

# **SOUTH AFRICAN PROPOSED REGULATIONS ON SAFETY STANDARDS AND REGULATORY PRACTICE FOR NUCLEAR REGULATION**

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## **1 ABSTRACT**

The National Nuclear Regulator Act promulgated during 2000 provided for a more consultative and transparent process to develop regulations on safety standards and regulatory practice related to the regulation of naturally occurring radioactive materials and nuclear installations. The board of the National Nuclear Regulator (NNR) recently approved the first draft of such regulations for submission to the Minister of Minerals and Energy.

In this paper, a brief discussion of the work and functions of the NNR will be provided. Additionally, the regulation developing process that is followed, as well as the way in which the regulations will fit into the hierarchy of regulatory documentation, will be described. An overview of the proposed regulations will be provided and the differences and similarities with current standards and regulatory practices will be highlighted.

## **2 INTRODUCTION**

In terms of the National Nuclear Regulator Act, Act No. 47 of 1999 (1), (Act) promulgated during 2000, the National Nuclear Regulator (NNR) is responsible for the regulation of installations, vessels and actions. An action means:

- (a) the use, possession, production, storage, enrichment, processing, conveying or disposal of, or causing to be conveyed, radioactive material;
- (b) any action, the performance of which may result in persons accumulating a radiation dose resulting from exposure to ionizing radiation; or
- (c) any other action involving radioactive material.

This includes facilities involving naturally occurring radioactive materials as well as facilities in the nuclear fuel cycle from mining and milling, facilities carrying out enrichment activities, nuclear power and research reactors and finally radioactive waste handling, storage and disposal facilities.

The NNR is not responsible for the regulation of radiation emitted from sealed sources or from equipment emitting ionizing radiation, thereby excluding medical and industrial applications. These are the responsibility of the Department of Health.

In this paper, a brief discussion of the work and functions of the NNR will be provided. Additionally, the regulatory developing process that is followed, as well as the way in which the regulations will fit into the hierarchy of regulatory documentation, will be described. An overview of the proposed regulations will be provided and the differences and similarities with current standards and regulatory practices will be highlighted.

### 3 WORK AND FUNCTIONS OF THE NNR IN TERMS OF NATURALLY OCCURRING RADIOACTIVE MATERIALS

Although the NNR had already been regulating power reactors, it only started regulating mining operations and other actions involving naturally occurring radioactive materials since the early 1990's.

Currently the NNR is responsible for the regulation of about 90 facilities ranging from various mining and associated processing plants (gold, rare earth extraction, mineral sands, phosphate rock, fluorspar and copper), to fertilizer plants, zircon millers, scrap processing and melting, refurbishment companies, companies recovering gold from redundant equipment and material and woodchips to companies and laboratories using small quantities of radioactive material.

The regulatory regime is applicable to the assessment and control of worker exposure, public and environmental exposure and the radioactive waste produced. It also includes all aspects of compliance assurance such as routine and occurrence reporting and the conduct of inspections and audits at the facilities of authorized actions.

Additionally, various studies have been and are being conducted to assess safety associated with the following types of actions – users of zircon, titanium dioxide, phosphogypsum and phosphate slag, coal mining and the uses of the ash produced, water treatment facilities, building materials and the aviation industry using thorium compounds in aircrafts. The need for the regulation of these actions is currently being considered by the NNR, and will be based on the safety assessments.

### 4 PROCESS TO DEVELOP REGULATIONS REGARDING STANDARDS AND REGULATORY PRACTICE

Under the Nuclear Energy Act, Act No. 131 of 1993 (2) safety standards and regulatory practices applied by the then Council for Nuclear Safety (CNS) were approved by its council. Although the council consisted of 7 non-executive members and the executive officer who were appointed by the Minister of Minerals and Energy (Minister), there was no provision for stakeholder consultation in the process of developing such standards or regulatory practice. The lack of such

consultation during the development process, contributed to the substantial criticism that the standards and regulatory practices of the Council for Nuclear Safety were subjected to from both industry and other stakeholders.

The Act that was promulgated in 2000 provided for a more consultative and transparent process to develop regulations on safety standards and regulatory practice.

Section 36 of the Act states:

- (a) The Minister must, on the recommendation of the board, make regulations regarding safety standards and regulatory practices.*
- (b) Before any regulations are made, the Minister must, by notice in the Gazette, invite the public to comment on the proposed regulations and consider that comment.*

The board of the NNR recently, and after many interactions with various stakeholders, recommended the first draft of these regulations to the Minister of Minerals and Energy.

Over and above the opportunity to public comment and contrary to the situation in terms of the previous legislation, the Act now also provides for the appointment of representatives of organised business, organised labour, affected communities, the Department of Minerals and Energy and the Department of Environmental Affairs and Tourism to the board of the National Nuclear Regulator. This broadens the input from the board prior to submission to the Minister.

## 5 HIERARCHY OF DOCUMENTATION

In the past the legislation under which the CNS operated enabled it to establish the conditions of authorization that it deemed necessary to protect persons and their property against radiation hazards. Safety standards and regulatory practices were encapsulated in such conditions.

Although the Act still enables the NNR in a similar manner, the above-mentioned requirements for regulations, in effect, lifted the safety standards and regulatory practice to the level of regulations. The conditions of authorization will therefore have to take account of the content of the regulations.

The change in the hierarchy of regulatory documents is shown in table 1.

Table 1: Hierarchy of documents

<b>NUCLEAR ENERGY ACT, 1993</b>	<b>NATIONAL NUCLEAR REGULATOR ACT, 1999</b>
Legislation	Legislation
	Regulations
Authorizations	Authorizations
Requirements documents	Requirements documents
Guide documents	Guide documents

## 6 OVERVIEW OF PROPOSED SAFETY STANDARDS AND REGULATORY PRACTICES

The proposed standards cover the whole spectrum of installations and actions that the NNR is responsible to regulate. Therefore some of the issues regarding standards that are raised in this paper, would not be applicable to the regulation of naturally occurring radioactive materials. It has however been presented below for the sake of completeness.

### 6.1 Fundamental Safety requirements

The fundamental safety requirements that apply to the design of, and operations associated with, nuclear installations, nuclear vessels and actions, are covered under the following topics:

- (a) Good Engineering Practice
- (b) Accident Prevention And Mitigation
- (c) Defence-In-Depth
- (d) Optimisation Of Protection And Safety
- (e) Fundamental Safety Criteria – The proposed operation must be demonstrated to meet the fundamental safety criteria as set out in Table 2 and the requirements for accident management and emergency planning.
- (f) Safety Culture

The above topics reflect the premise that safety is judged on a combination of quantitative and qualitative factors.

#### 6.1.1 Fundamental Safety Criteria

The fundamental safety criteria refer to limitations on the annual individual peak risk and average risk to members of the public and workers due to normal operational exposure and exposure as a result of accidents and are established based upon the following principles;

- (a) The risk presented by regulated activities must not increase significantly the total risks to which the population is exposed.
- (b) The risks from nuclear damage must compare favourably with those associated with other major industrial enterprises.
- (c) Allowance must be made for demands by society for higher standards of safety over the period for which the regulated activity is authorised.

Table 2: Fundamental safety criteria

	<b>NORMAL OPERATION</b>	<b>ACCIDENTS</b>
<b>ASSESSMENT TYPE</b>	<b>DETERMINISTIC</b>	<b>PROBABILISTIC</b>
<b>PUBLIC</b>		
<b>Average Annual Population Risk</b>	Risk to be controlled by the application of the ALARA principle	$10^{-8}$ fatalities per year per site (one fatality per one hundred million per year per site)
<b>Maximum Annual Individual Risk</b>	0.25 mSv annual effective dose limit to the average member of the critical group unless otherwise agreed by the Regulator on a case-by-case basis taking account of the 1 mSv annual limit for exposure of members of the public from all sources	$5 \times 10^{-6}$ fatalities per year (one fatality per two hundred thousand per year)
<b>WORKERS</b>		
<b>Average Annual Risk to Workers</b>	Risk to be controlled by the application of the ALARA principle	$10^{-5}$ fatalities per year per site (one fatality per one hundred thousand per year per site)
<b>Maximum Annual Individual Risk to Workers</b>	20 mSv per annum averaged over five years and 50 mSv per annum maximum in a single year	$5 \times 10^{-5}$ fatalities per year per site (one fatality per twenty thousand per year per site)

## 6.2 Exclusion, Exemption and Clearance

The Act provides for **Exclusion**:

- (a) *exposure to cosmic radiation or to potassium-40 in the body or any other radioactive material or actions not amenable to regulatory control as determined by the Minister; and*
- (b) *any action where the radioactivity concentration of individual radioactive nuclides, or the total radioactivity content, are below the exclusion levels provided for in the safety standards.*

The proposed regulations state as follows regarding the concept of Exclusion:

### 6.2.1 *Exclusion Of Actions*

6.2.1.1 Any action which could give rise to an exposure of 2.3 mSv per annum<sup>1</sup> or less from a terrestrial source of natural radioactivity is not amenable to regulatory control.

6.2.1.2 Where any action, which could give rise to an exposure in excess of 2.3 mSv per annum from a terrestrial source of natural radioactivity, and the Regulator is of the opinion that such action is not amenable to regulatory control, the Board must;

- a) recommend to the Minister to publish a notice determining the action as not amenable to regulatory control; and
- b) recommend to the Minister such appropriate steps which can be taken by the relevant level of Government or any person or body.

### 6.2.2 *In terms of the provisions of the Act;*

6.2.2.1 the level of radioactivity concentration of each radioactive nuclide in materials, below which the provisions of the Act do not apply is 0.2 Bq per gram, with the exception of potassium-40 for which the level is 5 Bq per gram;

6.2.2.2 the level of total radioactivity content below which the provisions of the Act do not apply is  $10^3$  Bq.

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<sup>1</sup> *The value of 2.3 mSv per annum is just above the value of 2.2 mSv per annum which is the estimated upper bound of the general natural background exposure in South Africa.*

The Act provides for **exemption** by means of the issuance of a Certificate of Exemption on the basis that the Chief Executive Officer of the NNR is satisfied that the action in question complies with the exemption criteria as specified in the safety standards.

The proposed regulations on safety standards state as follows regarding the concept of Exemption:

6.2.3 *The criteria, for the issue of a certificate of exemption, as contemplated in the Act, must be based upon the following principles-*

6.2.3.1 the radiation risks to individuals caused by the action involving radioactive material must be sufficiently low;

6.2.3.2 the collective radiological impact due to the action involving radioactive material must be sufficiently low; and

6.2.3.3 the action involving radioactive material must be inherently safe with no appreciable likelihood of scenarios that could result in the requirements set out in 2.1.1 and 2.1.2 being exceeded.

6.2.4 *Exemption Without Further Consideration*

Actions involving radioactive material may be exempted without further consideration where the following criteria are fulfilled in all feasible situations-

6.2.4.1 the effective dose to be incurred by any member of the public due to the exempted activity is 10  $\mu$ Sv per annum or less; and

the collective effective dose committed by performing the action for one year is no more than 1 person-Sv; or an assessment for the optimisation of protection shows that exemption is the optimum option.

Or-

6.2.4.2 either the radioactivity concentration, or the total radioactivity content of each radionuclide in the radioactive material, are below the levels specified in the Schedule that is attached to the proposed standards and the quantity possessed or processed in a period of one year is less than one tonne.

### 6.2.5 *Exemption With Further Consideration*

Actions which involve radioactive material requiring further consideration as a result of either the specific activity or the total activity of discrete radionuclides or exposure scenarios must be subject to case-by-case evaluation by the Regulator.

### 6.2.6 *The proposed regulations state as follows regarding the concept of Clearance:*

Radioactive materials, which fall within a nuclear authorisation, may be cleared from further compliance with the requirements of the authorisation provided that such material meets the principles for exemption, as detailed in 2 above, and that approval has been given by the Regulator on a case-by-case consideration.

The figures attached as Appendixes 1 and 2 depict the above proposals on exclusion and exemption.

## **6.3 Requirements on actions before and during operation**

The requirements contained in the regulations cover a number of areas:

- Regulatory Approval Of Radiation Protection And Nuclear Safety Measures
- Application to Radon Exposure - a specific set of requirements must be derived from this section applicable to situations where the occupational dose due to radon is less than 6 mSv per annum in all feasible situations
- Safety Assessment
- Controls And Limitations On Operation
- Maintenance And Inspection Programme
- Staffing And Qualification
- Radiation Protection
  - Justification Of Exposure
  - Optimisation Of Protection
  - Radiation Dose Limitation
- Radioactive Waste Management
- Environmental Monitoring And Surveillance
- Accident Management And Emergency Planning And Preparedness
- Transport Of Radioactive Material – In which regard the NNR is the National Competent Authority in terms of applying the IAEA Transport Regulations
- Physical Security
- Quality Management
- Records And Reports (including operational issues and occurrences)
- Schedules

The specific requirements applicable to various types of facilities will depend on the safety assessment.

#### **6.4 Decommissioning**

The codification of requirements on decommissioning improved considerably and includes requirements on:

- The Establishment of a Decommissioning Plan
- Availability Of Resources
- Requirements for Decommissioning Operations
- Release Of Radioactively Contaminated Land
- Provisions For Institutional Control
- Obligations Under Other Statutes

#### **6.5 Accidents, incidents and emergencies**

The provisions of this section are applicable to emergency exposure situations requiring protective action to reduce or avert temporary exposures. The requirements relate to:

- Definition of a Nuclear Accident and Incident
- Information to be supplied
- Emergency or remedial measures
- Information to stakeholders

### **7 CONCLUSION**

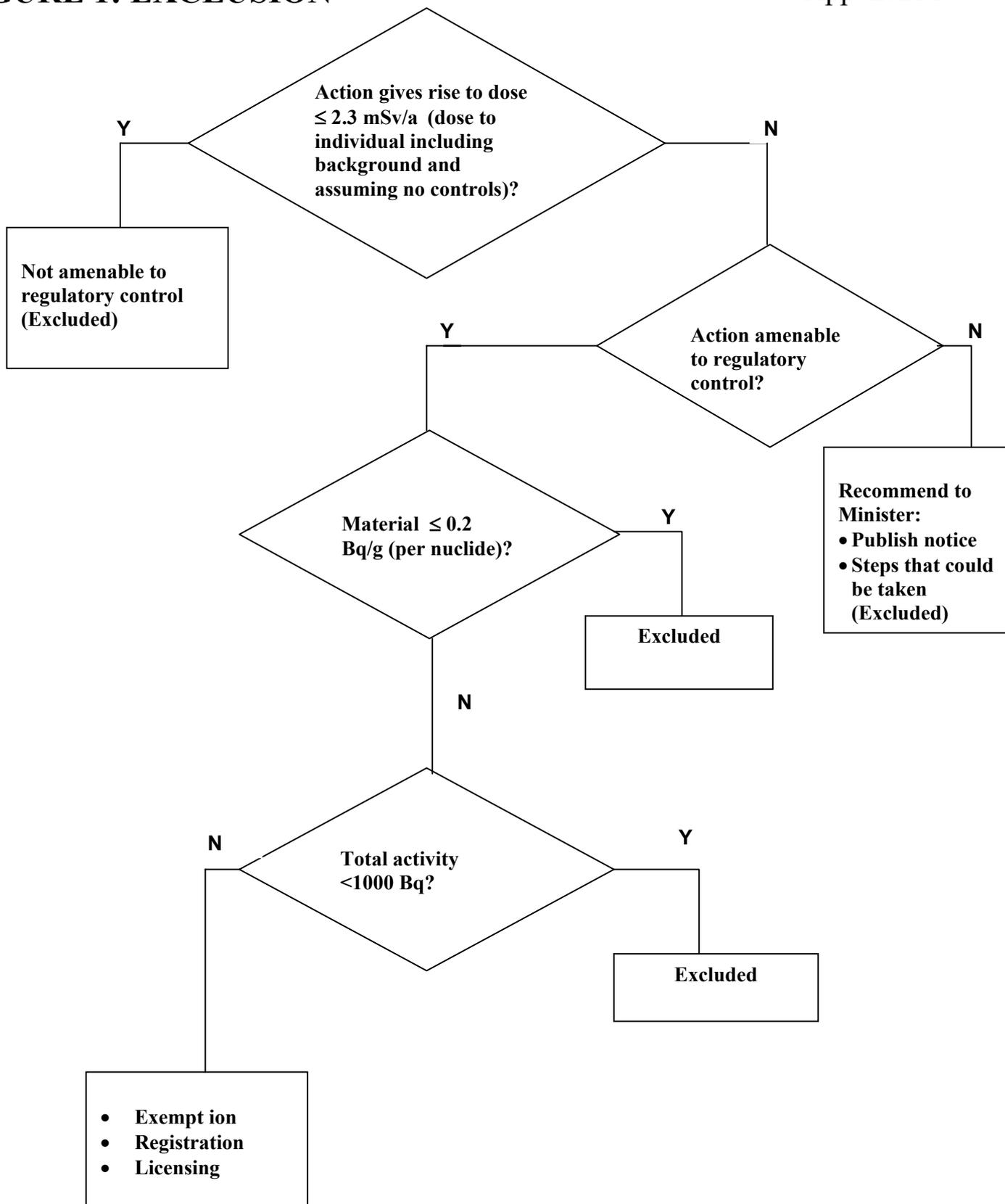
From the above it can be concluded that the Act and proposed safety standards and regulatory practices provide a powerful tool to regulate naturally occurring radioactive materials in South Africa. This is evident in the fact that:

- (a) It requires a transparent and consultative process of standards development.
- (b) It constitutes clear requirements regarding the concept of exclusion.
- (c) It ensures flexibility on aspects such as public dose limitation.
- (d) It puts a strong emphasis on safety culture.
- (e) It provides a comprehensive codification of requirements for decommissioning.

### **8 REFERENCES**

1. The National Nuclear Regulator Act, Act No. 47 of 1999
2. The Nuclear Energy Act, Act No. 131 of 1993

**FIGURE 1: EXCLUSION**



**FIGURE 2: EXEMPTION**

