THE ROLE OF AECB IN ACCELERATOR LICENSING

Atomic Energy Control Board
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1. Introduction

The Atomic Energy Control Board licenses particle accelerator facilities in Canada. There are 45 facilities now under licence, 23 in government laboratories, 14 in universities, 7 in hospitals and 1 in industry. There are also 11 others in various stages of planning.

The purpose of this paper is to outline how the AECB became involved and what its present involvement is, including: the licensing process, the standards and criteria applied, and the compliance action taken after a licence has been issued.

In addition, I shall attempt to indicate the direction which accelerator licensing may take in the future.

2. Involvement

In the early 1960's, accelerators were not included as "prescribed equipment" in the Atomic Energy Control Regulations, but a number of new accelerator facilities were funded by AECB. These machines, which were used primarily for nuclear research, were capable of producing intense radiation fields, radioactive and other effluents, radioactive materials and other hazards. Because of this, the owners and operators of a number of these facilities felt that their own internal review of the safety aspects was not sufficient and that a review by an independent body was necessary.

The Board agreed that, since it was supplying financial assistance to these facilities, it had a responsibility to see that the safety aspects were adequately reviewed. Since there was no independent body available to do safety reviews of accelerator facilities at the time, the Board decided in 1962 to establish a committee to advise the Board on the safety aspects of those accelerator facilities which it funded. This committee became the Accelerator Safety Advisory Committee or A.S.A.C.
The Committee is composed of senior scientists and engineers, chosen for their expertise in areas associated with the safety aspects of accelerator facilities. It also includes representatives from other federal and provincial agencies in whose jurisdiction the machine or facility may fall.

The mandate of the Committee was later extended to include facilities funded by NRC and facilities which requested a review.

In this way, the Committee reviewed a considerable number of accelerators operating in Canada. However, by 1970 this administrative procedure no longer seemed sufficient. The Board therefore recommended to the government that particle accelerators should be made "prescribed equipment" under the Atomic Energy Control Act. A regulation to this effect made particle accelerators subject to AECB licensing in 1970. Later, particle accelerators were incorporated as "nuclear facilities" when the Regulations were revised in 1974.

"Particle Accelerator" as defined in the Regulations means equipment that is capable of imparting high kinetic energy to charged particles through interaction with electric or magnetic fields and is primarily designed to produce or use in its operation atomic energy and prescribed substances.

Accelerators closely filling this definition are generally used for research purposes. However, the Board also licenses some accelerators used for medical and industrial purposes because these machines generate some radioactive prescribed substances.

Those accelerators which do not produce significant quantities of radioactive substances may be exempted from licensing under the Atomic Energy Control Regulations. The production of radioactive substances depends strongly on the energy of the accelerated beam, the materials used in the construction and the use of the accelerator. Because of the number of parameters involved, we have generally made exemptions for specific facilities or for specific accelerator models used for a particular purpose. Exempted machines are still subject to approval by other agencies, such as Health and Welfare Canada and provincial authorities.
In the case of electron accelerators used for medical treatment purposes, we have generally exempted low-energy machines of about 6 MeV or less and licensed high-energy machines of about 10 MeV or greater.

Where sufficient information is available concerning the accelerator, a decision on whether or not to exempt it from licensing is relatively straightforward. However, where detailed information is lacking, or for cases such as medical treatment accelerators in the medium energy range, we generally consult with the other agencies involved to resolve which agency will license the facility. Of course, the responsibility is on the owner to be aware of the legal requirement for a licence.

3. The Licensing Process

The licensing process involves two stages: construction approval and the licence to operate. Applications for construction approval or the operating licence must be accompanied by supporting documentation including a safety report as outlined in guideline AG-2 of AECB document 1066.

The Safety Reports and related documentation are reviewed by the staff of the Licensing Directorate and the Accelerator Safety Advisory Committee. In addition, a review may also be done by the staff of the Health Protection Branch of Health and Welfare Canada particularly if the accelerator is to be used for medical purposes.

The AECB staff study the application, the safety reports and any supplementary detailed information which may be relevant. Much of the AECB staff effort is to advise and assist the Committee in arriving at recommendations. The AECB staff may also prepare its own recommendations to the Board.

The Committee also reviews the safety reports and any relevant information presented by staff. Because Committee members are not engaged full time in their committee work, they would generally not be expected to review much of the supplementary information which may be reviewed by the staff. For this reason, it is important that the safety report alone be sufficient to show that the facility can be operated safely.
Prior to making recommendations on an operating licence, the Committee usually meets with the applicant and visits the site.

The time required for these reviews will depend considerably on the complexity and novelty of the facility and the completeness of the submissions. Normally at least three months should be allowed for relatively simple cases such as medical treatment accelerators.

4. Standards and Criteria

The safety standards for the design, construction and operation of an accelerator are designed to ensure that there is no undue risk to the operators, the users and members of the public arising from normal operation or due to malfunction.

The risk due to radiation depends upon, amongst other factors, the dose received, and limits have been specified in the Atomic Energy Control Regulations for the doses which any individual Atomic Radiation Worker or member of the public may receive. These limits follow the recommendations of the ICRP for maximum permissible doses.

In addition to specifying maximum permissible doses, the ICRP also recommends that doses be maintained as low as practicable or as low as readily achievable, economic and social considerations being taken into account. In assessing whether this objective is being met at accelerator facilities, we have been asking applicants to supply their most realistic estimates of the doses which are received or which are expected to be received under normal operating conditions by persons who normally occupy the areas surrounding the accelerator facility.

Based on the information received to date, there tend to be considerably less than the maximum permissible doses set out in the Regulations. For example, it is usually apparent that doses to non-atomic radiation workers do not exceed 1% of the maximum permissible. This level has been used by AECB staff as a design and operating target level.
This target should not be confused with doses normally used in calculations aimed at designing the shielding. Methods for doing such calculations for the case of a medical accelerator facility are given in publications such as NCRP-49 and RPB-SC-10. These design calculations normally contain a number of conservative assumptions and this conservative approach is useful as an aid to designing an accelerator facility. I believe that the majority of the accelerator facilities which we have approved and licensed to date have been designed using the conservative approach:

We request that, after the design has been essentially completed, estimates of the doses which would be received under realistic conditions be included in the safety report.

When an application for an accelerator licence is made, the staff and the ASAC examine among other factors the estimates of the doses which are expected to be received under normal conditions. If any of these factors appear to be out-of-line compared to facilities previously examined, we question the applicant regarding the reasons for this. We judge the acceptability of the applicants' response in respect to the overall safety of the particular facility under review.

These individual judgements and recommendations when taken together, form our standards. There are many interrelated factors which enter into these standards. The following are some of these factors.

1. **The Accelerator Itself**

The Board seeks assurances that:

- the basic characteristics of the machines are known for both normal and accident conditions or that conservative estimates are used;

- all appropriate codes and standards are complied with;

- the appropriate safety features such as interlocks, warning lights, signs, etc., are incorporated.
In the case of a commercially manufactured machine, the manufacturer should normally provide this information. If a number of similar machines are expected to be sold in Canada, we would consider the machine for type approval. In this way we need only look at the machine in detail once. However, each site and details of the installation in which the machine is placed have to be reviewed.

2. The Accelerator Facility

A. Radiation Hazards:

In the course of the licensing process the following considerations are taken into account:

- the annual doses which would be received by persons in or near the facility and the corresponding instantaneous dose rates;

- the production of radioactivity in components, air, etc., and the proposals for handling and disposal;

- the extent and nature of radiation monitoring (e.g. surveys, area monitoring, personnel);

- the safety systems associated with the facility (e.g. interlocks, warning lights and signs).

B. Non-Radiation Hazards:

These hazards are evaluated in the overall review of the facility since radiation and non-radiation hazards may be interrelated.

Generally, the Board seeks confirmation that these hazards have been examined by competent authorities (e.g. fire marshall, building inspectors).

C. Safety Practices:

The following considerations are of importance:
- the qualification and training of the personnel;

- the internal safety review mechanisms used by the applicant, such as internal safety committee;

- the written operating procedures and the written emergency procedures.

D. Contingencies:

The postulated accident conditions which could arise are examined with a view to determining how long these conditions may go undetected, how they would be detected, and the probable consequences.

All of these factors, as well as other more detailed questions, are considered in the review of an accelerator facility and, through the recommendations made for each case, form part of the AECB standards.

5. Compliance

After an accelerator licence has been issued, we maintain further contact with the accelerator facility through the following means:

5.1 The Licence Renewal Report: This report must be submitted as requested in the licence. The frequency depends upon the complexity of the facility and how much the facility or its operation may change with time; however, the normal period is about two years.

5.2 Significant Change Reports: We require a report for any modification to the facility and the procedures which could require a re-assessment of the information presented in the safety report.

5.3 Unusual Occurrence Report: We require a report on any unusual occurrences in which personnel or the public are, or might have been, exposed to radiological or other hazards, and their follow-up.
5.4 Visits and Inspections: Board staff and the ASAC make periodic visits and inspections. The frequency depends upon the complexity of the facility and its location.

6. Future Orientations

Our primary effort in the past few years has been centred on the review of individual accelerator facilities. This initial review is nearing completion and therefore more of our effort is being directed to the following items:

6.1 Exemptions: We are attempting to define more clearly, in co-operation with other federal and provincial agencies, which accelerators fall within the Atomic Energy Control Regulations and which could best be dealt with under other regulations. A large part of our effort has been directed to medical therapy accelerators; however, other cases are also under consideration.

Our aim is to co-ordinate, as far as legislation permits, the licensing and safety review process so that a licensee can deal with one regulatory agency and to establish a mechanism for producing and applying uniform standards.

6.2 Revised Guidelines: We are up-dating our guidelines for the information which must be submitted at the various stages of licensing. In addition, we hope to produce licensing guides for classes of accelerators. These guides would inform applicants of approaches and methods which we have found to be acceptable. Other approaches and methods may also be used, however, provided that these are shown to be acceptable.

6.3 Compliance: We are implementing a more systematic system of visits and inspections. We hope to be able to inspect each facility at a frequency appropriate to its safety-related characteristics, but not less than once every two years.

6.4 Type Approval: Much of our effort has been directed to reviewing individual cases because of the diversity of accelerators and their use.
We see, however, that for some cases such as medical accelerators, where the accelerator and its use may be essentially the same for a number of facilities, type approval may save some effort for all involved.

7. Conclusion

In brief, the review of accelerator facilities, which started 15 years ago with the formation of the ASAC, has evolved into today's formal licensing system. The basic licensing reviews are generally done on a case-by-case basis. For each case the staff and the Committee review many interrelated factors affecting safety, discuss these with the applicant and visit the site.