Nuclear Position in South Africa

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• Introduction of Necsa
• Global position of nuclear power
• IRP 2010 – 2030 and SA’s pursuit of an energy mix
• Nuclear position in South Africa
• Deployment of different energy sources
• SA as a nuclear energy country – Koeberg; SAFARI
• Benefits of nuclear
• Cost of nuclear
• Government commitment to a fair procurement process
Introduction: Necsa 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 co-operate with any person or institution in matters falling within these functions.

To process source material, special nuclear material and restricted material and to reprocess and enrich source material and nuclear material.

Execute institutional responsibilities on behalf of government, e.g. operation and utilisation of SAFARI-1, decommissioning and waste management, international obligations.
## Reactors currently under construction or planned

<table>
<thead>
<tr>
<th>Region</th>
<th>Under construction</th>
<th>Planned</th>
</tr>
</thead>
<tbody>
<tr>
<td>Europe</td>
<td>4</td>
<td>19</td>
</tr>
<tr>
<td>Russia and Former Soviet Union</td>
<td>11</td>
<td>30</td>
</tr>
<tr>
<td>China</td>
<td>27</td>
<td>56</td>
</tr>
<tr>
<td>Rest of East Asia</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>West Asia (Middle East)</td>
<td>2</td>
<td>8</td>
</tr>
<tr>
<td>South Asia</td>
<td>7</td>
<td>24</td>
</tr>
<tr>
<td>South East Asia</td>
<td>--</td>
<td>4</td>
</tr>
<tr>
<td>Africa</td>
<td>--</td>
<td>1</td>
</tr>
<tr>
<td>North America</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>South America</td>
<td>2</td>
<td>--</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>68</strong></td>
<td><strong>159</strong></td>
</tr>
</tbody>
</table>

Source: Based on WNA database.
Reactors currently under construction by type

Total number of reactors: 66

- Pressurised water reactor
- Boiling water reactor
- Pressurised heavy water reactor
- Fast breeder reactor
- High temperature gas-cooled reactor

Source: IAEA, 2015.
Global nuclear power status and growth

- As of 29 August 2015, there are 436 reactors operating in 31 countries.

- 70 reactors are under construction in 16 countries.

- African countries actively considering nuclear power programs are: Nigeria, Ghana, Senegal, Sudan, Uganda, Kenya and Namibia
The South African IRP2010 plan envisages a 23% nuclear compliment of the new electricity generation capacity by 2030.

Many developed parts of the globe are already powered by more than 400 nuclear power plants.

*Picture taken by NASA’s Defence Meteorological Satellite Program (DMSP)*
Nuclear Position in South Africa

- Director General of the IAEA, Mr Yukiya Amano visited South Africa in February 2013 on an Integrated Nuclear Infrastructure Review (INIR) mission to assess the 19 nuclear milestones for SA.

- In 2014, government successfully concluded nuclear vendor parade workshops with delegations from Russia, China, France, South Korea, and the United States of America.

- Moving forward, the South African government plans to launch the procurement process in 2016.
Current legislation used to govern the nuclear sector in SA:

- Nuclear Energy Act (Act 46 of 1999)
- National Nuclear Regulator Act (Act 47 of 1999)
- National Nuclear Disaster Management Plan (2005)
Deployment of different energy sources

Share of total new GW

- Solar PV: 8.4 GW
- CSP: 1.0 GW
- Wind: 17.8 GW

Import: 2.6 GW

Coal: 6.3 GW
Nuclear: 9.6 GW
Hydro: 2.4 GW
Peak OCGT: 3.9 GW
Renewables: 8.4 GW
South Africa as a nuclear energy country

Koeberg Power Plant 32 years old

SAFARI-1 Research Reactor 51 years old
SA imperatives for nuclear

- South Africa faces energy constraints.
- SA has an ageing energy infrastructure.
- SA development agenda is energy intense.
- Country needs a stable supply of electricity.
- Competitive economy requires reliable energy supply.
- Access to modern energy services is key to poverty eradication.
SA imperatives for nuclear

- The need to reduce carbon emissions by 34% by 2020 and 42% by 2025 calls for cleaner energy generation technologies.

- The need to use all sources of energy is important for diversity and resilience.
Benefits of nuclear build

- Job creation
- Build Knowledge Economy
- Energy security
- Manufacturing is engine of economic growth
- Become leader in supply of nuclear products and services
Cost of nuclear power

The R1 trillion figure, often repeated in the media, is totally unfounded. By international comparison it is not conceivable that South Africa’s nuclear new build programme could cost a trillion rands.

Localisation will systematically reduce the cost of consecutive plants with the last set of plants being the cheapest and being the ones with the greatest return in terms of job creation and skills developments.

The investment in the programme will contribute to energy security, economic growth, infrastructure development, skills development and job creation.
## Assumptions on cost and technology

<table>
<thead>
<tr>
<th>Technical assumptions</th>
<th>Nuclear</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity</td>
<td>1 000 MW</td>
<td>1 000 MW</td>
</tr>
<tr>
<td>Construction years</td>
<td>7</td>
<td>2</td>
</tr>
<tr>
<td>Lifetime</td>
<td>60</td>
<td>30</td>
</tr>
<tr>
<td>Electrical conversion efficiency</td>
<td>n.a.</td>
<td>0.55</td>
</tr>
<tr>
<td>Gross energy content of fuel unit</td>
<td>n.a.</td>
<td>1 MWh</td>
</tr>
<tr>
<td>CO₂ emissions per MWh</td>
<td>0</td>
<td>0.37 tCO₂/MWh</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Cost assumptions</th>
<th>Nuclear</th>
<th>Gas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overnight costs¹</td>
<td>EUR 4 000 per kW</td>
<td>EUR 851 per kW</td>
</tr>
<tr>
<td>O&amp;M</td>
<td>EUR 10.92 per MWh</td>
<td>EUR 3.54 per MWh</td>
</tr>
<tr>
<td>Fuel²</td>
<td>EUR 6.31 per MWh</td>
<td>Daily</td>
</tr>
<tr>
<td>Carbon (CO₂)³</td>
<td>0</td>
<td>EUR 14.44 per MWh</td>
</tr>
<tr>
<td>Decommissioning</td>
<td>EUR 600 per kW</td>
<td>EUR 43 per kW</td>
</tr>
</tbody>
</table>

1. Fuel costs for nuclear energy include cost for the back end of the fuel cycle.
2. The overnight costs for the gas plant are based on the median case in IEA/NEA (2010: 105). The overnight costs for the nuclear plant are based on NEA expert estimations.
3. Carbon costs in the NEA model correspond to the observed daily price in the EU emission trading system during 2005-2010. The table contains the average over the same period.

**Cost of nuclear power**

**Competitive fuel prices:**
In many places, nuclear energy is competitive with fossil fuels as a means of electricity generation. Waste disposal and decommissioning costs of nuclear are included in the operating costs.

**Environmental Impact:**
If the social, health and environmental costs of fossil fuels are also taken into account, the economics of nuclear power become outstanding!!.
Commitment to fair procurement

The Minister of Energy, in her 2015 budget vote speech, undertook that the procurement process would be competitive, fair, transparent and cost effective. This is in accordance with the Government regulations.
Conclusion

• Necsa will contribute to the localization of the nuclear build programme.

• We are the only company on the African continent with an ASME III certification allowing for the production of critical nuclear components.

• Necsa’s pronouncements on energy are aimed at revitalizing the South African economy. The expansion of nuclear energy should be seen as a part of the broader process of industrialization in South Africa.
THANK YOU