in Such ambient conditions, therefore this method can be used to Improve the performance of gas turbine and combined cycle plants to recover the Peak Demand .

The main purpose of this research is to investigate, analyze and calculate the effect of inlet air cooling. This method applies efficiently in garii power plant gas turbine.

The study results indicate that refrigerated cooling appear as The technically feasible, it can give the maximum benefits of turbine Inlet cooling. While evaporative cooling is economically feasible, it Is passive option that can utilize readily available Nile water without demineralization.

The study recommended that the suitable inlet air cooling type For garri Power station is the evaporative cooling system because it is highly efficient in hot and dry area.

التجربة

إنّ أداء التوربينات الغازية حسّاسٌ جداً إلى درجة حرارة الهواء الداخل للضاغط وفي السودان الطاقة المولدة تقل من الطاقة التصميمية نتيجة درجة حرارة الجو العالية. إنّ حلّ هذه المشكلة مهمٌ لأن فصل الطلب البالغ الذروة في السودان علي الكهرباء يحدّث في الصيف وأحدى الطرق المناسبة لتقليل الفاقد في الطاقة التوربينية الغازية والوحدات المشتركة هي التبريد التبخيري للهواء الداخل للتوربينية الذي يُخصّص للطقس الحار والجاف .

التوربينية الغازية والوحدات المشتركة في السودان ركّبت في مثل هذه الشروط البيئية، لذا هذه الطريقة يمكن أن تُستعمل لتحسين أداء التوربينية الغازية ومحطات الدورة المشتركة لمقابلة الطلب المتزايد علي الطاقة الكهربائية .

إنّ الغرض الرئيسي من هذا البحث أن تناقش بشكل تحليلي وتحسب تأثير تبريد الهواء الداخل . هذا ينطبق بشكل كفوء في التوربينات الغازية لمحطة كهرباء قري .

وتم التوصل الي ان التبريد باستخدام وسائط التبريد الميكانيكية ذات المبادلات الحرارية هو الافضل فنياً حيث يعطي الفائدة القصوى لتبريد الهواء الداخل .بينما وجد ان التبريد التبخيري هو الافضل اقتصادياً حيث يتميز ببساطة المكونات واستهلاك اقل للطاقة الكهربائية للانظمة المساعدة مع امكانية استخدام مياه النيل دون الحاجة لمعالجتها .

توصي الدراسة بان نظام التبريد المناسب للتوربينات الغازية في محطة قري هو نظام التبريد التبخيري لانها تعمل بكفاءة عالية في المنطقة الحارة الجافة .

NOMENCLATURE

| | |
|-----------------|---|
| NG | National Grid |
| NEC | national electricity corporation |
| NO _x | nitrogen oxides |
| So _x | sulphur oxides |
| CO ₂ | carbon dioxide |
| PB | payback period |
| CT | combustion turbine |
| TIAC | turbine inlet air cooling |
| CTIAC | combustion turbine inlet air cooling |
| GTIAC | gas turbine inlet air cooling |
| ISO | International Standards Organization |
| CHP | combined heat and power systems |
| IGCC | integrated coal gasification combined cycle |
| NPV | net present value |
| MWh | rate production of electrical energy |
| HRSG | heat recovery steam generator |
| KCP | kalaehoa cogeneration plant in Hawaii |
| FOD | foreign object damage |
| TES | Thermal energy storage |
| DSM | demand side management |
| HVAC | heating, ventilating and air conditioning |
| CTIAC | Combustion Turbine Inlet Air Cooling System |
| DSC | distribution and control system |
| GT1 | Garri Power Plant Gas Turbine Unit Number One |
| LPC | Low Pressure Compressor |
| HPC | High Pressure Compressor |
| Munters | international company for cooling system |
| TR | ton of refrigeration |
| EGT | exhaust gas temperature |
| CELdek | evaporative cooling pads |
| NO _x | nitrogen of oxides |
| P ₁ | compressor inlet pressure |
| T ₁ | compressor inlet temperature |
| r | pressure ratio |

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| | |
|-----------------|---|
| T_3 | turbine inlet temperature |
| T_4 | turbine outlet temperature |
| W_c | compressor work |
| W_t | turbine work |
| W_n | net work |
| η_{th} | cycle thermal efficiency |
| q_a | heat supplied to the heater |
| P_2 | compressor out let pressure |
| T_2 | turbine out let temperature |
| η_{isen} | compressor isentropic efficiency |
| $\dot{m}_a w_c$ | compressor power requirement |
| \dot{m}_a | compressor mass flow rate |
| f_{pl} | the combustion fractional pressure loss |
| f | mass fuel- air ratio |
| Q_a | rate of heat released by the combustion |
| P_n | power output of the gas turbine |
| gpm | gallon per minute |

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