National Nuclear Regulator

MDEP HTGR Workshop

FUEL SAFETY REQUIREMENTS: HTGR

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National Nuclear Regulator

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Introduction

- Vision : To be recognised as a caring and trusted nuclear and radiation safety Regulator.
- Mission: To provide and maintain an effective national regulatory framework through innovation in the protection of persons, property and the environment against radiation damage.
- The National Nuclear Regulator (NNR) is a public entity which is established and governed in terms of Section 3 of the National Nuclear Regulator Act, (Act No. 47 of 1999).
- The fundamental objective of the NNR is to provide for the protection of persons, property and the environment against nuclear damage through the establishment of safety standards and regulatory practices suited for South Africa.
- The NNR provides oversight and assurance that activities related to peaceful use of nuclear energy in South Africa are carried out in a safe manner and in accordance with international principles and best practices.

Description of Triso Fuel

The $U0_2$ is discretely dispersed in the form of a large number of CPs which are embedded in a spherical graphite matrix. This spherical graphite matrix is surrounded by a graphite matrix shell.

The embedded CPs (TRISO-particles) have a spherical UO_2 kernel consisting of low enriched uranium dioxide and coatings, consisting of a porous buffer layer, and two dense layers of pyrocarbon, with a silicon carbide layer in between the pyrocarbon layers.

The coated particles are overcoated with a graphite matrix before pressing.

General Requirements

The risk of fuel damage and subsequent radioactive releases will be minimised (ALARA) and at worst will not exceed limits stipulated and specified by the NNR for the safeguarding of workers, the public and the environment

The licensee who is responsible for the safety of the PBMR facility, must issue and submit documents defining the Quality and Safety Management System (QSMS) for manufacturing and testing of the PBMR fuel for acceptance by the NNR. They must introduce these documents into the fuel design, manufacturing and qualification.

Since the quality of the fuel manufacturing process is of importance for all safety aspects during the life cycle of the fuel, the NNR will attend at specific hold and witness points to be identified in the Manufacturing and Test Plans.

Fuel Safety process requirements

The QSMS must ensure that the fuel is designed using good engineering/scientific principles and appropriate standards. Design work, including amendments, must include applicable requirements and design bases. Design interfaces must be identified and controlled.

If past experience and records are used for licensing purposes, such information must be assessed and verified by a comprehensive QM process, including V&V.

The QSMS must identify the FDC which are derived from the safety case. Acceptance criteria must be derived from the FDC to demonstrate compliance with the test programme.

Appropriate standards, wherever applicable, must be used to develop, introduce, carry out and maintain the test programme. These standards must be identified by the licensee.

Fuel Safety specific requirements

Mechanical, geometrical, and chemical tests must be performed prior to with the irradiation tests, to demonstrate that the un-irradiated fuel /CPs comply with the specifications.

It is a principal objective of Safety Case that the fuel will adequately retain its integrity to contain fission products under operating and accident conditions. The integrity shall be ensured by the design and manufacture of the fuel and through the design provisions to fulfil the Fundamental Safety Functions (FSF).

The Fuel Spheres must provide sufficient mechanical integrity and dimensional stability with regard to the operational limits for fast neutron dose, burn-up and temperature, including handling process and storage loads.

General Conditions

General Conditions:

The performance of the fuel under normal and accidental conditions is the key to the safety of the SMR. There are two related issues:

1) Demonstration that the proposed fuel design is capable of achieving the high levels of safety performance specified.
2) Demonstration that the fuel can be manufactured consistent to the specified quality.

Specific Conditions

Specific Conditions

At the beginning of nuclear commissioning a number of preconditions have to be fulfilled for fuel qualification. The licensee has to specify these preconditions in detail. The numbers of tests which shall provide confidence must be specified at this stage, too. A statistical assessment has to be carried out to confirm that this approach is valid.

1) It is vital that completion of fuel tests will precede the corresponding burn-up in the reactor by a period of time. The period of time should be justified.

1) Eskom has to define how the results of fuel qualification relate to potential temperature transients on fuel in operating and accident cases.

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Thank you
for your attention.

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