CRITICALITY ACCIDENT IN ARGENTINA

BY ALEXANDRE RODRIGUES DE OLIVEIRA
RADIATION MEDICINE SECTION
NUCLEBRÃS

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Until quite recently, criticality accidents were considered to be part of the childhood and adolescence of nuclear age. This idea was justified by the fact that such accidents had not happened since 1965. In September 1983, the major Brazilian newspapers published the news that a serious accident had occurred at a nuclear facility of the CNEA (Argentina's Nuclear Energy Commission), causing the death of one operator of that facility.

In view of our interest in obtaining more details on that event, we contacted the Serviço de Radiofísica Sanitária (Health Physics Bureau) of the Argentine Health Ministry, which sent us a preliminar report on a criticality-type accident which occurred on September 23, 1983 at a critical assembly of an old nuclear facility belonging to the CNEA, namely the Centro Atomico Constituyente (CAC). A summary description of the principal aspects covered in that report is given below.

a) Nature of the facility

The RA-2, a 0.1 Watt critical assembly, consists basically of: MTR type fuel elements with 19 uranium plates, 90% enriched, control rods made up of fuel elements, 4 uranium plates of which were replaced by 2 cadmium ones, demineralized water as moderator, and graphite reflector.

b) Type of operation carried out on September 23/ genesis of the accident

On the day of the accident, a change in the core configuration was planned for a test of the pulsed-source type. In accordance with

the standard operating procedure, the operator should drain the moderator totally before proceeding to the change of configuration, which was done only partially. Some time after that change, a critical excursion developed which released approximately 10MJ, an amount of energy corresponding to 3×10^{17} fissions occurred in a few tens of milliseconds. The operator, the only individual present in the room, received and extremely high dose of γ radiation and neutronic emissions, and died 48 hours after the critical event.

c) Causes of the Accident

The committee designated by the CNEA to investigate the causes of the accident reached the following conclusions:

1) The operator did not empty the moderator completely prior to changi.. the configuration;

2) The fuel elements that should have been withdrawn remained inside the reactor, in contact with the graphite reflector;

3) Successive changes in the position of fuel rods diminished system subcriticality;

4) The operator inserted the fuel rods with 15 uranium plates, without the corresponding cadmium plates, and

5) The operation was carried out without an operation helper and without the presence of a technician from the radiation protection section.

d) Medical Aspects

On the basis of the results of dosimetric studies (especially those relating to the activation analysis of Na-24 and P-32) which provided doses of the order of 2,000 rads of γ and 1,700 rads of neutrons, one can establish an extremely reserved prognosis in

relation to the operator's survival possibility, regardless of any therapeutic measures that might have been taken. Twenty-five minutes after the accident, the patient complained of nausea, diarrhea, and headache, characteristic symptoms of the prodromal phase of the acute radiation syndrome. In the following 24 hours, a severe gastrointestinal status developed, which reinforced the pessimistic outlook of the injured person's clinical evolution. In the early hours of day 25, that is, two days after the accident, troubles of a respiratory (radiation pneumonitis) and cerebral nature appeared, and the injured operator eventually died at 16:15 that same day. The other persons who were working in contiguous rooms received relatively low doses of γ and neutron radiation, and showed a favorable evolution from the clinical point of view.

Comments:

After an analysis of the data contained in CNEA's preliminary report, one can conclude that the basic causes of the accident was human failure, regardless of the operator's being a professional with 14 years experience in the nuclear area. After the accident, he admitted he was in a hurry to go home (the accident happened on a Friday afternoon) for which reason he did not wait for the complete moderator drainage from within the tank, nor did he withdraw two fuel elements, the latter failure being the possible cause of the critical excursion.

On the basis of previous accidents in which high radiation doses were involved, we can speculate that the determinant cause of the operator's death was severe vascular shock which caused pulmonary and cerebral edema.

According to our Systematic Register of Nuclear Accidents, that is the fourteenth criticality accident ever reported since 1945, being

the first one after the Mol accident in 1965, involving a Venus reactor of the Centre d'Études Nucléaires (Belgium).

References

1) REAC/TS Newsletter - Fall 1983

2) CNEA Report - 1983

3) The Medical Basis for Radiation Accident Preparedness - 1980.

Summary

A recent criticality type accident, occurred in Argentina, is commented on in this paper. Considerations about the nature of the facility where this accident took place, its genesis, type of operation carried out on the day of the event, and the medical aspects involved are discussed.