

B. WATER AND AIR SYSTEMS

ENABLING OBJECTIVES:

- 5.5 Given a diagram, label the following light water systems:
- a) Water Treatment;
 - b) Condenser Cooling Water;
 - c) Common Service Water;
 - d) Unit Low Pressure Service Water;
 - e) Unit High Pressure Recirculating Service Water.
- 5.6 Match each of the systems in 5.5 with its purpose.
- 5.7 State the purpose of the Emergency Water System (EWS).
- 5.8 Match each of the following air systems with its purpose:
- a) Instrument Air;
 - b) Service Air;
 - c) Breathing Air.

LIGHT⁴ WATER SYSTEMS

Water for all purposes (cooling, feedwater make-up, fire protection, domestic use, etc.) is drawn into the nuclear station's intake channel from the lake through a tunnel which extends approximately 600 meters out under the lake bed. Each unit has its own pumphouse to supply condensor cooling water and service water. Domestic water and demineralized water for feedwater make-up are supplied from a water treatment plant aligned with Unit 0 at the station. System interconnections are shown in Figure 5.3. The systems shown (except water treatment) are duplicated in each unit.

⁴ H₂O - to distinguish from systems containing D₂O.

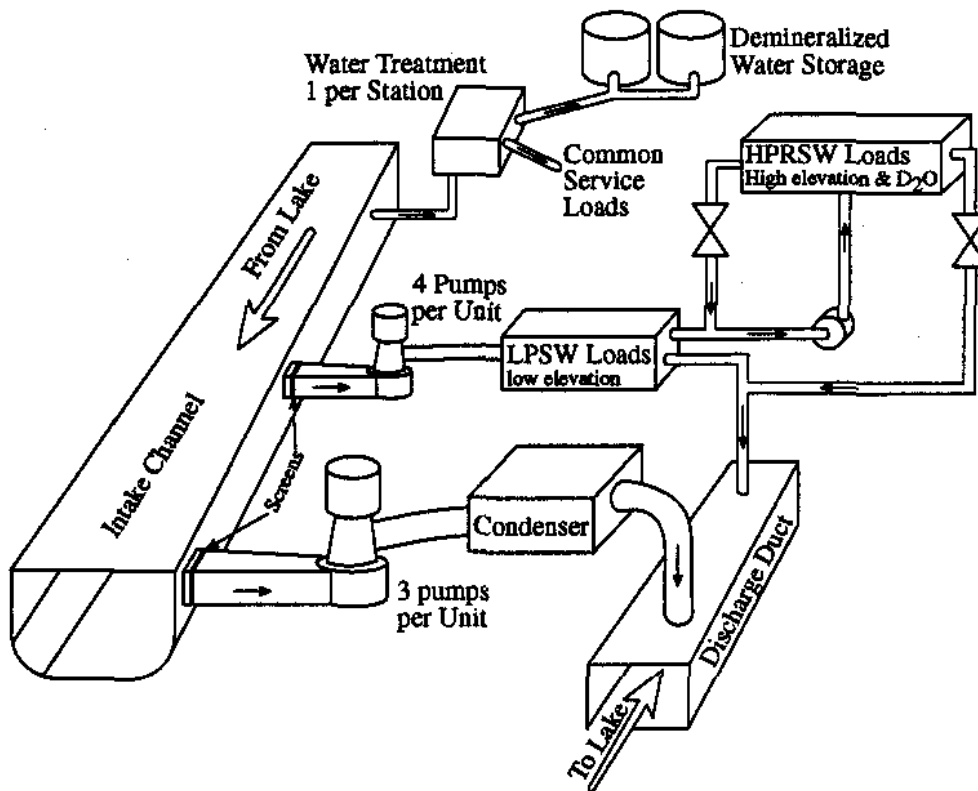


Figure 5.3
Water Systems

WATER TREATMENT

Water treatment has two purposes:

- to remove harmful constituents from the water,
- to treat the water with beneficial ingredients.

The water treatment plant produces demineralized water primarily for boiler feedwater makeup, but also for end-shield cooling, the closed loop demineralized water cooling system⁵, the irradiated fuel bay, and the chemistry lab. The chemical treatment process for each water system is varied and will be looked at in more depth during station systems training. Demineralized water is essential in systems that must be protected from corrosion or the buildup of scale and crud.

⁵ A special cooling system for equipment that must not get plugged or suffer scale buildup (eg. Liquid Zone Control System).

CONDENSER COOLING WATER

The purpose of the **Condensor Cooling Water (CCW)** system is to supply strained lake water to the condensers. The only treatment this water receives is filtering through screens to remove small debris such as entrained organic matter. Recently, chlorination injection systems have been added as well to deal with zebra mussel growth.

The CCW is one system required to have a certificate of approval.⁶ The CCW system must be capable of removing 70 per cent of the reactor's thermal power, but the certificate of approval requires it to do this without raising the discharge temperature more than 11°C above lake water temperature. To meet this requirement, the system must provide flows in the range of 31 m³/s for each unit. Over 85% of a station's total cooling water flow is required for condenser cooling. About four MW of electricity is required to drive the pumps for each unit.

COMMON SERVICE WATER

The **Common Service Water System (CSW)** provides a continuous flow of water to the Central Service Area, the Water Treatment Plant, the Vacuum Building, and the Ancillary (Auxiliary) Services Building. Common service water is strained and filtered before being distributed. It provides water for cooling, waste dilution, lawn watering, etc.

LOW PRESSURE SERVICE WATER SYSTEM

The **Low Pressure Service Water System (LPSW)** provides a continuous flow of strained lake water for specific cooling purposes such as to seals, bearings, and heat exchangers. The temperature of the LPSW ranges from 2°C to 27°C. The LPSW draws its supply from the intake channel.

HIGH PRESSURE RECIRCULATING SERVICE WATER SYSTEM

The **High Pressure Recirculating Service Water System (HPRSW)** is fed from the LPSW system. It increases the pressure and tempers the water to 15°C to 30°C to serve all applications where potential D₂O freezing⁷ is a problem or where equipment is located at high elevations

⁶ Refer to the writeup on documentation in Module 1, Section B.

⁷ D₂O freezes at 4°C. The temperature of the LPSW can fall below this in the winter, so it is not a suitable source for cooling water.

within the plant. Typical loads are the closed loop demineralized water cooling system, bleed cooler circuit heat exchanger, D₂O vapour recovery dryers, heat transport pumps, and moderator heat exchangers.

EMERGENCY WATER SYSTEM

The **Emergency Water System (EWS)** is environmentally and seismically qualified. It provides cooling water to critical systems when the normal systems (boiler feedwater and LPSW, and/or Class IV and III power) are unavailable. It draws its power from the EPS. Emergency water can be routed to the boilers, to the ECI heat exchangers, or to other equipment in the station as required. The EWS draws its water from the station outfall, providing an independent source in the event that the supply from the forebay is not available.

OTHER WATER SYSTEMS

The **Fire Protection Water System** provides water for fire fighting to areas such as fire hose cabinets in the station, hydrants, transformer deluge systems, turbine sprinkler systems, and an air foam system. In emergency situations it can supply water to the irradiated fuel bay, the ECI system, the vacuum building emergency water storage tank and the emergency water system. The system draws its supply from the common service water intake duct.

The **Domestic Water Distribution System** is different at each station but its uses are common. Hot and cold potable water is supplied to the plumbing fixtures (toilets, urinals, sinks, showers, drinking fountains, eyewash stations, safety showers) and laundry machines as required in the station, and ancillary buildings. Supply is drawn from a local pumphouse or a municipal water supply.

AIR SYSTEMS

A CANDU station has numerous uses for compressed air. The quality of the air required depends on the application. To handle the varying requirements, the station has a number of different compressed air systems.

INSTRUMENT AIR

The **Instrument Air System** provides instrument quality compressed air to all parts of the station. There are actually a number of systems, one for

the common areas of the station, and one each for the units. This air is used for control valve actuators, power operators, pneumatic controllers, and special applications in the chemistry lab and irradiated fuel bay where service air is of insufficient quality.

SERVICE AIR

The **Service Air System** provides general purpose compressed air to all parts of the station. This air is used for air-powered tools, cleaning, and water treatment plant regeneration.

BREATHING AIR

The **Breathing Air System** supplies breathing air to any areas of the plant that may require personnel to wear plastic suits. The primary use is for personnel working inside the reactor vault during shutdowns. Most of the air supplied to the plastic suits is for cooling.

ASSIGNMENT

1. State the purpose of the following systems:
 - a) Water Treatment
 - b) Condenser Cooling Water
 - c) - Common Service Water
 - d) Low Pressure Service Water
 - e) High Pressure Recirculating Service Water
2. What is the Emergency Water System and from where does it draw its supply?

3. State the purpose of the following systems.
- a) Instrument Air
 - b) Service Air
 - c) Breathing Air