Criterion Test

MODULE B.1

REACTOR

1. Give a major reason why reactor channel blockage is a serious condition and explain how this condition can be detected and may be confirmed.

2. Briefly explain how two major problems may result from low heat transport system pressure.

3. Briefly explain why crash cooling is necessary for a loss of coolant from the heat transport system that only results in a low rate of heat transport pressure decrease. Briefly explain how this condition may produce similar results to those found in a major LOCA.

4. Briefly explain how a loss of heat transport coolant may be detected.

5. Briefly explain the immediate and longer term effects of losing feedwater supply to the steam generators.

6. Briefly explain how the temperature and quality of the PHT coolant change when bulk boiling occurs.

7. Explain how the PHT thermosyphon is established and how the ROH temperature is used as a datum for the control of the thermosyphon.

Criterion Test

MODULE B.2

STEAM GENERATOR

1. Explain why it is necessary for the programmed steam generator level to increase with unit power.

2. (a) Explain a major problem with having a very high boiler level when the unit is at power.

   (b) Explain three problems that could result from a very low boiler level.

   (c) Describe the control actions that are designed to avoid these problems of extreme boiler level.

3. State the three elements which are used for boiler level control and explain why they cannot be used ~~as~~ at low power levels.

4. Explain how your station system responds to a rising boiler pressure when unit control is in the "normal" mode and the speeder gear is in 'auto'.

5. Explain why the BPC program is completed at 170°C when in the "cooldown" mode.

6. Explain how the temperature difference, between the steam generator and the PHT system, changes during a "crash-cool" exercise.

7. State how the average PHT temperature is affected by an increase in thermal resistance of the steam generator tubes.

Criterion Test

MODULE B.3.1

CONDENSER PERFORMANCE

You will need (a) a calculator
(b) a set of S.I. steam tables.

1. List and explain four advantages of using a condenser instead of rejecting steam to atmosphere from a steam turbine.

2. Explain the effect of a reduced CCW inlet temperature on condenser temperatures, pressure and flowrates. Summarize your answer in table form.

3. The pressure in a condenser is slowly rising. Describe the steps that you would follow to quickly determine some of the possible causes for the increase in condenser pressure. Explain why you are considering each parameter.

4. Explain two undesirable consequences for each of the following turbine condenser conditions:

   a) operating the condenser above design pressure
   b) operating the condenser below design pressure.

5. A condenser operates at a pressure of 6 kPa(a). CCW inlet temperature is 5°C and outlet temperature is 14°C. Steam enters the condenser at 700 kg/s and 10% moisture. Determine the CCW flowrate if there is no subcooling of the condensate.

Criterion Test

MODULE B.3.2

FEEDHEATER OPERATION

You will need (a) set of S.I. Steam Tables
(b) calculator.

1. Explain how conditions of pressure, temperature and flowrate change in a feedheater when the feedwater flowrate is increased. The feedwater inlet temperature remains constant and there is no change in turbine power.

2. A feedheater is supplied with extraction steam from a turbine. The steam is saturated at 170°C. The drains from the heater are at 155°C. The feedwater inlet and outlet temperatures are 134°C and 162°C. The feedwater flowrate is 740 kg/s. Determine the steam flow to the feedheater. Use a temperature/enthalpy diagram in explaining your logic.

3. Explain why steam is extracted from the turbine for feedheating and why there is a practical limit to the final feedwater temperature before entering the steam generator.

4. Saturated steam is supplied to a feedheater at 150°C. Demonstrate the benefit of feedheating by calculating the recoverable heat in the following turbine situations:

   a) turbine without feedheating
   b) turbine with feedheating.

   Use a temperature/enthalpy diagram to explain your reasoning and **state all your major assumptions.**

CRITERION TEST

MODULE B4.1

TURBINE WITH REHEAT

You will need a) a calculator
b) a set of S.I. steam tables.

1. The exhaust steam from a high pressure turbine flows at 1100 kg/s at a pressure of 1.5 MPa and with a moisture content of 12%. The steam flows to a moisture separator where the process steam becomes saturated and then passes through a reheater. Ignore the pressure drops through the separator and reheater.

   The reheater is heated with saturated steam at 3.8 MPa at a flowrate of 39 kg/s. The condensate is saturated.

   a) Sketch the process on a Mollier diagram.

   b) List the values of flowrate, pressure and moisture content at each step of the process.

   c) Determine the temperature of the process steam leaving the reheater.

2. In the previous question the steam from the reheater enters a low pressure turbine where it is expanded isentropically to a pressure of 15 kPa(a). Calculate the moisture in the exhaust steam from the turbine.

   NOTE: In both questions shown clearly how you proceed from one step to the next.

3. Explain how pressure and temperature change through the turbine unit as the load is increased from 25% to 100% full power.

CRITERION TEST

MODULE B4.2

ENTROPY, THROTTLING & MOLLIER DIAGRAM

You will need a) a calculator
b) a set of S.I. steam tables.

1. Steam which is saturated at 180°C is expanded, at constant entropy to 42°C. Determine the dryness fraction of the final steam condition.

2. Initially wet steam at 194°C is throttled to a pressure of 1.5 bar when the temperature is measured to be 150°C. Determine the dryness fraction of the wet steam.

3. Sketch your own Mollier diagram to illustrate the following series of processes: A high pressure turbine uses saturated steam at 250°C and exhausts steam at 180°C with 10% moisture to a moisture separator. The separator produces saturated steam and is followed by a reheater which raises the temperature of the steam to 235°C. The superheated steam expands in the low pressure turbine to 36°C and 12% moisture.

CRITERION TEST

MODULE B5

STEAM TABLES

You will need a) a calculator
b) a set of S.I. steam tables.

1. Identify the state of water in the following cases, as being subcooled water, saturated water, wet steam, saturated steam, superheated steam.

	Enthalpy	Temperature	Pressure
a)	2575.3 kJ/kg	40°C	0.05 bar
b)	2279.2 kJ/kg	137°C	3.317 bar
c)	561.4 kJ/kg	133.5°C	4.0 bar

2. 14% wet steam at 64°C is condensed to liquid which is subcooled by 12°C. Determine how much heat is removed in the condenser.

3. A steam generator produces saturated steam at 250°C from feedwater at 175°C. Determine:

   a) the heat added per kg in the steam generator

   b) the change in volume which occurs per kg of water from liquid to saturated vapour.

4. Briefly describe the process of "steam hammer" and explain why it is a problem and how it may be avoided.

CRITERION TEST

B6

BASICS

1. Define the following terms from memory:

   (a) Temperature.
   (b) Heat.

2. Explain the meaning of the following terms in your own words, from memory, when applied to the various states of water:

   (a) Saturation temperature.
   (b) Sensible heat.
   (c) Latent heat of vapourization.
   (d) Subcooled liquid.
   (e) Saturated liquid.
   (f) Wet steam.
   (g) Saturated steam.
   (h) Superheated steam.

3. Draw a graph of temperature plotted against the enthalpy of water, when heated at constant pressure. The graph should be fully labelled by making the following:

   (a) The axes.
   (b) Sensible heat region.
   (c) Latent heat region.
   (d) Saturation temperature.
   (e) Subcooled region.
   (f) Saturated liquid.
   (g) Saturated steam.
   (h) Superheated region.
   (i) Wet steam range.

4. Explain the following heat transfer mechanisms, in your own words and give an example of each mechanism:

   (a) Conduction.
   (b) Natural Convection.
   (c) Forced Convection.
   (d) Radiation.

5. Explain why the temperature of a gas rises during compression and why an aftercooler is used.

6. Explain how the pressure of a closed volume of gas changes when heated and illustrate your answer with an example from the station that uses a "feed and bleed" system.

7. Explain why gas cylinders should never be completely emptied and state how you would check the contents of a compressed gas and a liquified gas cylinder.

8. Explain why compressed gas should never be used for pressure testing.