

4 - Systems

320 - MODERATOR SYSTEM - GENERAL

7.0 INTRODUCTION

The moderator used is heavy water. The moderator system consists of the heavy water and the components which contain it and control its temperature and location. The entire system is a closed system for two reasons; first, to prevent loss of heavy water; second, to minimize the health hazard which would be caused from the leakage of irradiated heavy water and its associated tritium. Moderator volume is 1200 cu. ft. Heavy water reflector volume is 650 cu. ft.

A helium system is associated with the moderator system. The helium gas acts as the cover gas over the moderator surfaces and supports the moderator in the reactor core.

The power output of the reactor is regulated by control of the moderator volume.

A range of operating temperature is available in the moderator system to provide the reactivity necessary to override some transient xenon poison build-up and to re-start the reactor.

1.0 GENERAL DESCRIPTION

The following is only a brief description of the system and its functions.

The moderator system and the associated helium system contain the following major components; calandria, dump tank, heat exchanger, dump valves, control valves, moderator pumps, helium pumps, purification circuit, gasholder, recombination units and associated piping and valves. Drawing No. 320.CN.1 shows the equipment flowsheet.

The moderator system controls the power output from the reactor through regulation of the moderator volume in the calandria. Regulation of this volume is achieved by pumping heavy water from the dump tank to the calandria and supporting the heavy water in the calandria by a differential helium pressure developed across the moderator level by the helium pumps. By-pass control valves across the helium pumps permit various moderator levels to be obtained by modulating the flow out of the calandria through dump lines to the dump tank.

To protect the reactor against failure of the control system, quick opening butterfly valves are provided in a gas line between the top of the calandria and the dump tank. These valves open on a signal from the reactor protective system to allow rapid displacement of the helium from the dump tank to the top of the calandria, thus equalizing the pressure across the moderator and allowing it to fall by gravity to the dump tank.

Heat is generated in the moderator by radiation absorption. Additional heat is transferred to the moderator from the primary heat transport system and in turn all of the heat is transferred in the moderator heat exchanger to river water. The moderator pumps circulate sufficient heavy water for both the cooling and volume regulation flow requirements.

Additional duties of the moderator pumps are as follows:

- (1) To supply a small flow of heavy water to a purification circuit which maintains the chemical purity of the heavy water in the moderator system.
- (2) To supply heavy water for booster*cooling and spray cooling of the calandria tubes when they are exposed because of low heavy water levels in the reactor.
- (3) To supply make-up requirements in the primary heat transport system.
- (4) To supply, in an emergency, heavy water for the vault dousing system.
- (5) To supply cooling water to the helium pump seals.

* The booster is a device provided to insert fissile material into the reactor to increase its reactivity by 2.5 milli-k.

2.0 MODERATOR SYSTEM MATERIALS

Aluminum, stainless steel, inconel and carbon steel are the materials of construction used in the moderator system. Aluminum was chosen for the major part of the equipment because of its cost, compatability with the aluminum calandria and corrosion resistance.

Stainless steel has been used for pumps, valve bodies, valve trim and spray nozzles. The gasholder is of carbon steel. The moderator heat exchanger tubes are of **inconel** while the shell is of carbon steel.

From a corrosion standpoint, it is desirable to maintain the pH between 5 and 7 for an aluminum system and 10 to 11 for a carbon steel system. Therefore, to minimize potential corrosion, there is no carbon steel in contact with heavy water in the moderator system.