

ATOMEXPO 2015

South African status of the nuclear industry

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Introduction: Necsa's Main Functions (Mandate)

- To undertake and promote research and development in the field of nuclear energy and radiation sciences and technology and... to make these generally available.
- To process source material, special nuclear material and restricted material and to reprocess and enrich source material and nuclear material.
- To co-operate with any person or institution in matters falling within these functions.

Also: Execute institutional responsibilities on behalf of government, e.g. operation and utilisation of SAFARI-1, decommissioning and waste management, international obligations.

Status and importance of nuclear energy in South Africa



SAFARI-1 50th Anniversary

The SAFARI-1 Research Reactor celebrated **50 years** of safe operation on 18 March 2015

Over the past 50 years, SAFARI-1 has been operating with impressive efficiency, providing the world scientific solutions and enhancing millions of lives through its nuclear medicine production capability



SAFARI-1 Characteristics and Utilisation

1. 20 MW_{th} pool-type research reactor.
2. Operational since 18 March 1965.
3. Impeccable safety and environmental record.
4. Certified according to ISO 9001:2008, ISO 14001:2004 and OHSA 18001:2007.
5. Internationally recognised for high utilisation (> 300 operational days per year).
6. Fully converted to LEU silicide fuel.

Utilisation:

Irradiations for isotope production, neutron activation analysis, neutron beam-line research.

Koeberg power station

Koeberg nuclear power station is the only nuclear power station in Africa and it provides about 6% of South Africa's electricity.

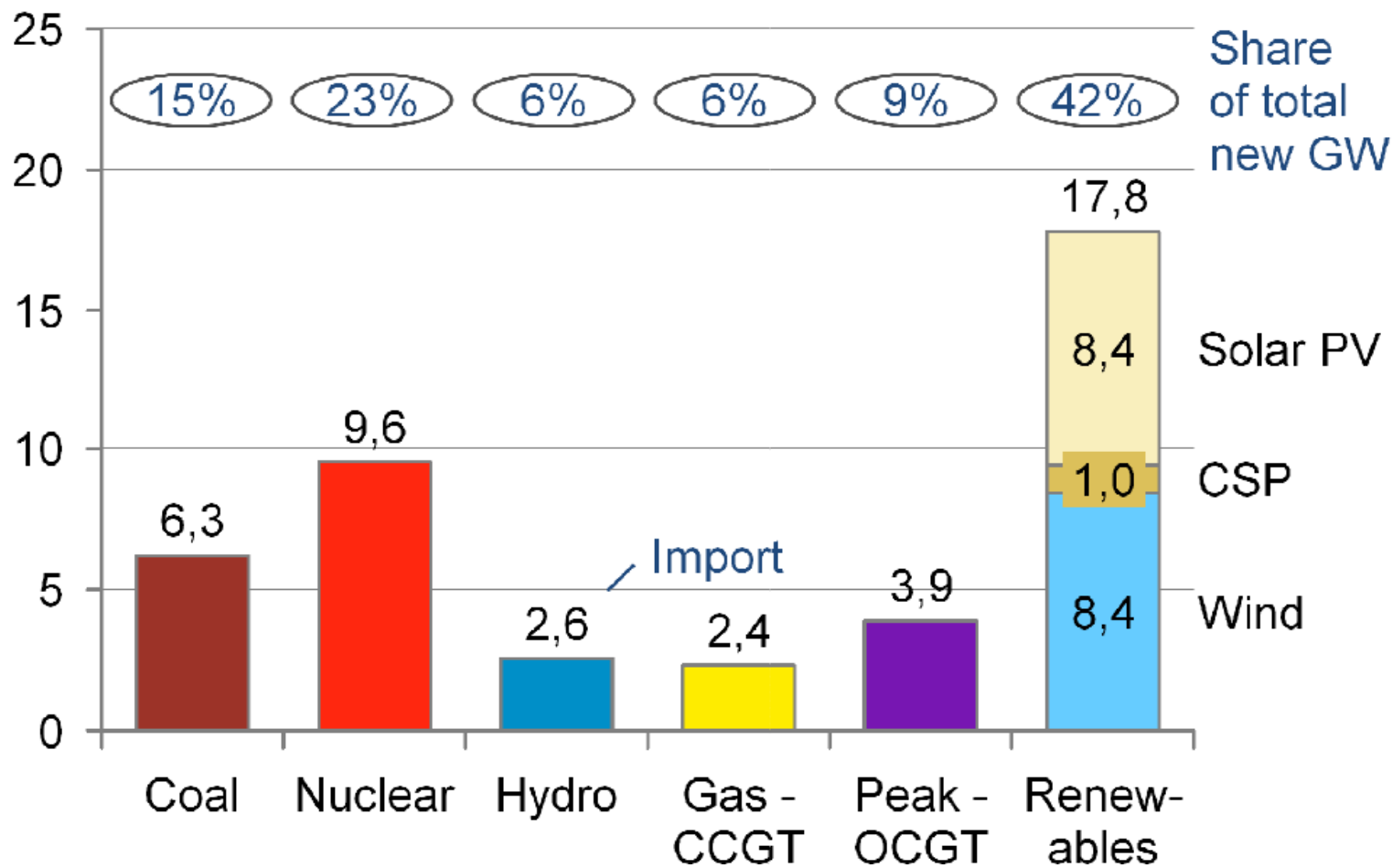
Koeberg supplies approximately 2000 MW of electricity from two Pressurised Water Reactors (PWR's), and runs on fuel elements fabricated from Low Enriched Uranium (LEU)



At the 2015 State of the Nation Address, State President Jacob Zuma stated the following:

- Government is also exploring the procurement of the 9 600 MW nuclear build programme as approved in the Integrated Resource Plan 2010-2030.
- To date Government has signed Inter-Governmental Agreements and carried out vendor parade workshops in which five countries came to present their proposals on nuclear.
- These include the United States of America, South Korea, Russia, France and China.
- All these countries will be engaged in a fair, transparent, and competitive procurement process to select a strategic partner or partners to undertake the nuclear build programme.
- Our target is to connect the first unit to the grid by 2023, just in time for Eskom to retire part of its aging power plants.

Integrated Resource Plan (IRP) 2010



Nuclear energy importance in SA

Base load capacity building:

Nuclear energy will provide base load to curb the shortage of electricity supply, arising from an aging energy infrastructure, an increasing population, and an ambitious socio-economic development trend.

Carbon emissions reduction:

The nuclear industry will allow other industries to increase their productivity without contributing to the carbon emission problem.

Demographic trends solution:

Nuclear energy will eliminate the difficult logistics of supplying electricity to the western areas of the country which are far from the coal fired power stations.

High level skills capacity building:

110 engineers, 22 scientists, 150 technicians, 2530 artisans and just over 30 project managers will have to be produced every year to meet the expected construction peak period of 2020 to 2023

Competitive fuel prices:

In many places, nuclear energy is competitive with fossil fuels as a means of electricity generation. Waste disposal and decommissioning costs are included in the operating costs. If the social, health and environmental costs of fossil fuels are also taken into account, the economics of nuclear power become outstanding!!.

Reliability and sustainability of energy supply:

Nuclear promises a guaranteed sustainable energy supply as one way to address poverty, inequality and to greatly reduce environmental degradation.

Local technology development:

The 'spin-off' technologies from nuclear, creation of local jobs and increased reliance on locally produced technologies is especially critical; fluctuations in the international exchange rates make industry especially vulnerable when products and services are outsourced.

Non-power nuclear applications in South Africa



Other non-power generation applications of nuclear are employed in the following industry sectors:

- Petrochemicals
- Food irradiation
- Construction
- Forensics
- Microchip processing
- Pharmaceuticals
- Archaeological analysis
- Neutron radiography
- Square Kilometre Array (SKA), etc.

These applications do not only save money for industries but also enhance efficiency, accuracy, productivity, and present other advantages when compared to conventional process methods.

NUCLEAR MEDICINE

South Africa uses a nuclear reactor to produce radioactive medicines everywhere needed to diagnose and treat illnesses and spend these nuclear medicines across the world. In nuclear medicine, radioisotopes are widely used for diagnosis and treatment, but are also critical for research. These isotopes may occur naturally, but many are artificially produced. The SAFARI-1 research reactor at Necsa makes radioactive isotopes. Specific isotopes are isolated to produce short-lived medicines that are critical to the health field. Today, nuclear medicine procedures are extremely common.

MEDICAL ISOTOPES: HOW THEY WORK AND WHO SUPPLIES THEM

MOLYBDENUM-99 DECAYS INTO TECHNETIUM-99M, A SHORT-LIVED MEDICAL RADIOISOTOPE USED IN ONE OF NUCLEAR MEDICINE PROCEDURES.

THE PROCESS

THE TIME FROM REFINING TO USE IS VERY SHORT. OUTAGES AT REACTORS OR PROCESSING PLANTS, EVEN TRANSPORTATION DELAYED, CAN BE DETRIMENTAL.

- MOLYBDENUM-99 IS CREATED IN A REACTOR THEN SHIPPED TO ANOTHER LOCATION FOR PURIFICATION.
- A TECHNETIUM-99M GENERATOR, CONTAINING THE MOLYBDENUM-99, IS CREATED.
- THE GENERATORS ARE SHIPPED THROUGHOUT THE WORLD FOR USE IN HOSPITALS.



NTP Radioisotopes SOC Ltd (NTP)

- NTP was established as a wholly owned subsidiary of Necsa in 2003 and operates as a commercial subsidiary of Necsa.
- NTP routinely serves customers in 60 countries on six continents with a range of radiation-based products and services and is one of the world's leading producers of radiochemicals, radiopharmaceuticals and other radiation technology-based products.

NTP's products & services

INDUSTRIAL SOURCES



RADIOCHEMICALS

- Mo-99, I-131

RADIOACTIVE SOURCES

- Ir-192, Cs-137, Co-60

IRRADIATION SERVICES

- Neutron Transmutation doping of Silicon,
- Neutron Irradiation Service
- Gamma Irradiation Service

RADIOPHARMACEUTICALS

- NovaTec-P Tc-99 Generator, FDG,
- MIBG, Cold kits, I-131 Capsules
- Ir-192 Brachytherapy



Non-power nuclear applications

Necsa, through its subsidiary, NTP Radioisotopes SOC Ltd delivers nuclear medicine to more than 60 countries around the world and enhances over 10 million lives every year.

The Necsa nuclear medicine revenue reached R1 billion (~US\$ 95 M) in 2013 and is expected to grow.





Pelchem SOC Ltd (**Pelchem**), is a 100% subsidiary of Necsa and it is the only fluorochemical production, sales and distribution company in the Southern hemisphere.

The company produces 25 fluorochemicals, which are exported to **26 countries** on all continents.

South Africa has the **largest reserves of fluorspar** in the world (third largest producer)

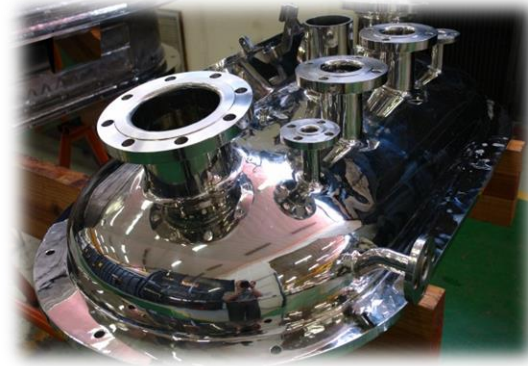
- Producing **nuclear fuel** for nuclear power generation (HF & F₂)
- Thin **film solar panels** manufacture (NF₃)
- **lithium ion batteries** for computers, cell phones and electric vehicles (LiPF₆)
- Processing rare earth elements (HF)
e.g. neodymium (used in **super magnets** for **electric vehicles**, **wind turbines** and computers disk drives) HF
- **Power transmission** (SF₆)
- Production of **petroleum** (HF)

- **Toothpaste** (fluoride salts)
- **Refrigerants** in fridges, freezers and air-conditioning
- Non-stick **cookware** (Fluoropolymers - Teflon)
- Modern **construction material** (Fluoropolymers)
- **Pharmaceuticals** (APIs for ARVs, anaesthetics,...)
- **Medical diagnostics** (^{18}F - Positron Emission Tomography (PET) scanner)

Pelchem's chemicals are in everyday-life products



Manufacturing - Pelindaba Enterprises



Pelindaba Enterprises (PE) is a division of Necsa specializing in heavy engineering and manufacturing of power generation components; it is the only manufacturing organisation in Africa that has acquired the ASME III Nuclear Certification.

Necsa acquired qualification as a component manufacturer in 2011, certified to manufacture power generation components according to the **American Society of Mechanical Engineers (ASME)** Code of Standards.

ASME N Stamp was acquired in 2014 and enables Necsa to design nuclear components.

The ability to manufacture power generation components will increase localisation and enhance high level technical skills around the nuclear Newbuild.



Manufacturing - Pelindaba Enterprises

Pelindaba Enterprises manufactures power generation components for the two local coal-fired power stations (Medupi and Kusile).

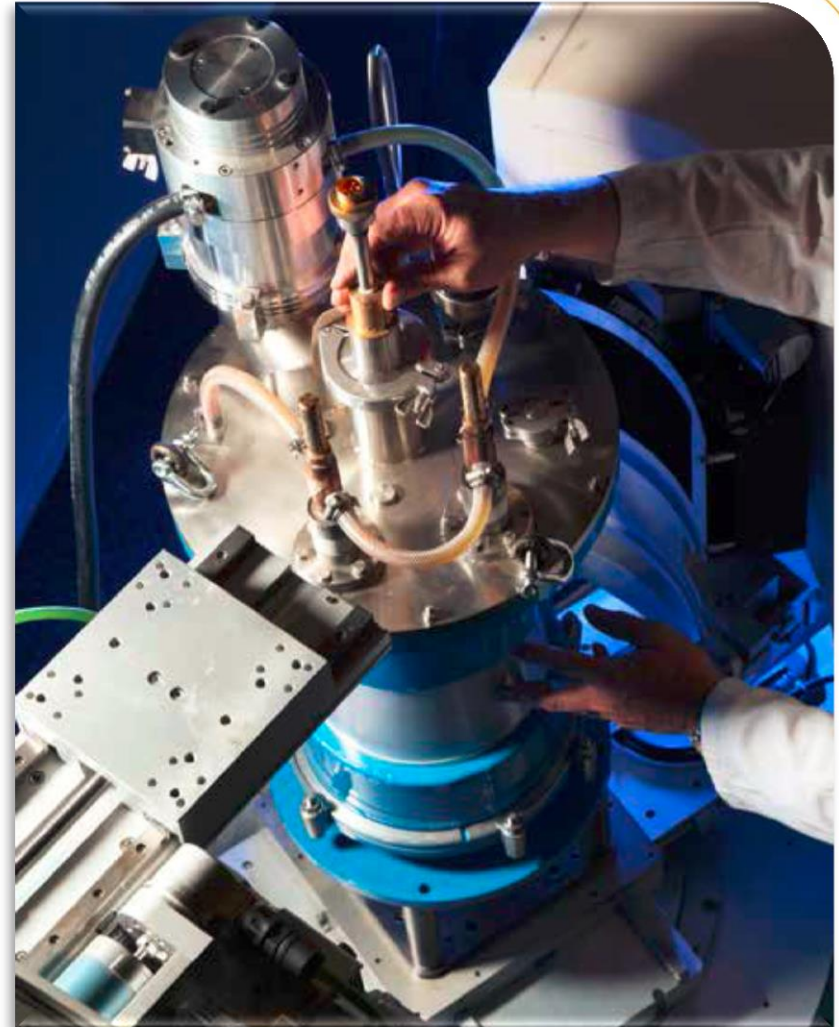
The enterprise is ready to support the SA nuclear build programme and plans to supply nuclear components to the international market in the long term.



Breaking new ground in nuclear R&D

Necsa is the only organisation on the African continent that offers both X-ray and neutron powder diffraction facilities to support Non-Destructive Testing (NDT) research within South Africa's National System of Innovation and in support of Industry.

Diffraction has been fundamental in revealing the structure of many materials (without destroying them) and often serves as the basis for innovation.

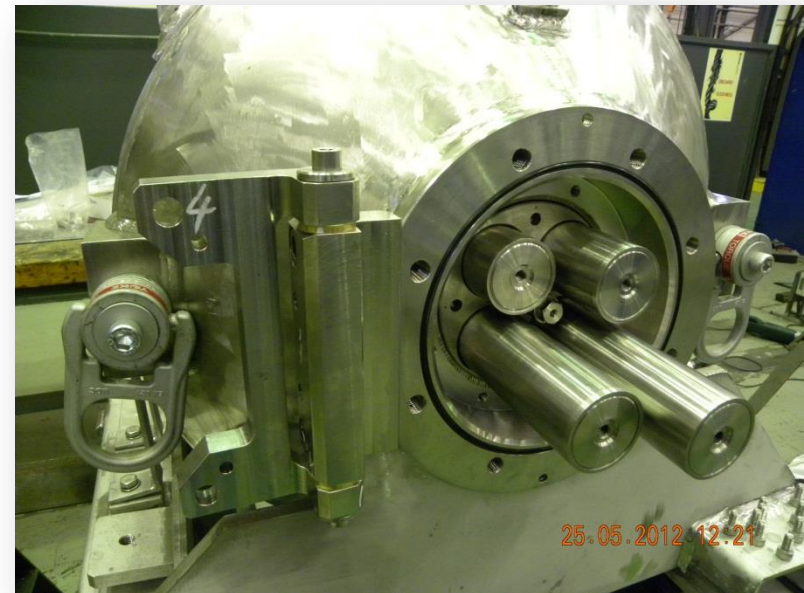


Serving the African continent

The **Mobile Hot Cell** (MHC) remains one of the only safe and reliable mechanisms in the world for the handling of disused high activity sealed radioactive sources.

The MHC is a unique technique for handling radioactive sources and it is developed and owned by Necsa.

Necsa is routinely contracted in many African countries to perform MHC operations and safely take care of disused radioactive sources.



Skills and capacity building

Since 1983, Necsa has trained thousands of youth in technical trades such as draughting, boiler making, welding, electrical work, turning & fitting, etc. This includes engineering graduates from universities.



Nuclear Policies

South Africa has a well established framework of policies for the operation of nuclear installations ranging from a research reactor (SAFARI-1 Research Reactor) to power reactors (Koeberg twin units). This is coupled with more than 50 years of experience in operating and maintaining such facilities.

Nuclear Economics

The South African Newbuild programme is estimated at over R 400 billion for the installation of 9.6 GW by 2030. Several funding models are currently being analysed.

THANK YOU

