Nuclear Industry in Iran

Bushehr and Darkhovain

The Bushehr nuclear power plant is the first nuclear power plant of Iran which has a PWR type reactor with nominal electric power of 1000MW. The planet was connected to the national power grid in 03.09.2011 and has been working since then.

Primary circuit:

Nuclear fission is the source of heat energy in the reactor core. This heating energy is transferred to steam generator by water in the primary loop to circulate in a closed route. Heat exchange inside the steam generator will cause the water of the second circuit to turn into steam in a completely separated cycle.

The water in the first loop after exiting from steam generator will be returned to the reactor by the pump of the first circuit in order to withdraw the heat from the core again.

Second circuit:

The steam produced in the second circuit is led to the turbine and through the turbine circulation.

Mechanical energy is converted to electrical energy by a generator and electricity is produced. The outgoing steam from the turbine is turned to water by a condenser, and again this cycle for completion and repetition is returned to the steam generator.

Third loop or cooling system:

In order to condense outlet steam of the turbine, sea water as a cooling fluid in a circuit completely separated from the second loop, is led to the condenser and after removing the heat, water returns back to the Persian Gulf.

Bushehr nuclear power plant is of the pressurized light water type which has the ability to produce 3000MW heat energy.

The Reactor pressure vessel is coated with stainless steel.

Water enters the reactor as a coolant and neutron moderator, and by heat removal from the reactor core with a 321C condition, is led towards the steam generator where steam is produced by exchanging heat with water of the second circuit.

The source of heat production of this reactor is 3.92% enriched dioxide nuclear fuel. The nuclear fuel is made in the form of cylindrical pellets which are placed inside fuel rods.

The hundred and eleven fuel rods with a (hexagonal) arrangement make up a fuel assembly and 163 fuel assemblies beside each other form the reactor core. The heat generating mechanism is due to the fission of uranium235 atom. As a result, lighter fission fragment along with the release of energy and production of neutrons 2.3 appear which support the chain reaction. The control of the nuclear reaction and, as a result, the control of the reactor power, is established by means of boric acid dissolved in water and the controlling rods that are connected to the control system and safety drivers. The steam turbine complex with a normal power of 1000 MW functions to move the alternating current generator.

Instrument and control system of Bushehr power plant are composed of one of the most advanced automation system. The system is of the distribution control type divided into three control layers called upper, middle and lower layers. At present the safety of the nuclear power plants, throughout the world, is based on (defense in depth principle). This principle leads the designer to assort a series of physical barriers behind each other on the way of radioactive radiation exposure to the environment. The presence of such physical protective layers will protect the operational personnel, power plant's environment and the people living around the power plant from being exposed to the hazardous effect of radioactive material. Bushehr nuclear power plant is a pressurized water reactor plant, which from the structural and functional point of view, is totally different from the Chernobyl power plant and is the same as western power plants operating by (PWR) reactor.

This power plant enjoys inherent safety characteristic and with control which leads to the decrease of reactor power.

In the case of a probable accident, the four-channel safety system 4×100% is capable of assuring safe shutdown of the reactor and removing the heat energy residue from the reactor core. The existence of the one channel and its right performance completely suffices at the time of the accident, and the existence of the other three channels is merely designed to increase the system performance safety coefficient. These channels are completely separated from each other and act independently. The reactor's structure is resistant against the clash of fighter aircraft and 8 Richter scale earthquakes.

In case such accident occur, no damage will be inflicted on the reactor installation or its core and the power plant's control system and safety mechanism will easily return it back to the safety standard.

The Atomic Energy Organization of Iran, in order to realize a plan for the production of 20,000 mw atomic generated electricity, through the deployment of its scientific and technical capacities, since 2008, has acted to design and build a nuclear power unit in Darkovain Ahvaz with 360 MW capacity. At present, the basic design stage of this project is being performed with high quality, and its detailed designing is also well under way. Obtaining necessary warrants from the national and international sources, upgrading the country's scientific, technical and industrial ability as well as involving the domestic contractors for participation in building this power plant is among the main future plans of this project.

Production of Heavy Water in Arak Complex

Hydrogen is the only element whose nucleus has no neutron and deuterium is the hydrogen isotope having one extra neutron in its nucleus. In natural water, there is only one deuterium atom, in around 7000 common hydrogen atoms (around 145ppm). Therefore, heavy water is a type of water whose hydrogen molecules are heavy hydrogen type or deuterium.

There are different processes for the production of heavy water of which, dual temperature hydrogen sulfide-water exchange (known as GS) and vacuum distillation are among these processes. The production of heavy water on the industrial scale is usually done by the combination of these processes (GS

vacuum *distillation*). Heavy water is needed for reactors that operate by natural low enriched uranium as fuel. Such reactors are called heavy water reactors and a very famous type is the (CANDU) reactor, which operates by Canadian technology. Since the fuel used for most of the nuclear reactors is enriched uranium, it could be stated that through access to the technology of producing heavy water, another way is paved for operating a sophisticated reactor, and it is considered an amazing ability in the future for the production of energy in the country .