بسم ا الر ن الرحيم

قال ا تعا :

(الله لَا إِلَٰه إِلَّا هو الْحي الْقَيوم لَا تأْخذُه سنةٌ ولَا نوم لَّه ما في السماوات وما في الْأَرضِ من ذَا الذي يشفَع عنده إِلَّا بِإِذْنِه يعلَم ما بين أَيديهِم وما خلْفَهم ولَا يحيطُونَ بِشيءٍ من علْمه إِلَّا بِما شاءَ وسع كُرسيه السماوات والْأَرض ولَا يئُوده حفْظُهما وهو الْعلي الْعظيم).

صدق ا العظيم

البقرة الآية (255)

ABSTRACT

The purpose of this study is both to further optimize the investigation and to improve the hydromatrix turbine performance (Jebel Aulia Dam). Optimization of the turbine efficiency has been made by the analysis of the turbine performance with the variation of the blade length and number using a commercial CFD code (Fluent 6.3 2003). The results show that length and number of the runner blade give considerable effect on the performance of the turbine

Mathematical modeling technology application in turbomachinery design is a powerful tool for equipment optimization from the design phase, shortening the realization cycle. The conservation equations governing the flow in the model runner blades were solved by the prediction techniques and the computer program (Fluent 6.3 2003) using standard turbulent model. A performance prediction code for hydromatrix turbine based on these governing equations and loss models is developed and performance results are compared with design data. A generalized design procedure for number and length runner blades is proposed in this work. Resulting in the creation of runner blade number optimization in an attempt to maximize the turbine efficiency of the entire turbine.

Finally a comparison was made between the experimental results and the computer program predictions for each case to ensure that the program has a good prediction to turbulent flow, the standard ($k - \varepsilon$) Model was the good turbulent modeling which gives a good value with smallest error compared with the experimental as shown in comparison figures.

الملخص

يهدف هذه البحث إلى دراسة و تحسين أداء التوربينات المصفوفة بخزان جبل اولياء. تم التحقق من كفاءة التوربينات بتحليل أداءها مع اختلاف طول و عدد ريش المراوح باستخدام رمز CFD التجاري (Fluent 6.3 2003) . تظهر النتائج أن طول و عدد المراوح يؤثر تأثيراً كبيراً على أداء التوربينات.

يٌعتبر تطبيق تكنولوجيا النمذجة الرياضية في مجال تصميم الآلات التوربينية أداة قوية لتحسين المعدات في مرحلة التصميم ولتقصير دورة الإنشاء. تم حل المعادلات التي تتحكم في تدفق نموذج الريش الدوارة عن طريق تقنيات التنبؤ وبرامج الكمبيوتر (Fluent 6.3 2003) باستخدام نموذج قياسي للإنسياب المضطرب و كذلك تم التنبؤ بالأداء للتوربينات المصفوفة على أساس هذه المعادلات و نماذج الخسارة. أيضاً قُورنت نتائج تجارب الأداء مع البيانات التصميمية. بعد تنفيذ تحليل حساسية شامل من الرمز،تم إقتراح بعض التغييرات في التصميم لتحسين الأداء و لتحقيق أقصى قدر من كفاءة التوربين.

أخيراً تمت مقارنة النتائج التجريبية وتنبؤات برنامج الكمبيوتر لكل حالة للتأكد من أن البرنامج لديه توقعات جيدة لتدفق الإنسياب الدوامي. و يُعتبر مقياس نموذج (k-ε) الذي أعطى قيمة جيدة مع هامش خطأ صغير بالمقارنة مع النتائج التجريبية .

DEDICATION

It is of honor, dedication of this thesis,

To my parents' innumerable sacrifices and untiring support throughout my life

To my teachers,

To my family.

ACKNOWLEDGMENTS

Thanks to **GOD**, who gives me the strength, courage and power to achieve this work. I ask god to accept this work and make it sincere for God's face.

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Before and after all thanks to ALLAH for every things.

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NOMENECLATURE

Symbol	Quantity
g	Gravitational acceleration, m/s2
G_b	Generation of turbulent kinetic energy, k, due to buoyancy
G_k	Turbulence kinetic energy production
H	Height, m
m	Mass, kg
p	Pressure, Pa
Re	Reynolds Number, Re = ρ U l / μ
t	Time, s
T	Temperature, K
$\bar{u}_i$	Mean velocity components, m/s
u_i'	Fluctuating velocity components. m/s
V	Computational cell Volume, m^3
U	Axial velocity, m/s
$\vec{v}$	Velocity vector, m/s
w	Instantaneous velocity component in z direction, m/s
x, y, z	Cardinal coordinate components

Abbreviations

2D	Two dimensional configurations
3D	Three dimensional configurations
CFD	Computational Fluid Dynamics
CPU	Central Processing Unit
DNS	Direct Numerical Simulation
LES	Large Eddy Simulation
RANS	Reynolds average Navier- Stokes equations
RNG	Renormalization group

RSM	Reynolds Stress Model
SIMPLE	Semi-Implicit Method for Pressure-Linked Equations
SIMPLEC	Semi-Implicit Method for Pressure-Linked Equations Consistent
VLH	Very low head
NEC	National Electricity Corporation
TWL	Tail Water Level
CFS	Cubic feet per second
CPU	Control Processor Units
MRF	Multiple reference frame
MHD	Magneto hydrodynamics
(TG-unit)	Turbine-generator unit
Exp.	Experimental
Ref.	Reference
Cal.	Calculated
SST	Shear Stress Transport