Overview Notes

for Course on

Licensing of Nuclear Facilities

to be given at

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Licensing of Nuclear Facilities

Definition: Licensing is a form of regulation - a means by which governments can authorize and control an activity.

Overview of course:

This course will attempt to provide an overview of the licensing of nuclear activities with emphasis on the licensing of nuclear facilities, in particular, nuclear power plants, under the following headings:

1. - role of government in nuclear regulation
2. - general requirements for a nuclear regulatory body
3. - Canadian experience in nuclear regulation
4. - use of advisory committees and other agencies
5. - regulating the use of radioisotopes and the transportation of nuclear materials
6. - licensing of nuclear reactors - general / IAEA recommendations
7. - licensing systems in selected countries:
   - Finland - France - USA - UK - Canada
8. - licensing requirements for nuclear power plants in Canada
9. - physical security, safeguards, operator certification
10. - Convention on Nuclear Safety

1(a). Role of Government in Nuclear Regulation

- The need for government control over nuclear activities stems from:

(1) the inherent risk to human health and the environment (safety)

and (2) the risk of mis-use of nuclear science and technology in non-peaceful ways (security).

- All countries with significant nuclear activity have enacted , typically strong, legislation stating or clarifying the government's regulatory role.

The role of government includes:

- passing legislation to clarify control over nuclear activities and to establish a regulatory regime;
- providing the legal basis for ensuring that nuclear facilities are sited, designed, constructed, commissioned, operated and decommissioned so that there is no undue risks to persons or the environment;
- ensuring that there is adequate financial indemnification for third parties in the event of a nuclear accident.

continued

1(b). Role of Government in Nuclear Regulation (cont.)

- In many countries a central regulatory body has been established to effect this control. In some, the control has been dispersed among those departments and agencies having responsibility for the functional areas of concern, such as public health and safety, environment, etc.
- The regulatory body (bodies) must have the responsibility (and requisite authority) for full governmental surveillance and control over all aspects of nuclear activities affecting safety or security.
- It is recommended that the regulatory body not be involved in the promotion of nuclear activities.
- The regulatory body should be independent of organizations owning, building, operating, nuclear facilities.
- If the regulatory body is established within a larger government unit it should be instituted, and have the legal authority to function as an autonomous body.

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Task 1: Briefly set out the advantages and disadvantages of having a separate regulatory agency in Thailand for all nuclear activities compared to distributing the responsibility among existing functional departments.

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2 (a) Role of / Requirements for / Nuclear Regulatory Body

Role:

- The nuclear regulatory body (bodies) is (are) responsible for government surveillance and control over nuclear activities to ensure safety to persons, protection of the environment, liability assurance and associated national security aspects.
- In the case of nuclear facilities the regulator should oversee and regulate the siting, design, construction, commissioning, operation and decommissioning , including waste management.

Requirements:

The regulatory body needs:

- clear legislation authority
- sufficient resources to carry out its functions.

The regulatory body needs, either within its organization or through consultants, advisory committees or other government agencies, the capability to oversee the various steps of a nuclear facility, as noted above.

2 (b) Role of / Requirements for / Nuclear Regulatory Body (cont.)

Requirements (cont.)

The regulatory body requires the capability to:

- review and assess safety related information, including safety analyses, submitted by applicants or licensees;
- deal with information provided by consultants, advisory committees, other organizations;
- establish rules, guides, etc, as appropriate;
- issue, amend or revoke licences or other approvals;
- conduct inspections;
- ensure corrective actions are taken when needed;
- take enforcement actions when appropriate;

Some regulatory bodies also carry out functions such as:

- conducting radiological surveys around nuclear facilities;
- carrying out testing and quality control measures;
- conducting or sponsoring safety related research and development;
- providing personnel monitoring services.
- providing public information on nuclear safety.

2 (c) Role of / Requirements for / Nuclear Regulatory Body (cont.)

Structure and Size:

The structure and size of the regulatory body will depend on a number of factors, including:

- **its responsibilities;**
- **the constitutional and legal systems of the country;**
- **the organization of industry and the electrical utility; (utilities);**
- **the size of the nuclear programme;**
- **the existing capabilities of other government departments or agencies;**
- **the extent of procurement from foreign vendors.**

- Responsibilities:

If the regulatory authority is constituted as one separate agency with the responsibility to conduct all activities "in house" it will need to be much larger and have broader capabilities than one that primarily coordinates activities of other groups.

- Constitution:

The structure and size of a regulatory body in a country with a centralized country may be quite different than one with a federal system.

2 (d) Role of / Requirements for / Nuclear Regulatory Body (cont.)

- Industry / utility organization:

In the case of the licensing of nuclear power plants, if there is just one utility, the operation and, therefore, the structure of the regulatory body can be simpler than if there are several utilities with which it must deal. The greater number of organizations the more complex the regulatory problem.

- Size of nuclear programme:

For a beginning nuclear power programme, the regulatory body can be of modest size, making use of consultants, advisory committees, other government agencies, etc. In the case of Canada, the professional staff of the Atomic Energy Control Board assigned to nuclear power plants at the time of the Construction Approval for the first Pickering 4-unit plant was less than 20.

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3(a) Canadian Experience in Nuclear Regulation

Background

Canada is a federation, with legislative powers divided between the central (federal) government and that of the ten provinces and two territories.

Under the basic constitution, responsibility for health, worker safety, and resources rest with the provinces, but the federal government has, or can assume, powers affecting these areas if needed in the "national interest".

The Canadian nuclear programme began with the "Montreal Laboratory" which was established in 1942, during World War II, with mostly British and European scientists There, research and design work was conducted towards a heavy-water moderated, natural uranium fueled, reactor for the production of plutonium. Construction of the NRX reactor was begun at the Chalk River laboratory in 1944. When the war ended in 1945, the Canadian government decided to continue the programme but for peaceful purposes. A smaller, test reactor, called ZEEP, was built and, when it went critical in September 1945, was the first nuclear fission reactor outside the USA.

Canada also had (and has) reserves of uranium which were made available for the US Manhattan Project.

3(b) Canadian Experience in Nuclear Regulation (cont.)

Regulatory History

In 1946, the federal government passed the *Atomic Energy Control Act* which gave it total control over all aspects of "atomic energy", with the full consent of the provinces.

The *Atomic Energy Control Act* established a governing body, the *Atomic Energy Control Board*, and assigned it very broad powers to direct, control and regulate: the development, research, production, of atomic energy; the prospecting for, mining, refining of uranium and thorium; the production, import, export, transportation, etc., of "prescribed substances" (which includes radioisotopes).

Originally, the *Atomic Energy Control Board* (AECB) controlled directly the Chalk River project and the government-owned uranium mines. In 1954, the only significant amendment to the *AEC Act* was made. After the amendment, the government-owned company, *Atomic Energy of Canada Limited,* which had been created in 1952 to take over the Chalk River laboratory and pursue the nuclear programme, reported directly to a Minister, and the AECB became strictly a regulatory agency.

Initially, the primary regulatory focus was on security and secrecy. The first regulations dealing with health and safety were issued in 1960.

3(c) Canadian Experience in Nuclear Regulation (cont.)

The *AEC Act* provides the AECB with very broad, discretionary powers over all aspects of all activities involving "atomic energy", including the mining and refining of uranium and thorium and the production of heavy water. The AECB has issued general regulations, the *Atomic Energy Control Regulations,* which are largely procedural, and more specific ones dealing with: Transport Packaging of Radioactive Materials; Uranium and Thorium Mining; Physical Security, and Cost Recovery (fees).

The only other legislation dealing specifically with nuclear matters is the *Nuclear Liability Act.* This Act spells out the absolute liability of operators of nuclear installations, sets third party insurance requirements and provides for payments by the government in the event that total liabilities from a nuclear accident exceeds the amount of insurance.

In 1996 a proposed new Act, the *Nuclear Safety and Control Act,* was introduced into the Parliament of Canada as Bill C-23. As of the end of January 1997 that Bill is still be to tabled for "Third Reading" ; final discussion and vote. The new Act, if passed, will transform the Atomic Energy Control Board into the Canadian Nuclear Safety Commission.

The AECB staff has grown from a total of about 10, with three professionals, in 1959, to about 400 today, with four regional offices and resident officers at each of the five nuclear power plant sites.

3(d) Canadian Experience in Nuclear Regulation (cont.)

The AECB is organized into five directorates: Secretarial; Reactor Regulation; Fuel Cycle and Materials Regulations; Analysis and Assessment, and Administration.

The Directorate of Reactor Regulation conducts the licensing and inspection of reactor installations, including manning the resident offices at each of the nuclear power plant sites.

The Directorate of Fuel Cycle and Materials Regulation conducts the licensing and inspection of uranium mines and refineries, waste management facilities, and radioisotopes, including staffing the four Regional Offices.

The Directorate of Analysis and Assessment, as the name implies, provides analytical support to the two licensing directorates.

As well as the normal functions, the Directorate of Administration includes a Training Division that offers training both internally for new staff and externally for staff of nuclear regulatory agencies from other countries interested in the Canadian approach.

3(d) Canadian Experience in Nuclear Regulation (cont.)

There are currently:

- **seven nuclear power plant licences;**
- **nine research reactor licences (six of which are for SLOWPOKE reactors at universities);**
- **two research establishment licences (Chalk River and Whiteshell Laboratories);**
- **16 uranium mining or milling licences;**
- **21 waste management licences; and**
- **over 3,800 radioisotope licences.**

Under a government policy adopted in the late 1980s, the AECB is required to recover most of its operating costs, which it does through licence fees and charges for special services (such as training).

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Consolidated Licence [illegible] (Mcmaster for example)
[illegible] Licence [illegible] ?

4(a). Use of Advisory Committees

Canadian experience:

- **In the early years of the Canadian nuclear programme, from the mid 1950s to the late 1970s, the AECB relied heavily on advisory committees. During that period a major role of the staff of the AECB was to assist the advisory committees.**
- **Some of the early advisory committees were:**
  - **Reactor Safety Advisory Committee** (1956 established)
  - **Heavy Water Safety Advisory Committee**
  - **Nuclear Reactor Operator Certification Committee**
  - **Radioactive Waste Safety Advisory Committee**
  - **Accelerator Safety Advisory Committee**
  - **Radioisotope safety Advisory Committee**

[illegible] ... for members of the Board AECB [illegible] committee [illegible]

By 1980 the size and capability of the staff and the number and complexity of the projects being licensed made this arrangement less practical. The advisory committees above were all disbanded and two broad committees were formed to look at "generic" issues - the *Advisory Committee on Nuclear Safety* and the *Advisory Committee on Radiological Protection*.

4(b). Use of Advisory Committees (cont.)

International Atomic Energy Agency (IAEA) position

- In the IAEA NUSS document on government organization (IAEA - Safety Series No. 50-C-G-rev.1) *Code on the Safety of Nuclear Power Plants - Government Organization"* it is stated:

... advisory committees are an excellent means .. to obtain the use of experts. Member states just beginning to develop nuclear power should give careful consideration to .. advisory committees.

- The same document notes that the role of advisory committees could include any or all of the following:
  - advising on general matters, generic issues, etc.;
  - providing advice on licence applications;
  - assist in coordinating the work of outside consultants.
- The IAEA notes that if one or more advisory committees are established it should be clarified:
  - whether the committee(s) will be standing (a) body or bodies an. ad hoc as the need arises;
  - whether the committee(s) are specifically involved in licensing or not;
  - to whom they report.

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4(c). Use of Advisory Committees (cont.)

Other countries:

Most countries employ advisory committees of one sort or another. For example, the US Nuclear Regulatory Commission has two: the *Advisory Committee on Reactor Safeguards* (ACRS) and the *Advisory Committee on Nuclear Waste* (ACNW), while the UK Health and Safety Executive has the *Advisory Committee on the Safety of Nuclear Installations* (ACSNI). The US committees are established by legislation which spells out their mandate.

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Task 2: Discuss briefly, with rationale, whether or not Thailand should create one or more advisory committees to assist in the safety regulation of nuclear activities. If you support the creation of advisory committee(s) suggest its (their) scope, the source of members, and to whom it (they) should report.

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5(a) Regulating Radioisotopes and Transportation of Radioactive Material

Radioisotopes

The users of radioisotopes are often small organizations or even individuals and their use of radioisotopes is often only incidental to their main activity. This is in marked contrast to the large organizations associated with nuclear facilities. It has been recognized, therefore, that such users need clear, specific rules. This has been the approach of most nuclear regulatory bodies.

The *International Atomic Energy Agency* (IAEA), through the input of representatives from many countries, has produced a number of guides and proposed regulations for radioisotopes. (See IAEA Safety Series No. 102, *Recommendations for the Safe Use and Regulation of Radiation Sources in Industry, Medicine, Research and Teaching*.)

The topics of concern in issuing a licence for the use of radioisotopes include:

- qualifications of person responsible and person(s) using or handling the radioisotopes
- the radiation protection measures in place (including the training of personnel)
- security measures
- and
    - if in a laboratory or hospital, etc.,
    - the physical layout
    - equipment
    - ventilation

5(b) Regulating Radioisotopes and Transportation of Radioactive Material

Radioisotopes (cont.)

In Canada a particular form of radioisotope licence has been developed for organizations (such as universities or large hospitals) having many locations where radioisotopes are used . This is called a Consolidated Licence. Such a licence provides a degree of self-regulation but requires the establishment of an over-seeing committee and the appointment of a radioisotope safety officer.

Transportation

Since the transport of radioactive materials often crosses international borders there was an early recognition that international rules were needed. Through the IAEA, representatives of many countries met during the 1960s and into the 1970s to produce "regulations" for the transportation of radioactive materials. Recognizing that national nuclear regulatory bodies may not have jurisdiction over the various modes of transport and that it was, in general, impractical to have detailed conditions on the handling of a package as it proceeds through a typical trip, these IAEA "regulations" concentrate on the packaging requirements for various classes of radioactive material. These are very detailed and specific. (See IAEA Safety Standards Series No. ST-1, *Regulations for the Safe Transport of Radioactive Material.)* Like most countries, Canada has essentially adopted these IAEA "regulations".

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6(a) Licensing of Nuclear Reactors - General

This section will deal primarily with the licensing of nuclear power plants but will also provide some comments on licensing of smaller reactors for research or isotope production.

As will be covered more explicitly in section 7, most countries exercise their regulatory control over nuclear facilities through licences. Such licences provide not only authorization for a particular activity but also contain the conditions which must be met to maintain the licence.

A licence serves the following purposes:

- **authorizes a specific activity**
- **typically sets out time limits**
- **sets out requirements and conditions which must be met to keep the licence in force**
    - **these conditions may be procedural, technical, financial, etc., in nature.**

* บางครั้งต้องทำตามกฎหมายของแต่ละเงื่อนไขที่ตั้งไว้ *

The typical stages of licensing, i.e., the licensing steps, are:

- siting; - design; - construction; - commissioning; - operation; - decommissioning

6(b) Licensing of Nuclear Reactors - General (cont.)

Not all countries issue formal licences for all of these steps. Some combine authorization for several steps in one formal document. Nevertheless, the various stages are controlled through conditions and sub-approvals. On the other hand, additional steps of approval are often applied, such as for the approval to load fuel as a part of the commissioning process.

The duration or time limit of licences varies greatly from countries to country. For example, the US Nuclear Regulatory Agency issues Operating Licences for nuclear power plants for 40 years, while in Canada, the typical AECB Operating Licence for a nuclear power plant is for two or three years. In some countries no time limits are specified. However, in all countries with nuclear power programmes, there is some form of on-going or periodic review of the operation (or other licensed activity).

In countries where public hearings are employed or where a separate environmental impact assessment is carried out, these typically take place at the time of siting approval. Some countries also hold or make provision for public hearings at the Operating Licence stage.

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7(a) NPP Licensing Systems in Selected Countries

Finland:

Background: Finland is a small country with a central government. It has two utilities with nuclear power plants, one of which is privately owned , the other state owned. there is a central nuclear regulatory body - the *Finnish Centre for Radiation and Nuclear Safety* (STUK), which reports to the Minister for social Affairs and Health. the overall licensing authority is the Council of State (the senior governing body).

Licensing System: There are three formal stages of licensing:Decision in Principle; Construction Licence; Operating Licence. An application, supported by extensive documentation, is required for each stage. The application and supporting documents are reviewed by STUK and by three advisory committees: Advisory Committee on Nuclear Safety; Advisory Committee on Radiation Protection; Advisory Committee on Nuclear Energy. Emergency preparedness measures are reviewed by the Ministry of the Interior.

7(b) NPP Licensing Systems in Selected Countries

France:

Background: France has a centralized form of government and a state-owned utility (Electricite de France - EdF). It has a very large nuclear power program. Two Ministers share authority over nuclear facilities - Industry, and Environment. In addition the Minister of Health must give consent.

There are two technical organizations that conduct reviews- the *Direction de la* surete *des installations nucleaires* (DSIN), which is within the Ministry of Industry, and the *Institut de protection et de surete nucleaire* (IPSN), which is part of the *Commissariat a l'energie Nucleaire* (CEA)

Licensing System: There is, nominally, one application to construct the installation, leading to one "decree" to setup (build). In practice there are several approval steps. Separate approvals are issued for commissioning and operation.

The applications are referred to the DSIN and the IPSN for review. their work is coordinated by a Groupe Centrale which reports to the head of DSIN.

The applicant is required to hold public information meetings.

A draft decree is developed by the Ministers of Industry and Environment and sent to the Interministerial Committee for Large Nuclear Installations and also to the Minister of Health for his consent. The Prime Minister issues the final, formal, decree.

7(c) NPP Licensing Systems in Selected Countries

United Kingdom

Background: The United Kingdom (UK) has basically a central government with a number of powers delegated to Scotland. The electrical utilities were state-owned up until a few years ago. Now they are privatized, with a separate utility operating the nuclear power plants.

The primary legislation affecting nuclear installations is: the *Nuclear Installations Act* of 1965, the *Health and Safety at Work Act* of 1974. The *Nuclear Installations Regulations* of 1971, and *the ionizing Radiation Regulations* of 1985 augment these basic Acts. The *Health and Safety at Work Act* created the *Health and Safety Executive* (HSE) and brought the *Nuclear Installations Inspectorate* (NII) under its broad direction. The HSE normally reports to the Secretary of State for Employment but for nuclear matters reports to the Secretary of State for Energy or the Secretary of State for Scotland.

Licensing System: There is, nominally, just one step in the licensing process - a Site Licence - but in practice there are many stages of approval. A proponent submits an application to the HSE, following consultation with NII since the requirements are not spelled out in legislation or regulation. The NII reviews the Preliminary Safety Report and other documents requested and advises the HSE. Typically the HSE requires the applicant to provide information to local authorities and land use permission from the appropriate local authority is required. If deemed necessary the Secretary of State can hold a public inquiry (e.g. Sizewell "B"). The HSE also consults its *Advisory Committee on the Safety of Nuclear Installations* (ACSNI). The Secretary of State issues the licence with such conditions as the NII and HSE consider appropriate.

7(d) NPP Licensing Systems in Selected Countries

United States of America

Background: The United States of America (USA) is a federal country but the authority over nuclear matters rests with the federal government. In the case of radioisotopes authority and responsibility can be delegated to a state through an agreement.

The USA has many utilities, most of which are privately owned, several nuclear vendors(designers) and several architect / engineers (which handle the balance of plant). This structure of the industry combined with the legislative philosophy led to quite detailed laws and regulations.

The central regulatory agency is the United States Nuclear Regulatory Commission (USNRC). The major legislation is the *Atomic Energy Act* which was originally passed in 1954 and the *Energy Reorganization Act* of 1974 which abolished the *Atomic Energy Commission (USAEC)* and created the *Nuclear Regulatory Commission* (USNRC).

A number of other laws also apply, the most important of which are the *National Environmental Policy Act* and other environmental legislation.

7(d) NPP Licensing Systems in Selected Countries - USA (cont)

Licensing System: The rules for the licensing process for nuclear installations are spelled out in regulations: *Title 10, Code of Federal Regulations (CFR), Chapter 1 - Nuclear Regulatory Commission* (10CFR1*)*. There are two major steps - Construction Licence & Operating Licence.

Recent amendments allow for a one step process with prior approval of the design. An Early Site Permit, also called a Limited Work Authorization (LWA) may be issued prior to a Construction Licence to allow for site preparation work, according to 10 CFR 2. Typically, Operating Licences for nuclear power plants have been issued for a period of 40 years but most have had several amendments and there is an on-going review..

An application is required for each step, supported by extensive documentation. The criteria for siting for nuclear reactors are set out in regulations (10 CFR Part 100) while the information required to support an application for a Construction Licence is spelled out in 10 CFR Part 50. The submitted information is reviewed by the large staff of the USNRC and by the *Advisory Committee on Reactor Safeguards* (ACRS) and, if appropriate, by the *Advisory Committee on Nuclear Waste.*

A public hearing is required before a Construction Licence can be issued and may be held for an Operating Licence. These formal hearings are conducted by a three-member *Atomic Safety and Licensing Board* appointed by the five-member Commission.

An environmental assessment is required which is reviewed by the Environmental Protection Agency (EPA) and the state concerned, as well as by the USNRC.

7(e) NPP Licensing Systems in Selected Countries

Canada

Background: Section 3 reviewed the Canadian experience in nuclear regulation and the Canadian setting. Although Canada is a federal country there is a central, federal, nuclear regulatory body, the *Atomic Energy Control Board* (AECB). Nuclear installations are subject to the *Canadian Environmental Assessment Act.*

Licensing System: Although only a Construction Approval and an Operating Licence are specified in the *Atomic Energy Control Regulations* there is normally a prior step of Site Acceptance. An application for Site Acceptance is submitted to the AECB which will also refer it to the *Canadian Environmental Assessment Agency* (CEAA) which will form a panel to conduct environmental hearings. Applications for Site Acceptance must present a summary description of the proposed installation and detailed information on the site. The AECB will primarily examine the effect of the site characteristics on the proposed plant while the CEAA will focus on the impact of the installation on the area.

An application for a Construction Approval (now called a Licence) must be accompanied by a Preliminary Safety Report and such other information requested by the AECB. This is reviewed by AECB staff. Pressure retaining components must be approved by the appropriate provincial regulatory authority working jointly with AECB staff. The AECB may hold public meetings, not hearings. Typically, information, analyses, etc. continue to be submitted during the construction period.

7(e) NPP Licensing Systems in Selected Countries - Canada (cont)

An application for an Operating Licence must be accompanied by :

- **a Final Safety Report based on the "as-built" plant;**
- **a commissioning plan**
- **proposed "Operating Policies and Principles" (for approval by AECB and appended to Licence)**
- **evidence of conformance with other applicable legislation and regulation, federal or provincial**
- **evidence of insurance as required by the *Nuclear Liability Act***
- **an operating organization ***

  *** Key members of the operating staff, such as shift supervisors and control room operators, must be individually certified by the AECB through an examination process.**

Typically, there will be separate approvals for fuel loading and for initial start-up.

Operating Licences for nuclear power plants have typically been issued for a two-year period.

Applications for AECB licences (Site, Construction, Operation) must be accompanied by the licence fee as stipulated in the *Cost Recovery Regulations* made pursuant to a government policy.

8(a). NPP Licensing Requirements in Canada

There are relatively few formal (documented) requirements for the design, construction, or operation of nuclear power plants in Canada. The broad approach has been that the applicant proposes a design and the AECB assesses its adequacy, following the philosophy that the owner (operator) had primary responsibility for safety..

In the 1960s and early 1970s safety goals were developed and criteria established for the safety aspects of the design. These had evolved from reviews of the accident to the NRX research reactor in 1952 and developments around the world. The safety goals were probabilistic in nature (long before this became popular). Initially a target of a major release of 10^{-5} per year was proposed which was advanced to 10^{-6} per year.

A fundamental requirement was (and is) that there are special safety systems completely independent of operating systems. Further, safety systems must be testable during operation to demonstrate an unavailability of 10^{-3}.

Limits were established for the calculated dose to a member of the most critical group for two broad scenarios:

- **a major failure of any part of the operating systems; and**
- **a combination of a major failure of an operating system and failure of any one safety system.**

This is often referred to as the "single failure / dual failure criteria" (and originally called the "siting guide").

8(b). NPP Licensing Requirements in Canada (cont.)

It was assumed, and required, that the frequency of major operating system failure (such that a safety system would be required) would be less than 1 in 3 years. Therefore the likelihood of a "dual failure" should be less than 3×10^{-4} ($1/3 \times 10^{-3}$) per year .

For such a "dual failure" the maximum calculated dose to a member of the public must not exceed 250 mSv (25 Rem). Following that approach a major release of fission products could only occur with a "triple" failure - a major failure of an operating system and the failure of two, independent safety systems. The likelihood of that should be less than 3×10^{-7}($1/3 \times 10^{-3} \times 10^{-3}$) per year,

A.T.W.S. - Anticipated Transient Without Scram $\rightarrow 10^{-7}/y$

The requirements for the :special safety systems" have been spelled out in "Regulatory Documents":

- **R-7** *Requirements for Containment systems for CANDU Nuclear Power Plants* **1991**
- **R-8** *Requirements for Shutdown Systems for CANDU Nuclear Power Plants* **1991**
- **R-9** *Requirements for Emergency Core Cooling Systems for CANDU Nuclear Power Plants* **1991**
- **R-10** *The Use of Two Shutdown Systems in Reactors* **1977**

It may be noted that R-10 was issued 20 years ago. It was the first AECB "regulatory" document and was issued to formalize what is now an unique Canadian reactor safety requirement. With the introduction of two fully capable, separate, independent, and different shutdown systems the need to consider "runaway" accidents is essentially eliminated.

8(c). NPP Licensing Requirements in Canada (cont.)

The three "Regulatory Documents" R-7, 8, 9 were initially issued in 1980, at the time of the building of the four-unit Darlington, the last nuclear power station to be built in Canada, as "Consultative documents". At the same time AECB staff also proposed an extension of the "single / dual failure" criteria which was set out in another "Consultative Document":

- C-6 *Requirements for the Safety Analysis of CANDU Nuclear Power Plants* 1980

This established five categories of accident scenarios to be analyzed. C-6 was applied in the licensing of Darlington on a "trial Basis" along with the requirement to meet the "single / dual failure" criteria. AECB staff are still modifying C-6 which may be issued as a "regulatory document" in the future.

As well as these distinctly Canadian requirements, applicants for an NPP licence must meet requirements that are relatively universal for: Quality Assurance; Pressure Retaining Components; Reliability; Human Factors; etc. (pressure vessel)

The only specific requirement pertaining to the site is a traditional one (not spelled out) for an exclusion area, totally controlled by the licensee of a thousand yards (now translated into 917 metres) radius from the centre of the reactor(s). However (as will be discussed in the lectures on "Siting" potential sites are examined and analyzed for many factors, such as seismicity, hydrology, meteorology, etc.

9 (a) Physical Security, Safeguards, Operator Certification

These are quite divers topics which are grouped only for convenience.

Physical Security:

Even though the emphasis in nuclear facility licensing is on safety, the potential mis-use of nuclear materials and the danger of saboteurs, insurgents, or others using a nuclear facility to threaten the population dictates the need for appropriate physical security measures. The basic standard for such measures has been agreed internationally.

In Canada the requirements are spelled out in: *Physical Security Regulations* issued under the Atomic Energy Control Act. These Regulations set out minimum requirements for barriers, fencing, entry, etc.

Safeguards:

The term "safeguards" refers to the measures to account for nuclear material. It is also often used to refer to the system of international inspection and accounting conducted by the International Atomic Energy Agency.

Agreement to allow IAEA safeguards inspection is a basic component of the Treaty on the Non-Proliferation of Nuclear Weapons (usually abbreviated to NPT). The national regulatory body is expected to cooperate with the IAEA in accounting for nuclear material and in arranging inspections of nuclear facilities in the country.

9 (b) Physical Security, Safeguards, Operator Certification (cont.)

Operator Certification:

It is recognized that the operators of a nuclear facility must be highly qualified. Most countries with a nuclear power programme have some mechanism for ensuring that operators have appropriate education, are well trained, and are suited to their particular function.

In Canada, it has been the practice of the AECB, since the beginning of the nuclear power programme, to require that key operating staff, such as shift supervisors and control room operators, pass examinations set by the AECB. This is over and above the requirement that the licensee (e.g. the utility) provide evidence of suitable training and pertinent experience. The intention is to have an independent evaluation of the candidates qualifications.

Initially the examinations were entirely written. Subsequently, these were augmented with oral or "walk around" examinations. In recent years more use has been made of the Simulators that exist for each station, in which supervisors and operators can be tested in a simulated "real life" situation.

The AECB also checks the qualifications of persons proposed for positions such as Plant Manager, Health Physicist and reviews the operating organization.

10. Convention on Nuclear Safety

In the fall of 1996, the *Convention on Nuclear Safety* came into force.

The move to have an international convention on nuclear safety grew after the Chernobyl accident of 1986. A large drafting group convened rom 1990 to 1993 and the convention was opened for signature in the fall of 1994. To come into force, 22 countries, including 17 having at least one nuclear power plant, had to ratify the Convention. This occurred in the summer of 1996. As of the fall of 1996, the Convention had been signed by 63 countries.

The Convention essentially provides for a inter-nation "peer review". Signatory nations will produce national reports covering regulation, management and operation of their nuclear facilities. These will be reviewed at international meetings to be held at least every three years.

The Convention obligates signatory nations to establish and maintain an effective legislative and regulatory framework.

A preparatory meeting will be held early this year to lay out the structure of the required national reports and the mechanism for the peer reviews.

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TWO SHUT DOWN SYSTEMS

- difficulty of predicting consequences of runaway and of designing containment to cope with it

  (arise with Bruce 'A'

- follows basic concepts of separate special safety systems

- after considerable debate, decide (early 1970's) to accept, then require:

  two shut down systems

  must meet all requirements for "special safety systems", i.e.,

  - separation / independence
  - diversity
  - reliability
  - testability
  - effectiveness

TABLE 2

AECB REGULATORY DOCUMENTS RELATED TO POWER REACTORS

R-7	Requirements for Containment Systems for CANDU Nuclear Power Plants	1991
R-8	Requirements for Shutdown Systems for CANDU Nuclear Power Plants	1991
R-9	Requirements for Emergency Core Cooling Systems for CANDU Nuclear Power Plants	1991
R-10	Use of Two Shutdown Systems in Reactors	1977
R-77	Overpressure Protection Requirements for Primary Heat Transport Systems in CANDU Power Reactors	1987
R-90	Policy on the Decommissioning of Nuclear Facilities	1988

TABLE 3

CANADIAN / CSA STANDARDS

CAN3-N285.0, 1, 2, 3, 4, 6	Requirements for Pressure Retaining Systems and Components in CANDU Nuclear Power Plants
CAN3-N286.0 to N286.5	Quality Assurance Requirements for Nuclear Power Plants
CAN3-N287.1 to N287.7	Requirements for Concrete Containment Structures for CANDU Nuclear Power Plants
CAN3-N288.1	Guidelines for Calculating Derives Release Limits for Radioactive Material in Airborne and Liquid Effluents from Normal Operation of Nuclear Facilities
CAN3-N288.3.2	High Efficiency Air Cleaning Assemblies for Normal Operation of Nuclear Facilities
CAN3-N289.1 to N289.4	Requirements for Seismic Qualifications for CANDU Nuclear Power Plants
CAN3-N290.1	Requirements for the Shutdown Systems of CANDU Nuclear Power Plants
CAN3-N290.4	Requirements for the Reactor Regulating Systems for CANDU Nuclear Power Plants
CAN3-N290.6	Requirements for Monitoring and Display of CANDU Nuclear Power Plant Status in the Event of an Accident
CAN/CSA-N293	Fire Protection for CANDU Nuclear Power Plants

RECENT AECB REQUIREMENTS

Reliability Analysis

- current AECB staff position given in Consultative Document C- 98

- recognized reliability analysis methods must be used

- probability of severe core damage is less than 10^{-5}-per year

Human Factors

- this refers to the consideration and evaluation of the effect of human behaviour on safety through design, operation, maintenance, etc.

- AECB staff position is given in Consultative Document C - 119

OPERATING POLICIES AND PROCEDURES

- this is a document that licensees must submit as one of the requirements for an Operating Licence

- in it the licensee will specify technical operating limits, such as:

  - - maximum total power
  - - maximum channel power

    - - and, organizational or procedural rules such as:

  - - minimum number of staff at all times
  - - operating organization
  - - rules for changing operating procedures
  - - in-service inspection

TYPICAL AECB LICENCE FOR NPP

CONSTRUCTION APPROVAL

- basic licence one page, with attached "schedules" and appendices
- all documents that have been submitted, and accepted, as "licensing documents" are listed
  - for Darlington NGS, 39 documents were listed
- a "schedule" sets out conditions governing the construction of the facility, such as:
  - submission of reports, tests, analyses, etc.
  - requirements for international safeguards and physical security
  - requirement to maintain "exclusion zone"

  - requirement to comply with provincial laws "otherwise applicable"

OPERATING LICENCE

- basic licence, one page, with attachments

- attachments refer to "Operating Policies and Procedures", as approved by the AECB

- specify that certain key members of operating must be approved by AECB

- specifying maximum total power, maximum channel power, maximum fuel bundle power

- maintaining ownership of "exclusion zone"

- reporting requirements

- control over changes

INTERNATIONAL ATOMIC ENERGY AGENCY (IAEA)

Nuclear Safety Series No. 50 "NUSS"

- 5 parts
  - Government Organization
  - Siting
  - Design
  - Operation
  - Quality Assurance

- In each there is a Code and several Guides, numbered such as:
  - 50 - SC - G (rev.)Code on Government Organization
  - 50 - SG - S9 Site survey for Nuclear Power Plants

(highly recommended as reference)

IAEA LICENCE RECOMMENDATIONS (cont)

Construction Licence

Typical conditions:

- must be designed and built in accordance with design basis approved by regulatory body
- must be built in accordance with approved design
- licensee conduct a pre-operational radiological survey of area

Operating Licence

Typical conditions:

- not operate in excess of maximum authorized power
- modifications, or procedure for modifications to be approved by regulatory body

- in-service inspection

INTERNATIONAL ATOMIC ENERGY AGENCY

Recommendations regarding licences:

- should clearly state authority, (Act, Law)
- clearly identify what activity is being authorized
- include conditions, either in licence or attachment(s)
- typical general conditions include:
  - provide access to authorized regulatory representatives
  - licensee must report all incidents, unexpected events
  - licensee must keep complete records