EVALUATION OF THE RADIOLOGICAL IMPACT DUE TO THE OPERATION OF NUCLEAR POWER STATIONS IN ARGENTINA

Oliveira, A.A.; Curti, A.R.; Nollmann, C.E.

Comision Nacional de Energia Atomica (CNEA), Argentina
Gerencia de Proteccion Radiologica y Seguridad Nuclear

INTRODUCTION

There are at present in Argentina two commercial nuclear power stations in operation, Atucha I and Embalse, generating about 10% of the total electrical energy output. Atucha I NPP, equipped with a pressure vessel reactor, has an output capacity of 345 MW(e), while Embalse NPP is equipped with a Candu-type reactor and its output capacity is 670 MW(e). Both plants operate with natural uranium as a fuel, and heavy water as a coolant and as a moderator.

Atucha I is located at the right side of the Parana de las Palmas river, 100 km from Buenos Aires city, and Embalse is situated at the homonomous town in the province of Cordoba, 620 km from Buenos Aires, next to the Embalse del rio Tercero lake.

GASEOUS AND LIQUID EFFLUENTS

During the operation of both nuclear installations, radioactive fission and activation products are produced. These radioactive materials are for the most part retained within the fuel elements. Most of the radionuclides which diffuse into or are formed within the coolant are removed by the gaseous and liquid waste processing systems. Low-level releases which occur during normal operation are controlled and monitored. Radionuclides may reach the environment through either the gaseous or liquid effluents streams.

GENERAL PROCEDURE FOR DOSE ASSESSMENT

In this report, the terms individual dose and collective dose are used to mean individual and collective effective dose equivalent commitment respectively.

The general principles followed in assessing individual and collective doses for both nuclear plants are similar to those used by UNSCEAR (1). The type of models used are those called concentration factor or equilibrium models, where steady state among nuclide concentrations in different environmental compartments was assumed. In this approach, simple multiplicative coefficients were used to obtain the concentration of radionuclides at the point of intake by man (2). Dosimetric factors were taken from published reports (3,4).

Local data, either site specific or regional, was used when possible, such as transfer factors, ingestion rates and other habit data. Default values presented in specialized

reports were used in case of lack of site specific data (2).

As the actual dose equivalents received by members of the public vary widely depending on such factors as age, sex, dietary and other habits, as well as on variations in their environment, appropiate critical groups were identified. These groups are representative of those individuals in the population expected to receive the highest dose equivalents from the installations under consideration. The individual doses in the critical groups estimated in this report, represent the mean effective dose equivalents , assuming the most unfavourable conditions. These values are used to compare with the corresponding individual dose equivalent limits fixed by the Regulatory Authority.

The collective dose commitment represents a measure of total exposure of the population over time from a given release and it is usually considered as an indicator of the total detriment to health from the consequent irradiation. Modelling procedures were similar to those used for estimates of individual doses, and the concentrations of radionuclides in environmental compartments extending over large regions were estimated (5). Global assesments include only H-3 and C-14, because of the small contribution to these evaluations due to Kr-85 and I-129 releases from these plants (1).

Releases activity and composition were informed by the nuclear power plants operators, accordingly to the licensing requirements established by the Regulatory Authority.

RESULTS

Individual and collective doses were calculated for both nuclear installations, by using the previously described methodology. The corresponding values are presented in tables 1 and 2. The main contributors to individual doses in critical groups and regional collective doses are H-3, Kr-88, Xe-133 and Xe-135 for gaseous releases, while H-3, Co-60 and Cs-137 are the most relevant nuclides in assessing doses due to liquid discharges.

Global collective doses for H-3 and C-14 were calculated by using measured and estimated releases (6,7). These collective dose commitments, per unit electrical energy generated, are 1 man Sv/GW(e).a and 7E-02 man Sv/GW(e).a,for H-3 releases from Atucha I NPP and Embalse NPP respectively. The corresponding values for C-14 gaseous discharges were estimated to be 46 man Sv/GW(e).a and 37 man Sv/GW(e).a

CONCLUSIONS

The regulatory authority in Argentina has fixed the pair of values 0.3 mSv/a and 15 man Sv/GW(e)a as upper bounds for limiting the annual exposure of individual members of critical groups and for the collective dose commitment per unit electrical energy generated during the operation of nuclear power plants(8).

The above collective dose commitment is the incomplete quantity, integrated over the period of the practice, assumed to be several centuries (500 years). The results presented in this report are well below the limiting values for individual doses. The normalized global collective doses estimated for C-14 are lower than expected values,(1), but higher than the present upper-bound, which was not standing during Atucha I NPP and Embalse NPP designing period. Besides, much more data, particularly from continous monitoring, are needed before a reliable assessment of the C-14 release rate and its environmental impact can be made.

On the other hand, as an application of the optimization requirement to C-14 releases, a retention system will be installed at the third Argentine nuclear power plant, Atucha II, at present under construction (9).

REFERENCES

1) UNITED NATIONS SCIENTIFIC COMMITTEE ON THE EFFECTS OF ATOMIC RADIATION, 1982 Report to the General Assembly, Ionizing Radiation : Sources and Biological Effects, United Nations, New York, 1982

2) INTERNATIONAL ATOMIC ENERGY AGENCY, Generic Models and Parameters for Assessing the Environmental Transfer of Radionuclides from Routine Releases. Exposures of Critical Groups. IAEA SAFETY SERIES 57, Vienna, 1982.

3) INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION. Statement from the 1983 Washington Meeting of ICRP, Ann. ICRP 14, 1, Pergamon Press, Oxford, 1984.

4) Greenhalgh, J.R.; Fell, T.P. and Adams, N., Doses from Intakes of Radionuclides by Adults and Young People, NRPB-R162, 1985

5) Escribano, T.L., Informes Internos, C.N.E.A, Seccion Radiactividad Ambiental, 1981/1982. (not published)

6) Oliveira, A.A.; Gomez, J.C.; Nollmann, C.E., Carbon-14 Sampling and Measurement in Gaseous Releases from the Atucha Nuclear Power Plant, presented at IRPA 6th International Congress, Berlin (West), May 7-12, 1984

7) ATOMIC ENERGY OF CANADA LIMITED, Embalse Nuclear Power Plant Final Safety Report, chapters XII and XIII, 1984

8) COMISION NACIONAL DE ENERGIA ATOMICA, Consejo Asesor para el Licenciamiento de Instalaciones Nucleares, Limitacion de Efluentes Radiactivos, Norma de Seguridad CALIN 3.1.2., 1979

9) Beninson, D.J.; Gonzalez, A.J., Application of the Dose Limitation System to the Control of Carbon-14 from Heavy Water Moderated Reactors, IAEA-SM-258/53, 1981

TABLE 1
INDIVIDUAL DOSES IN CRITICAL GROUPS (Sv/a)

YEAR	ATUCHA I NPP ATMOSPHERIC RELEASES	ATUCHA I NPP LIQUID RELEASES	ATUCHA I NPP TOTAL RELEASES	EMBALSE NPP ATMOSPHERIC RELEASES	EMBALSE NPP LIQUID RELEASES	EMBALSE NPP TOTAL RELEASES
1974	6.0E-07	5.8E-07	1.2E-06			
1975	2.2E-07	1.6E-06	1.8E-06			
1976	2.1E-06	2.5E-06	4.6E-06			
1977	1.4E-06	1.5E-06	2.9E-06			
1978	3.4E-06	1.1E-06	4.5E-06			
1979	3.1E-06	1.6E-06	4.7E-06			
1980	2.8E-06	1.2E-06	4.0E-06			
1981	1.3E-06	1.3E-06	2.6E-06			
1982	1.4E-06	8.7E-07	2.3E-06			
1983	3.1E-06	6.4E-07	3.7E-06			
1984	9.0E-07	9.6E-07	1.9E-06	1.6E-08	1.6E-07	1.8E-07
1985	1.2E-06	8.9E-07	2.1E-06	4.8E-07	1.3E-06	1.7E-06
1986	1.5E-06	7.0E-07	2.2E-06	2.4E-07	5.6E-06	5.8E-06

TABLE 2
COLLECTIVE DOSES (REGIONAL) (man.Sv)

YEAR	ATUCHA I NPP ATMOSPHERIC RELEASES	ATUCHA I NPP LIQUID RELEASES	ATUCHA I NPP TOTAL RELEASES	EMBALSE NPP ATMOSPHERIC RELEASES	EMBALSE NPP LIQUID RELEASES	EMBALSE NPP TOTAL RELEASES
1974	1.7E-02	1.8E-02	3.5E-02			
1975	2.5E-04	7.3E-02	7.3E-02			
1976	6.8E-02	1.4E-01	2.1E-01			
1977	4.7E-02	2.4E-01	2.9E-01			
1978	1.0E-01	2.4E-01	3.4E-01			
1979	9.2E-02	2.8E-01	3.7E-01			
1980	9.2E-02	3.0E-01	3.9E-01			
1981	4.0E-02	4.1E-01	4.5E-01			
1982	4.8E-02	3.0E-01	3.5E-01			
1983	1.0E-01	2.4E-01	3.4E-01			
1984	3.0E-02	4.0E-01	4.3E-01	1.2E-04	5.6E-03	5.7E-03
1985	3.7E-02	3.7E-01	4.1E-01	4.7E-03	1.5E-02	2.0E-02
1986	4.2E-02	2.6E-01	3.0E-01	1.1E-02	8.9E-02	1.0E-01