3-1 Dr. Mahmoud Shareif Thermal Power Station

The Dr. Mahmoud Shareif Thermal Power Station consist of phase 1 commissioned on (1985), phase 2 commissioned on (1996) and phase 3 commissioned on (2010). Which are designed to produce (386 MW) power by six steam turbine driven, air cooled generators, each phase containing two units, phase 1 each unit rated at 33MW , phase 2 each unit rated 60MW and phase 3 each unit rated 100MW Maximum Continuous Rating (MCR).

Single cylinder, multi-stage, condensing steam turbines are employed double cylinder in phase 3. The four section, four pass condensers are cooled with water from circuit cooling water system which incorporates induced draught cooling towers. The units are arranged with five stage of feed heating, producing feed water at 180°c and 220°c MCR) phase 1and phase 2 respectively but seven stages at phase 3.

Steam for the turbines is supplied by Fuel Oil fired boilers producing superheated steam at a pressure 65 bar gauge and a temperature of 485°c for phase1, steam at pressure 88 bar gauge and a temperature of 510°c for phase2 and steam at pressure 89 bar gauge and a temperature of 530°c for phase3, operating on a unit basis.

Each unit is capable of full automatic control over arrange of 100-30% MCR, and is capable of operation for prolonged periods at any load within this range. The units are capable of responding quickly to change in load through the 100-30% MCR range, under governor action. The normal loading rate should not exceed 5% MCR per minute. The operators' attention is drawn to limitations, in which indicates the effects of excessive loading.

3-2 Study Areas that Generating heat Losses [6]

Step one: Use the ***Infrared Thermal Camera*** to measure surface temperatures. Let is watch this in the following thermal images:

- Thermal Camera were set up by atmospheric temperature 30°c , distance 2m, rang of temperature +0 to 500°c ,and emissivity 0.89

Step two: Calculate heat losses by radiation and convection

Step three: Calculate fuel losses due to heat losses

Step four: Calculate optimum insulation thickness

3-2-1 Radiation losses calculation

Where

q= Heat radiate from real body W/

$\sigma =$ Stefan Boltzmann’s Constant=5.669W/ (

ε = Body emissivity

= Surface temperature K (Kelvin)

= ambient temperature K (Kelvin)

3-2-2 Convection losses calculation [3]

The essential components of heat transfer by convection mechanisms are given in Newton’s law of cooling:

Q = hA (-) ………………………… (2)

To calculate convection coefficient (h) first must check the flow by Reynolds number

If Reynolds number less than 5 the flow is laminar if greater than 5x the flow is turbulent.

Re= Reynolds number

……………………………………… (3)

= kinematic viscosity

All fluid characteristics (Prandtl number Pr, kinematic viscosity

&thermal conductivity k) are evaluated at film temperature

.... (4)

= film temperature

To calculate convection coefficient h

.... (5)

h= convection coefficient

Nu=nusselt number

L=length of plate

If the flow is laminar

= if Re 5 .... (6)

Or the flow is turbulent

If Re 5 .... (7)

3-3 Sample of calculation

3-3-1 Heat losses by radiation

A (that area shot by thermal camera) =0.785 ε =0.89

=27°c =300 k =175°c=488 k

Q=A

Q=0.7850.895.669-)

Q=1272(W)

3-3-2 Heat losses by convection

A (that area shot by thermal camera) =0.785 =27°c =175°c L=1m v=0.5m/s

= = 101°c

***At 101°c from air characteristic table**

K=0.0314 (w/m. °c) Pr=0.703 =23.06/s

= =21682 less than 5

The flow is laminar

= = =

=89.94

h= = =2.73

h=2.73 (w/)

Q = hA (-)

Q=2.730.785(175-27) = 317.1(w)

3-4 Infrared Thermal Camera [6]

3-4-1 Infrared thermal camera defined

Infrared thermography is the science data of collection and analysis of thermal information from non-contact thermal imaging devices, about measuring temperature with radiation is that the camera show in Figure (3-1) is able to see one thing, electromagnetic radiation in a certain wavelength band, and then we want to measure something completely different-temperature is relates to the movement of molecules within our target

Fig 3-1Thermal camera

3-4-2 Thermal camera calibration

Input data use for calibration the camera

- Atmospheric temperature
- Scale of colors
- Emissivity of the metal
- Distance between the camera and the image
- Range of temperature

3-4-3 Advantage of thermal camera

a- It is non-contact- uses remote sensing.

b- It is two-dimensional.

c- It is real time

3-4-4 Thermal Camera Application on Power Station

- Research and development.
- Mechanical and electrical maintenance.
- Non-destructive testing.
- Tanks and vessels.
- Fluid flow problems.

3-4-5 Purpose of use thermal camera

- Detection of areas heat generating losses by radiation
- Measure losses radiation temperature
- take thermal image and normal image

3-5 Real body radiation

The camera now knows how much radiation comes from the target. We will call that the real body radiation, the camera also knows the emissivity of the target-our real body. With those two bits of information, we will find out the temperature.

3-6 *Stefan -Boltzmann's* Law for real bodies

Discussed Stefan- Boltzmann’s Law earlier, and how it showed us that the radiation intensity from a black body is related to the absolute temperature raised to the fourth power, and our target is not a black body, but a real body then it will emit less radiation than a black body would do, at any given temperature. All we have to do to make our equation valid for real bodies is to introduce the emissivity factor. We would get this formula.

…………………………….(8)

Where

$WRB =$ Radiate power for real body W/

$\sigma =$Stefan Boltzmann’s Constant=5.667(W/(

ε = Body emissivity

T = Absolute temperature K (Kelvin)