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A PATH FOR HORIZING YOUR INNOVATIVE WORK

NUCLEAR REACTOR SAFETY

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Abstract

Nuclear power is an Important source of electricity-ran Ontario' because it produces power safely, economically and cleanly. Its fuel source. Natural raniumjis found in abundance in Ontario. Today, the power of the atom supplies more than 40% of the electricity needs of Ontario's homes, schools, stores and industries. Coal- fired and water-powered stations supply the rest. Ontario Hydro operates four nuclear stations with a total of 16 reactors. An additional 5 (reactors at two sites are under construction. Wren all these reactors are operating by the I early 1990's, they will help make Ontario, much more energy self-sufficient. The generation of electricity from nuclear ~power results in the production of highly radioactive materials. Harmful amounts of there must be prevented from entering the environments.

INTRODUCTION –

These barriers are designed considering possible equipment failures, design imperfections and operator errors. The barriers are protected by careful plant operation and maintenance, regular testing and inspection of equipment and components, I and by the training of reactor operators to respond to normal and emergency conditions. This care and attention to good design and 3S safe operation has resulted in an enviable '1: Its safety record at Ontario Hydra's nuclear, power plants.

WHAT IS A REACTOR?-

In a nuclear station, the reactor performs the safety philosophy used in nuclear the same function that the furnace does in a power plants is to limit the chances of an coal, gas or oil-fired generating plant -it accident occurring and to limit the effects of produces heat, to turn water to steam, to an accident, should it occur. The drive a turbine Defense-in-depth approach attempts to the heat is created in a reactor by the prevent accidents by providing high-quality "visioning" or splitting of uranium atoms. Design, Equipment and operators. It When the center or nucleus of a uranium recognizes that one or more of these may atom fissions, it splits to fragments which be imperfect.

1. High-quality station equipment. Specifications to minimize the possibility
2. Independent safety systems. Failure.
3. Barriers to contain or minimize Even so, some reactor process systems
4. High standards for nuclear operator training. .
5. A continuous program of fault detection and correction.

STATION EQUIPMENT

In the safe operational a nuclear station, the first line of defense is to build reliable station equipment called process systems which include pumps, values piping, tanks and instrument. These are the systems which produce the electricity.

However, as with any mechanical system components sometimes fail or break down. Components designed for use in a nuclear station is built to strict engineering specrtifcation of minimize the possibility of failure. Designed with "redundancy", so that if one component fails, another is available to take over. Redundancy means that the failure of one component does not jeopardize the over-all safe operation of the station because another component is ready to take over. A dual braking system, found in most cars, is a common example of engineered redundancy.

Safety systems if a major process system failure does occur during normal operation, the safety systems provide further lines of defense. Reliable safety systems are provided to compensate for a failure of the process systems by shutting down the reactor (reactor shutdown systems), providing additional fuel cooling (emergency cooling system), or confining radioactivity which has escaped from the fuel (containment systems). These safety systems are designed. wherever possible using the following principles to provide a high degree of reliability. This ensures that the failure of one component will not result in the safety system being unable to do its job.1 Separation: The components of different safety systems are physically separate from one another. This means that a mechanical failure in one plant location will not affect system components in other plant locations. Diversity:

REDUNDANCY:

This means that more than one component is available. For example, two pumps are connected in parallel where only one is required.

INDEPENDENCE:

Safety systems are independent of each other. One example is independent power supplies wherever possible.

FAIL-SAFE:

This means that failure of a component or system automatically triggers that component or system to move to a safe condition. For example, power is required to hold the shut-off rods above the reactor. If the power fails, they drop into the reactor, shutting it down.

SHUTDOWN SYSTEMS

A major process system failure or any abnormal reactor condition results in rapid, automatic reactor shutdown. There are three diverse types of shutdown systems that can be used in Ontario Hydro's reactors:

1. Shut-off rods are made of a neutron-absorbing material called cadmium. The introduction of the rods into the reactor rapidly shuts off the chain reaction because not enough neutrons are available to keep the fashioning process going.

2. A second shutdown system is the moderator dump which simply drops the heavy water moderator into a tank below the reactor. The reactor shuts down automatically once the operator is removed because there is no longer any medium for slowing down the neutrons enough to sustain a chain reaction

EMERGENCY COOLING SYSTEM

After shutdown, the fuel in the reactor

Continues to give off some heat. This heat has to be removed to prevent damage to the fuel and to the reactor structure.

CONTAINMENT SYSTEM

In the event of an accident that results in the release of radioactive materials from the reactor, the containment system is designed to "contain" or limit the release of those radioactive materials to the outside environment. Containment is provided by the thick, reinforced concrete structure surrounding the reactor and its piping. In multi-unit stations such as Pickering, Bruce and Darlington, the containment system consists of a reactor building for each rector and a single, common vacuum building connected by a large duct to each reactor building..A separate vacuum building is connected to the reactors by a large duct. The vacuum building is always kept at about one-tenth of atmospheric pressure. Any build-up of pressure inside the reactor building causes pressure relief valves to open and the steam to be sucked into the vacuum building.

MULTIPLE BARRIERS

A series of physical barriers acts to prevent the release of radioactive materials during normal or emergency situations. Two have already been mentioned briefly -the main cooling system and the containment system. , There are three additional ones for a total of j five barriers.

The outer most barriers are the distance between the station and residential areas. It is an exclusion zone approximately one kilometer in radius. Public access to this area is controlled. In the event of a release of radioactive materials from the station, this exclusion distance allows for significant dilution of any radioactive release. The next physical barrier is containment consisting of the thick-walled reactor building and the vacuum building. The fuel bundles are located inside a closed, high-pressure main cooling system. This system acts as a physical barrier because it is a continuous, closed, metal piping system designed and built to high-quality standards and to withstand high internal pressure. It is operated at a pressure far below its design limit. The defense-in-depth concept ensures that the only way a harmful release of radioactive materials to the outside environment could occur would be for all these barriers to be breached simultaneously.

OPERATOR TRAINING

Training competent nuclear reactor operators is another important component of the safety philosophy. Operators are carefully selected and trained a for work in nuclear power station control rooms. They spend at least eight years in training and must pass a series of examinations before they are given authorization and responsibility for reactor operation. These examinations are set by Ontario Hydro and the federal government's nuclear regulatory body, the Atomic Energy Control Board (AECB).

During training, the operators undergo both classroom instruction and supervised practice in an operating plant. Once authorized by the AECB, operators are required to keep their knowledge and skills up-to-date.

DETECTION AND CORRECTION OF FAULTS

There is a continuous program of testing and inspection of station components and safety systems to ensure that they are operating properly and to promptly detect and correct any faults. All of the construction requirements, equipment, safety systems and operating procedures for nuclear plants must be approved by the AECB.

Once plants are in operation, Ontario Hydro reports regularly to the AECB which continuously updates and monitors safety requirements of nuclear plants. In addition, AECB inspectors are stationed at all large nuclear generating stations. In applying for an operating license, Ontario Hydro submits a final safety report documenting the ''as-built'' design of the station. It contains up-to-date analyses of possible accidents and the capability of safety systems to cope with them and limit .their consequences.

The AECB issues an operating license when it is satisfied that the design and oper9ting procedures for a plant are safe. The AECB continues to monitor the nuclear station throughout its life.

COMMONLY ASKED QUESTIONS

Here are some answers to the most frequently asked questions about nuclear power reactors. *Can it explode like a bomb?*

The natural uranium used in a CANDU reactor simply cannot explode like a bomb. Fuel for a bomb must be very pure. In a CANDU reactor, less than 1 per cent of the fuel is fissionable. That is far below the purity of fissionable atoms necessary to make a bomb. If reactor control were lost, this could result in the fuel overheating and perhaps some reactor damage. But not an explosion.

What is a *meltdown?*

After a reactor is shut down, the fuel continues to produce a small amount of heat. If the fuel is not cooled at all, it may be possible for the temperature to raise high enough to cause fuel to melt. However being a ceramic, natural uranium fuel can withstand very high temperatures before; melting occurs.

What are the worst accidents analyzed? The worst accidents analyzed in detail are major loss-of-coolant accidents resulting from a break in the main cooling system. Several types of major accidents are postulated. The most severe are used to determine safety system requirements. In analyzing these accidents, it is assumed that only some of the safety and containment systems operate as designed. Dispersal of radioactive material that might escape to the environment is also considered in the analyses.

RADIATION

Radiation has always existed on earth. It comes from natural substances in the earth's crust, from the sun and from outer space.

We get it in food and water. The human body has some of its own and building materials also give off radiation.

So it's really a question of how much radiation exposure we receive from both natural and man-made sources.

While radiation is with us in some form all the time, large doses received over a short time can cause damage to body cells and very large doses can kill. A lethal dose of radiation over a short period is considered to be about 500 000 milligrams.

CONCLUSION-

Nuclear power is an important source of electricity-ran Ontario') because it produces power safely, economically and cleanly}: Its fuel source. Natural raniumjis found in abundance In Ontario. Today, the power of the atom supplies more 1 1than 40% of the electricity needs of Ontario's ! Homes, schools, stores and industries.

REFERENCES-

1. H. Gaztanaga, I. Etxeberria-Otadui, D. Ocnasu, and S. Bacha, "Real-time analysis of transient response improvement of fixed-speed wind farms by using a reduced-scale STATCOM prototype," IEEE Trans. Power System, vol.22, no. 2, pp. 658-666, May 2007.

2. Ying Chenge, Chang Qian, Mariesa L. Crow, Steve Pekarek, "A comparison of diode-clamped and cascaded multilevel converter for a STATCOM with energy storage", IEEE Trans. On Industrial Electronic, vol. 53, no. 5, pp. 1512-1521, Oct.2006.

3. Z. Yang, C. Shen, L. Zhang, M. L. Crow, "Integration of STATCOM and battery energy storage.", IEEE Trans. on Power System,vol.16, no. 2, pp. 254-262, May 200