

THE NNR REQUIREMENTS TO ADDRESS MODIFICATION, MODERNIZATION, REFURBISHMENT AND AGEING MANAGEMENT

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1. ABSTRACT

The National Nuclear Regulator (NNR) is a national competent authority in South African which has been mandated under Act 47 of 1999 to provide for the protection of property people and environment [1]. The NNR achieves its mandated by issuing Nuclear Authorisations in case of Nuclear Installations and Certificate of registration for the mining industry. Currently SAFARI-1 Research Reactor at Pelindaba site is the only Research Reactor that is licensed by NNR through a Process based licensing. SAFARI-1 is a 20 MW research reactor and has been in operation since 1965 and is approaching its full lifetime. Regular, periodic and systematic examination, inspection, maintenance and testing of all plant, systems, structures and components have been developed and implemented. Modification and refurbishment has been implemented over years since its construction. Ageing of structural components and obsolescence is now becoming a challenge; as a result, Ageing Management Programme has been developed to address these issues.

In accordance with the NNR requirements any modification that the licensee plan to implement, must comply with NNR approved processes and procedures relating to control of such modification to the design of existing plant, facility or system design, including modifications that may be of a temporary nature.

2. INTRODUCTION

The National Nuclear Regulator (NNR) as a competent regulatory authority regulates the nuclear industry of South Africa. In terms of the National Nuclear Regulatory Act no. 47 of 1999 the NNR has been established as an independent Regulatory Authority to carry out the objectives as stipulated in section 5 of the NNR Act. The objectives of the NNR, as defined by the Act No. 47 of 1999, are to:

- a) provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices;
- b) exercise regulatory control related to safety over-
 - i. the siting, design, construction, operation, manufacture of component parts, and decontamination, decommissioning and closure of nuclear installations; and
 - ii. vessels propelled by nuclear power or having radioactive material on board which is capable of causing nuclear damage, through the granting of nuclear authorisations
- c) exercise regulatory control over actions, to which this Act applies, through the granting of nuclear authorizations;
 - i. provide assurance of compliance with the conditions of nuclear authorizations through the implementation of a system of compliance inspections;
- d) fulfill national obligations in respect of international legal instruments concerning nuclear safety; and
- e) Ensure that provisions for nuclear emergency planning are in place.

- f) Act as the national competent authority in connection with the International Atomic Energy Agency's Regulations for the Safe Transport of Radioactive Material.

2.1 Regulation of Nuclear Activities

In accordance with the provisions of the NNR Act, the NNR is mandated to exercise regulatory control over nuclear installations, nuclear vessels and other actions capable of causing nuclear damage. The purpose of the regulatory process is to ensure the protection of persons, property and the environment from nuclear damage. The regulatory process entails authorisation, safety case review and assessment, and the undertaking of compliance assurance and enforcement activities as appropriate.

a) Nuclear Authorisation Process

Prior to the granting of an authorisation the applicant is required to apply to the NNR, in the prescribed format, detailing the intended activities and providing a demonstration of the safety and compliance to the NNR requirements. The documentation submitted must address safety in the design of any facilities concerned and safety in the way the facility will be constructed, commissioned, operated, maintained and decommissioned.

The authorisation conditions represent a framework within which the applicant or holder of the nuclear authorisation is obliged to adhere to particular requirements in respect of design, operation, maintenance and decommissioning. The conditions of authorisation also oblige the holder of the authorisation to provide a demonstration of compliance through the submission of routine and non-routine reports.

Standard conditions included in a nuclear authorisation address:

- The description and configuration of the authorised facility or action;
- Requirements in respect of modification to facilities;
- Operational requirements in the form of operating technical specifications, procedures or programmes as appropriate;
- Maintenance testing and inspection requirements;
- Operational radiation protection programmes;
- Radioactive waste management programmes;
- Emergency planning and preparedness requirements as appropriate;
- Physical security;
- Transport of radioactive material;
- Safety Committee
- Quality assurance; and
- Reporting.

The NNR Act makes provision for the granting of four categories of nuclear authorisation. These are:

- Nuclear installation Licences;
- Nuclear Vessel Licences;
- Certificates of Registration; and
- Certificates of Exemption.

These enable the NNR to issue authorisations that are commensurate with the hazards posed by the relevant facility or action.

b) Safety Case Review and Assessment

A safety case is a collection of safety arguments and evidence in support of the safety of a facility or action. The safety case provided must identify and characterise all sources of radiation associated with the facility and all possible exposure pathways that may arise from such sources, under normal operating conditions and under accident situations. The NNR undertakes an evaluation of the submitted documentation to ensure that the action or facility will meet the standards and requirements. From the evaluation, conditions are identified for inclusion in the nuclear authorisation.

c) Compliance Assurance

The NNR conducts compliance assurance activities to determine the extent to which holders of nuclear authorisations comply with the conditions of authorisation. The nature of the NNR's compliance assurance activities are commensurate with the nature of authorisation issued and the risk posed by the facility or action. The compliance assurance activities involve a combination of audits, routine inspections, non-routine inspections, review of routine reports and review of occurrence reports.

d) Enforcement

Where non-compliance with the conditions of authorisation is identified, the NNR may initiate enforcement actions. Enforcement actions are designed to respond to non-compliances with specified conditions and requirements. The enforcement actions are commensurate with the seriousness of the non-compliance and may take the form of written warnings, penalties, curtailment of operations, suspension of the authorisation, or ultimately withdrawal of the authorisation. In all cases, the holder of the authorisation is required to:

- remedy the non-compliance,
- to perform a thorough investigation in accordance with an agreed timescale and
- to take all necessary measures to prevent recurrence.

In certain instances, the NNR performs its own investigation.

2.2 Safety Standard and Regulatory Practice

The approach adopted by the NNR was to set high level standards (dose, risk criteria and conformance to international norms) and to allow the authorisation holder the freedom to adopt a design basis and operating practices which are appropriate for the plant and then justify the choice in terms of NNR standards [2]. Once accepted by the NNR, the intent of the authorisation would effectively be to hold the authorisation holder to its provisions and commitments. The regulator would then monitor the implementation of these processes through surveillances, inspections, audits, etc.

2.3 Regulated Facilities

The NNR regulates various Nuclear Installations (including NPP, RR, low and intermediate level radioactive waste disposal, fuel cycle facilities, various facilities under decommissioning and some radioisotope manufacture), Mining and Mineral processing facilities associated with Naturally Occurring Radioactive Materials (NORM), including small users and scrap metal recyclers. The following are typical facilities under the NNR regulatory control.

- Koeberg Nuclear Power Station in Cape Town,
- The various facilities at the Nuclear Energy Corporation Of South Africa including SAFARI-1 research reactor at Pelindaba, 25 km West of Pretoria,
- Vaalputs national radioactive waste disposal facility, in the Northern Cape.
- The mining and mineral processing facilities associated with NORM such as gold, uranium, heavy minerals, including laboratories and scrap metal recyclers handling NORM.

3. SAFARI-1

SAFARI-1 is a 20 MW light water-cooled, beryllium reflected, pool-type research reactor, and owned and operated by South African Nuclear Energy Corporation (NECSA) at their facility in Pelindaba, South Africa. SAFARI-1 has been in operation since 1965. Regular, periodic and systematic examination, inspection, maintenance and testing of all plant, systems, structures and components have been developed and implemented. Modification and refurbishment has been implemented over years since its construction. Considering the age of the reactor, an Ageing Management Program has been developed. The programme includes a number of projects that require NNR approval. This projects ranging from;

- Reactor vessel lifetime assessment
- Replacement of gamma safety channels
- Replace Reactor Primary Pumps, motors and Switchgear
- Conversion to LEU fuel
- Safety Re-assessment following the Fukushima accident:
 - ✓ Re-flood Nozzle for Core
 - ✓ Emergency Water Return
 - ✓ Second Shutdown System
 - ✓ Seismic Trip Assess

4. NNR REQUIREMENTS

For any modification that the licensee plan to implement, must meet the following NNR licensing requirements;

- The proposed modification must comply with NNR approved processes and procedures relating to control of such modification to the design of existing plant, facility or system design, including modifications that may be of a temporary nature.
- The aforesaid processes must provide for the classification of modifications according to their safety significance.
- Where appropriate, modifications must be divided into stages and where the NNR has so specified the licensee must not commence nor thereafter proceed from one stage to the next of the modification, prior to the NNR approval.

- The processes must include a requirement for the provision of adequate documentation to justify the safety of the proposed modification and shall, where appropriate, provide for the submission of such documentation to the NNR.
- The licensee must establish and implement processes for the periodic and systematic review and reassessment of safety cases.
- The licensee must if so directed by the NNR, carry out a review and reassessment of safety and submit a report of said review and reassessment to the NNR at such intervals, within such period and for such matters or operations as may be specified in the directive [3].

5. SUBMISSIONS OF APPLICATIONS FOR AUTHORIZATION TO THE NNR

For any modification to the existing plant, a licence holder is required to develop a safety case and justification. Prior to finalization and submission of a safety case to the NNR, holder must undertake safety evaluation to assess the safety significant of such modification [4]. The modification project must also be categorized to determine which level of complexity of the modification.

Safety Significant

The safety significant considers three levels as shown below;

Level 1 – Direct influence on the safety performance of the nuclear installation

The licensee as well as suppliers assigned responsibility for products of high importance to nuclear safety must additional to the Quality Management System implements a Safety management system as part of an integrated Management System.

Level 2 - Product important to the nuclear safety

A QMS is required for organizations providing products important to nuclear which are compliant with ISO 9000: 2000 Series including ISO 9001:2000 or any equivalent international accepted QM standards.

Level 3 – All product of an appropriate QMS is mandatory as a basis for all organization involved in the product related to an application for or operation of a nuclear installation.

Safety Categorization

For any modification, the facility will register a project and the determine safety category as follows:

- a) Category 1: Project with little impact on Safety Health, Environment and Quality and design can be approved by facility management.
- b) Category 2: Project with design requiring no change in OLC will require NNR approval.
- c) Category 3: Projects with design requiring changes to OLC will require NNR approval.

Safety Categorization	Safety Approval Matrix			NNR Requirement level
	Category 1	Category 2	Category 3	
Nuclear safety Critical System	Safety Committee	NNR	NNR	1
Nuclear Safety Important Systems	Safety Committee	Safety Committee	NNR	1
Nuclear Safety Support System	Safety Committee	Safety Committee	NNR	2
Other Support System	Facility Management	Facility Management	Safety Committee	3
General Items	Facility Management	Facility Management	Facility Management	3

Table 1: Safety Categorization

Category 2 and 3 Modification projects

Category 2 and 3 projects are modification that will require a change in the nuclear installation licence or/and could affect the risk of nuclear damage, then requires NNR approval. Then the licence holder is required to submit such proposed modification to the NNR under NNR Authorization Request (NAR) or Authorization Change Request (ACR). If it considered that the modification will not have a significant impact on the existing safety assessment, the submission should consist of a brief description of the modification to support this position. Therefore, the NNR will decide whether or not a further, more detailed submission is required. However, if it is clear that modification will have significant impact on the safety assessment the licence holder will submit the licensing strategy and quality project plan to the NNR.

5.1 Licensing strategy

The licensing covers the comprehensive lists of all requirements which are applicable to the project and shall include amongst others [5]:

- a) Project description, purpose and justification
- b) Pre-Study
- c) Performance and fitness for purpose of the system, subsystem or component.
- d) A detailed assessment on the effect of the modification on the existing safety assessment of the plant.
- e) Safety case documentation including SAR and methodologies
- f) All relevant documentation to enable detailed technical assessment.
- g) Anticipated project stages
- h) Supplier qualification
- i) Submissions schedule which will include the following
 - i. Project quality plan
 - ii. Reviewed SAR that incorporate the safety of the modification in the existing plant
 - iii. Design basis
 - iv. Basic and detailed design
 - v. Construction plans
 - vi. Cold and hot Commission plans

The NNR will set hold point to allow verification and inspection to be conducted prior the licence holder to continue to the next stage of the project.

5.2 Quality plan

The quality plan will details the submissions, proposed dates, suppliers' qualification, and NNR hold point. The NNR will assess, and observe where necessary, the implementation of the applicants' supplier qualification process. The NNR reserves the right to perform its own audits on suppliers if it deems it necessary [6]. The following conditions will apply when the NNR observes audits by the applicant or its suppliers:

- The NNR is not a member of the audit team but an independent observer.
- The NNR can introduce questions for consideration during audits in advance of the audits to avoid an active role during the audit.
- The NNR will maintain independent audit records and an independent audit report.

6. APPROVAL PROCESS OF MODIFICATION

Upon receiving the submission the programme Manager will conduct initial review and assess if the authorization is required or not. Then a formal technical assessment and review is conducted by the in-house specialists. Depending on the recommendation made by a team of specialist, then the submission will be either accepted or rejected with comments. The comments will be sent to the license holder.

7. CONCLUSION

Any modification to the existing plant, a licence holder is required to develop a safety case and justification. The NNR will conduct safety review and assessment of such modification. Depending on the outcome of the review and assessment the NNR will grant approval or reject it.

8. REFERENCES

1. NNRA, National Nuclear Regulatory Act of 1999.
2. Safety Standard and Regulatory Practices
3. NIL-02, Nuclear Installation Licence Conditions
4. RD0034, Quality and Safety Management Requirements for Nuclear Installation, NNR, 2008
5. LD1049, Requirements in respect of modification to licensed nuclear installations of the AEC.
6. PP-001, Position Paper, NNR information Manual