



UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

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March 14, 2001

MEMORANDUM TO: William D. Travers
Executive Director for Operations

FROM: Ashok C. Thadani, Director *A.C. Thadani*
Office of Nuclear Regulatory Research

SUBJECT: REPORT ON TRIP TO SOUTH AFRICA FOR DISCUSSIONS ON
THE PEBBLE BED MODULAR REACTOR (PBMR)

On February 26 thru March 2, 2001, Mr. Thomas L. King and I visited South Africa and held discussions with various organizations there with respect to the status of and plans for the PBMR in South Africa. The PBMR is a 110 Mwe high temperature gas-cooled reactor with on-line refueling capability whose concept was originally developed and tested in Germany and is currently, at smaller scale, being tested in China. The South Africa (SA) government is potentially interested in PBMR as a source of electricity to meet their growing demand. The organizations visited and individuals contacted are show in Attachment 1, along with the agenda for the week.

The trip was organized and hosted by the U.S. Department of Energy (DOE) which was very helpful and supportive in achieving our objectives. Their staff and others in their delegation in attendance were:

- Dr. Gail Marcus, Deputy Director, Office of Nuclear Energy, Science and Technology, DOE-NE
- Mr. Mark Roth, Director International Cooperation Program, DOE-NE
- Robert Whitesel, Policy Analyst DOE-NNSA
- Dr. Ralph Bennett, Director, Advanced Nuclear Energy Idaho National Engineering and Environmental Laboratory
- Mr. Kenneth Apt, Safeguards Engineer, Los Alamos National Laboratory

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Agenda and Individuals ContactedFebruary 26, 2001

- U.S. Embassy, Pretoria, SA:
 - John W. Blaney, Deputy Chief of Mission
 - James F. Freund, Regional Resources Officer
 - Paul M.T. White, Resources Specialist
- NECSA:
 - Fanie Ventner, Fuels Manager, PBMR, Ltd.
 - Robert Peters, Fuels Engineer, PBMR, Ltd.
 - Charles S B Piani, PhD, Manager: Safari-1 Research Reactor
 - W. van Zyl de Villiers Ph, Divisional Manager: Nuclear Technology
 - Karel Fouché, General Manager: Pelindaba Nuclear Institute

February 27, 2001

- Eskom:
 - Dr. Steven Lennon, Executive Director, Resources and Strategy
 - Mervin Harris, Head Client Office
 - A K (Tony) Stott, Sci Nat MSc (London) AEP (Unisa), Environmental and Nuclear Services Manager
 - Premysl (Premek) Skopal, Chief Engineer PBMR Client Office
 - David Lowton, CEng, MIEE, MINucE, Chief Engineer - Safety Assessment & Licensing
 - W.D. (Dave) Wynne, PBMR EIA Project Manager
- PBMR, Ltd.
 - David R. Nicholls - CEO
 - Albert Koster, Nuclear Safety Manager
 - Sakkie Du Plessis, Mechanical Designer
 - Wynn Roscoe, Manager Management Services
 - Reuben R. Garrett, Manager, International Construction (Exelon)

February 28, 2001

- NNR:
 - Nchakha Moloi, Acting Chief Executive Officer
 - G A Clapison, Senior Manager Power Reactors
 - Sietse Van Der Woude, Senior Manager Mining, Waste & Nuclear Technology
 - Tim Hill, Manager: Koeberg Project
 - Dr A Mysen Msc, Phd, MinucE, Manager PBMR
 - TseLiso B Maqubela, Manager Nuclear Technology and Waste Projects

- R A Kirk BMet, C.Eng, Mim, BA, Manager Reactor Assessment Department
- Thiagan Pather, Manager Scientific and Technical Services

March 1, 2001

- DME:
 - Smunda S Mokoena, Deputy Director-General Energy
 - Schalk de Waal PhD, Director Nuclear Energy

March 2, 2001

- Eskom Generation (Koeberg Plant) - Capetown
 - Mervin Harris, Head Client Office
 - Reuben R. Garrett, Manager, International Construction (Exelon)

EVENT FREQUENCY	SAFETY REQUIREMENTS	SAFETY CRITERIA
<p>Category A Category A events (or combinations of events) are those which lead to exposure and which could occur with a frequency of more than one in one hundred years ($\geq 10^{-2} \text{ y}^{-1}$). Such events are treated as part of normal operation.</p>	<p>The design shall be such to ensure that under anticipated conditions of normal operation, there shall be no radiation hazard to the workforce and members of the public. Normal operation includes exposures resulting from minor mishaps and misjudgements in operations, maintenance and decommissioning. In addition all doses shall be kept ALARA and the principle of defence-in-depth shall be applied</p>	<p>Individual radiation dose limit shall be :</p> <ul style="list-style-type: none"> - 20 mSv.y⁻¹ to plant personnel and - 250 μSv.y⁻¹ to members of the public
<p>Category B Category B events (or combinations of events) are those which lead to exposure and which could occur with a frequency of between one in one hundred years (10^{-2} y^{-1}) and one in one million years (10^{-6} y^{-1}).</p>	<p>The design shall be such to prevent and mitigate potential equipment failure or withstand externally or internally originating events which could give rise to plant damage leading to radiation hazards to plant personnel and members of the public in excess of the safety criteria.</p> <p>The analysis performed to demonstrate compliance with this requirement shall be conservative.</p> <p>In addition radiation doses and risks associated with these events shall be kept ALARA and the principle of defence-in-depth shall be applied.</p>	<p>Individual radiation dose limit shall be :</p> <ul style="list-style-type: none"> - 500 mSv to plant personnel and - 50 mSv to members of the public <p>for one single event or combination of events in this category</p>
<p>Category C Category C events (or combinations of events) are all possible events that could lead to exposure. As such, Category C events will include Category A and B events as well as events which occur with an annual frequency of less than 10^{-6}.</p> <p>Consideration may be given to the exclusion of very low frequency events in the range below 10^{-5} per year.</p>	<p>The design shall be demonstrated to respect the risk criteria for plant personnel and members of the public</p> <p>The analysis performed to demonstrate compliance with this requirement may use best estimate data provided it is supported by an appropriate uncertainty analysis. The analysis must also demonstrate a bias against larger accidents. See appendix E.</p> <p>In addition radiation doses and risks associated with these events shall be kept ALARA and the principle of defence-in-depth shall be applied.</p>	<p>Limitation of risk to the values set by the risk criteria.</p> <p>Plant Personnel</p> <ul style="list-style-type: none"> - $5 \times 10^{-5} \text{ y}^{-1}$ peak individual risk and - 10^{-5} y^{-1} average risk <p>Members of The Public</p> <ul style="list-style-type: none"> - $5 \times 10^{-6} \text{ y}^{-1}$ peak individual risk and - 10^{-6} y^{-1} average population risk per site

Table 2: Licensing Requirements for the PBMR