

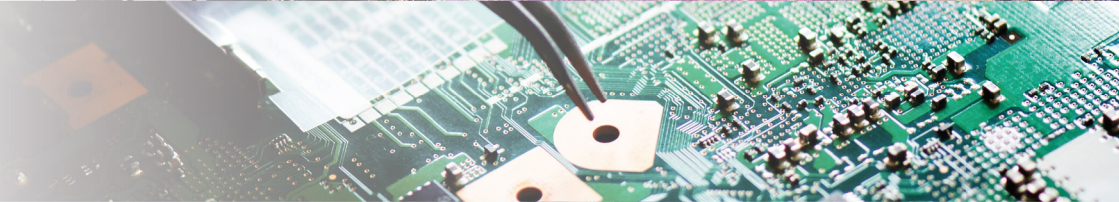
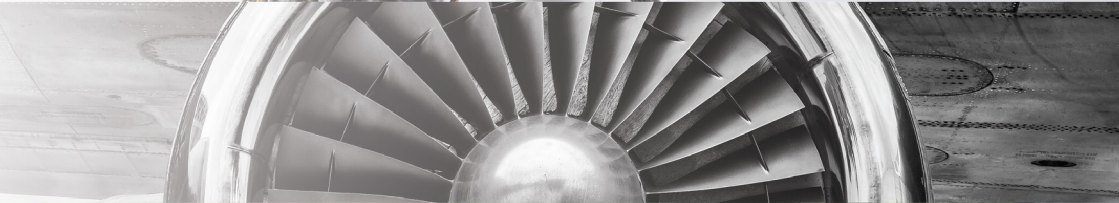


NWU FACULTY OF ENGINEERING

# IMPACT INITIATIVES

NUCLEAR ENGINEERING: *Powering Protection*





N W U F A C U L T Y O F E N G I N E E R I N G





# CHANGING THE WORLD FOR THE BETTER

The vision of the North-West University is to discover new frontiers and opportunities that benefit society, advancing our relevance and impact.

At the NWU Faculty of Engineering, we live this vision through our commitment to creating meaningful change. An Impact Initiative is a strategic program that cuts across research groups and academic programmes and draws upon many stakeholder relationships to address pressing societal needs, foster innovation, and create measurable, long-lasting benefits. These initiatives embody our dedication to driving progress, advancing industries, and uplifting communities through sustainable and transformative solutions.

Our mission is clear: to benefit society by excelling in knowledge creation, innovation, and collaboration. We see engineering as a driving force for transformation, where multidisciplinary teamwork and forward-thinking solutions ensure progress that balances technological advancement with environmental and societal well-being. Through our Impact Initiatives, we are shaping a future of impactful innovation and meaningful change.

# B A C K G R O U N D

*Where it all started*



*Where it all started*

The start of the NWU's Nuclear Engineering Impact Initiative dates back over three decades, to a period when South Africa was shaping its energy future and regulation framework.

As the sole university in the country offering postgraduate qualifications in Nuclear Engineering, the NWU has gradually developed into a hub of excellence that supports national capacity, industrial innovation and international collaboration.

**PROF VISHANA NAICKER**







Today, this initiative is home to multiple research poles, ranging from nuclear safety systems and reactor design to radiological protection and energy policy. While the academic programme continues to train future nuclear scientists and engineers, the research arms are actively contributing to major national and international projects, including support for institutions such as the International Atomic Energy Agency (IAEA), Koeberg Nuclear Power Station and NECSA, which produces medical isotopes.

The university's nuclear engineering legacy was shaped through its involvement in various major South African projects, and the establishment of a dedicated nuclear engineering chair, which funded numerous research initiatives and supported the development of students.

**What unites all these streams is a single, vital mission: ensuring that nuclear energy – one of humanity's most powerful tools – is harnessed safely, responsibly and for the benefit of society.**

# INNOVATION & TECHNOLOGY

**The NWU's Nuclear Engineering team is deeply involved in the development of nuclear science and technology in South Africa, with a strong focus on innovation that protects lives and ecosystems.**

***Several cutting-edge research thrusts are currently underway:***

## REACTOR PHYSICS AND NUCLEAR SAFETY ANALYSIS

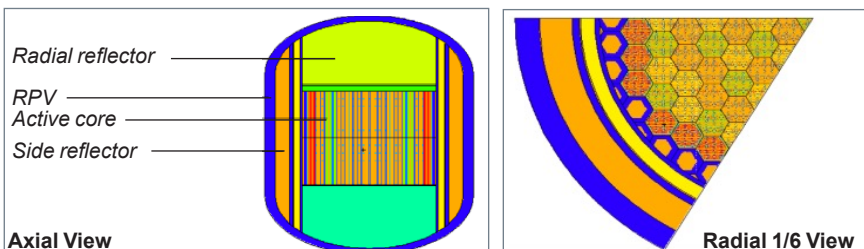
Modelling and simulation tools are being developed and applied to assess the safety, behaviour and control of nuclear reactors – ensuring reactors can shut down safely, even under extreme conditions. Tools in use include neutronics codes, thermo-hydraulics simulation tools, and fuel performance modelling.

## FUEL CYCLE AND WASTE MANAGEMENT

This pole emphasises sustainable approaches to the entire nuclear fuel cycle, including options for long-term waste storage and reprocessing – essential for the responsible use of nuclear energy.

## THERMAL-HYDRAULICS AND SYSTEMS ENGINEERING

Researchers are modelling how heat and fluids behave in nuclear systems to help optimise reactor cooling, prevent overheating, and enhance emergency response systems.



*Reactor Core modelling using NWURCS*





### EDUCATION AND SKILLS DEVELOPMENT

The NWU is also shaping future leaders in the field through its internationally recognised Postgraduate Diplomas, Master's and PhD programmes, combining theory with practical experience to produce graduates who are equipped to make meaningful contributions to the field.

### MULTIPHYSICS

Multiphysics modelling enables the accurate simulation of complex nuclear systems by integrating thermal, structural, fluid and neutron behaviour into a single predictive framework.

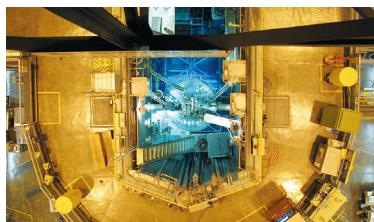
The NWU's research is especially distinguished in the field of uncertainty propagation. The team previously participated in a Coordinated Research Project (CRP) of the International Atomic Energy Agency (IAEA) and is currently involved in a new CRP on improving fuel performance models. Prof Marina du Toit is the chief scientific investigator for the South African application of this project.

A particular research focus is on accident-tolerant fuels, which aim to minimise the risk of fuel failure in extreme conditions. This field directly addresses lessons from historic events such as Fukushima and Chernobyl.

**Together, these focus areas equip the NWU to advance the frontiers of nuclear knowledge while developing practical, scalable solutions to some of the field's biggest challenges.**



Marina and Gezekile at the HPC, with the system administrator



Safari Reactor Core

# IMPACT & OUTCOMES

*When Safety Powers Society*

**What difference does all this make? In a word: confidence.**

**Confidence that the next generation of nuclear experts will be ready to lead with integrity. Confidence that nuclear technology, if properly governed, can be a tool for clean energy, medical breakthroughs and national resilience.**

***Here's how that impact plays out on the ground:***

## PERSONAL IMPACT

Graduates of the NWU's nuclear engineering programmes are employed across the globe – from Eskom and NECSA to international agencies, research reactor facilities and reactor manufacturers, such as X-energy, USNC, NRG and SCK Cen, Belgium, to name a few.

Many have cited their NWU training as a career-defining advantage, especially the hands-on problem-solving experience they have gained. The programme continues to attract postgraduate students from around the world who seek both academic excellence and industry relevance.



*Koeberg Nuclear Power Station*

## INSTITUTIONAL IMPACT

The NWU is a key research partner for several national regulatory and energy agencies. The university has contributed to training workshops for the National Nuclear Regulator (NNR) and the Department of Mineral Resources and Energy (DMRE). Additional collaborations include engagements with NECSA, Lesedi, Sanedi and STL Nuclear.





### **SOCIAL AND ENVIRONMENTAL IMPACT**

The NWU's research directly feeds into improved reactor safety, better waste management, and informed regulatory practices – helping to prevent accidents, safeguard communities and protect natural ecosystems from radiation exposure.

### **ECONOMIC IMPACT**

By supporting the safe and reliable operation of nuclear infrastructure, the NWU is helping to stabilise energy supplies in South Africa – a vital enabler of economic growth. The programme also promotes job creation by developing high-level nuclear capacity locally, reducing reliance on expensive international consultants.

**From designing safer systems to equipping future leaders, this initiative reflects the NWU's firm belief that impact starts with integrity – and ends in trust.**



*IAEA Headquarter at Vienna*



INNOVATION & TECHNOLOGY







## *Expanding Our Impact* PREPARING FOR A COMPLEX FUTURE

**The global nuclear landscape is changing, and the NWU is preparing South Africa to meet that future head-on.**

Over the next few years, the team will focus on expanding their applied research collaborations with partners such as Eskom, NECSA and international universities.

A significant current project is the five-year IAEA Coordinated Research Project on fuel performance codes, which seeks to improve predictions around failure fractions and fission products from TRISO particle fuel. NWU's contribution, under the leadership of Prof Marina du Toit, positions the institution as a continental leader in this field.

There are also plans to grow the NWU's short course offerings in nuclear safety and policy, targeting professionals already working in the field but in need of deeper technical insights.

As South Africa reopens the debate on new nuclear builds and small modular reactors, the NWU aims to be at the centre of the conversation, offering academic expertise and acting as a national think tank for safe, sustainable nuclear development.

The next frontier will require both innovation and diplomacy, and the NWU is committed to delivering both.



# ADVANCING GLOBAL GOALS (UN SDGs)

***The NWU's Nuclear Engineering Impact Initiative directly supports several of the United Nations Sustainable Development Goals:***

## **Goal 7: Affordable and Clean Energy**

By improving the safety, efficiency and sustainability of nuclear power, the NWU helps make clean baseload energy a viable option in the transition from fossil fuels.

## **Goal 9: Industry, Innovation and Infrastructure**

The initiative advances national infrastructure resilience through innovation in reactor safety, systems engineering and waste management.





### **Goal 13: Climate Action**

Clean nuclear power is essential to reducing carbon emissions. The NWU's work ensures this option remains viable and responsible.

### **Goal 4: Quality Education**

By training a new generation of engineers, scientists and policy specialists, the NWU empowers lifelong learning and skills development in a critical, scarce-skills field.

### **Goal 12: Responsible Consumption and Production**

Focus on the nuclear fuel cycle, waste minimisation and improved disposal strategies supports sustainable resource use.

***In every sphere – research, education, regulation, and innovation – the NWU is enhancing capacity to ensure that nuclear energy meets not only today's needs but also tomorrow's ambitions.***

# C O N C L U S I O N

*Leading with Caution,  
Building with Courage*

**Nuclear energy is complex. It requires precision, discipline and, above all, trust.**

**At the NWU, we believe in an approach to nuclear engineering that is smart, responsible and transparent. From safety analysis and shielding design to postgraduate training and policy engagement, every component of this initiative is driven by the belief that science should serve people, not just power.**

**We are proud to lead South Africa's charge toward safer, more sustainable nuclear engineering. And we are committed to doing so with the same values that have always defined us: *rigour, responsibility and relevance.***

## MEET *the Team*



Prof Vishana  
Naicker



Prof Marina  
du Toit



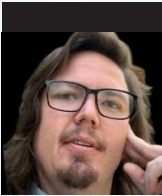
Prof Bismark  
Tyobeka



Prof Dawid  
Serfontein



Prof Charl  
du Toit



Dr Ockert  
Koekemoer



Mr Johann  
van Rooyen



Mr Frederik  
Reistma



Prof Frik van  
Niekerk



Prof Pavel  
Bokov



Prof Rian  
Prinsloo

**The Nuclear Engineering Impact Initiative is driven by a multidisciplinary team of experts, each contributing unique knowledge and leadership across research, education and industry engagement. Together, this team represents a national centre of excellence in applied nuclear engineering that is grounded in safety and inspired by possibility.**



REACH OUT TO  
FIND OUT MORE

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