

SAFARI-1: ADJUSTING PRIORITIES DURING THE LEU CONVERSION PROGRAM

SOUTH AFRICAN NUCLEAR ENERGY
CORPORATION (Necsa)

SAFARI-1: PELINDABA

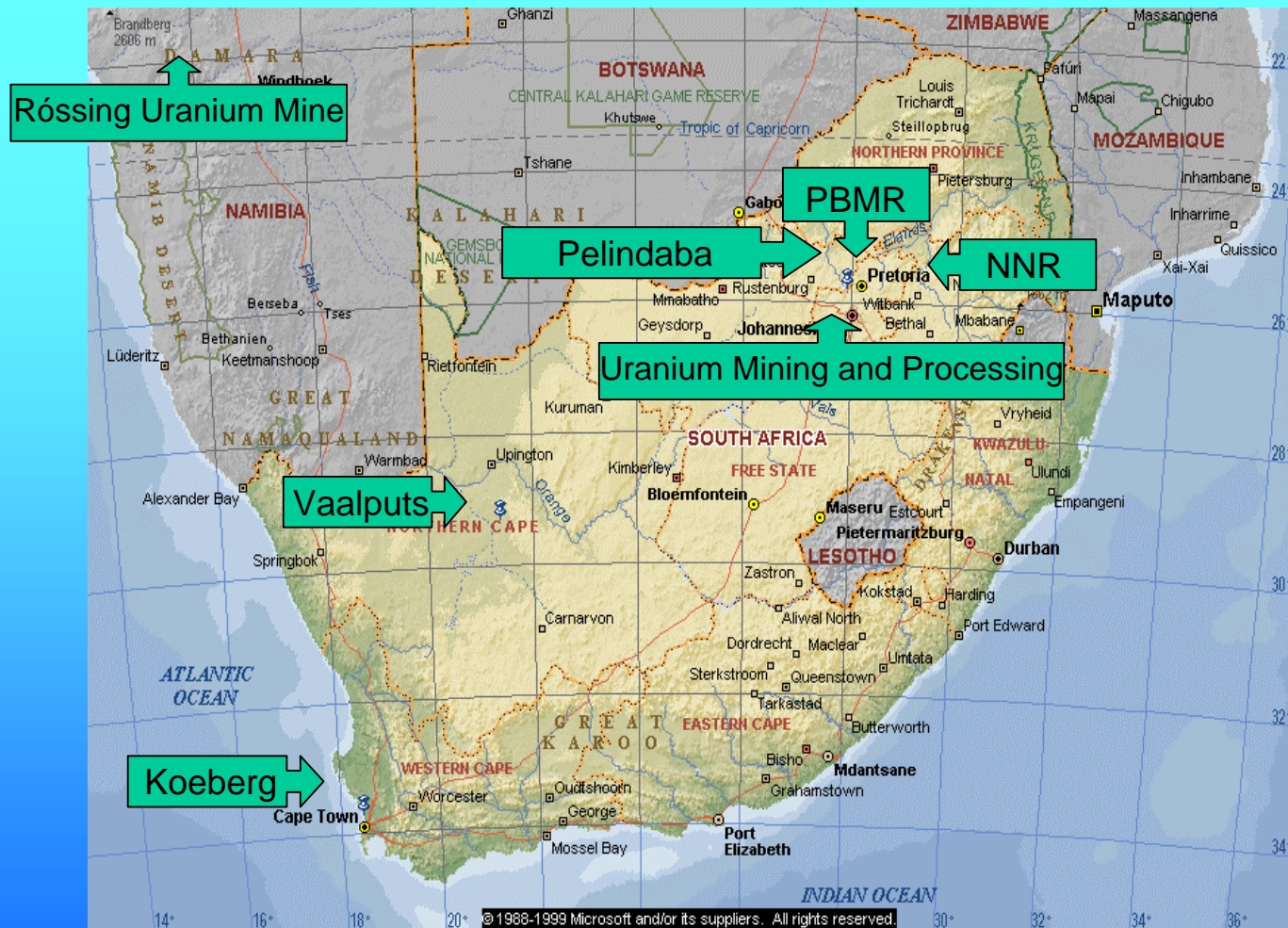
CSB PIANI

Content

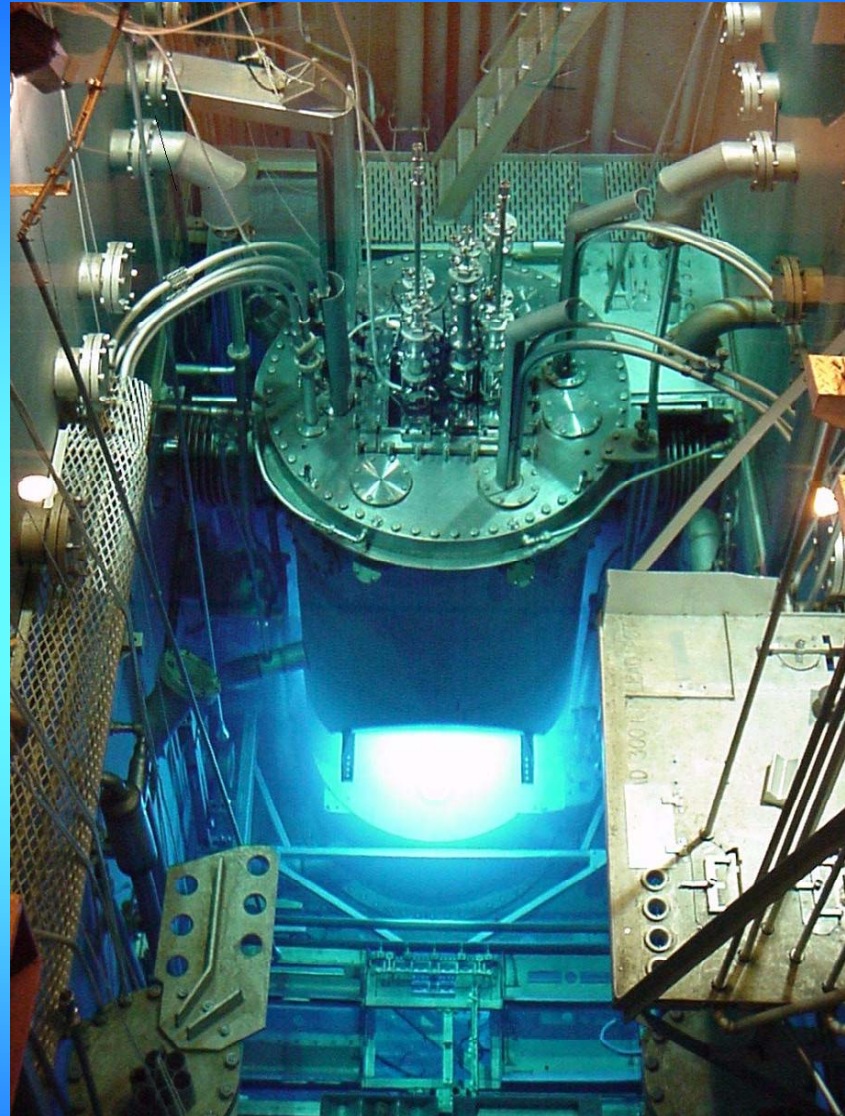
- **1: Introduction**
 - Recap of Previous Information
- **2: SAFARI-1: Role in Isotope and R&D**
 - Commercial
 - Developmental
- **3: Operational Strategy**
 - Current Operational Schedules
- **4: Postulated Conversion**
 - Impact on Operational and Commercial Activities
 - Phase I: Manufacturing Ability
 - Phase II: Preparation for Conversion
 - Regulatory Expectations
- **5: Conclusion.**

1: RECAP

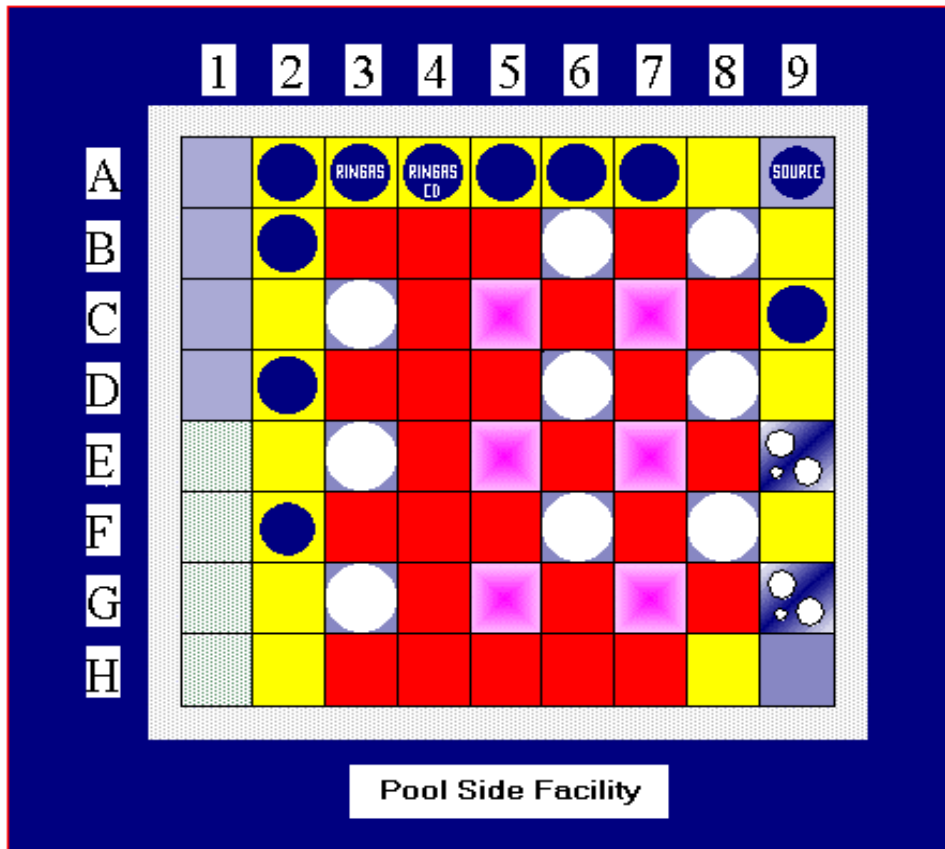
Nuclear Resources and Facilities in South Africa













SAFARI-1 Research Reactor



SAFARI-1 CORE LAYOUT



-  Fuel Assembly
-  Control Assembly
-  Solid Beryllium Element
-  Solid Aluminium Element
-  Hollow Beryllium Element
-  Hollow Aluminium Element
-  Lead Reflector
-  Hydraulic Rabbit
-  Aluminium Water Box
-  Aluminium Core Box

January 2004

2: ROLE IN ISOTOPE PRODUCTION AND R & D

APPLICATIONS OF SAFARI-1

| Facility | Typical Applications | Examples |
|----------------------------|---|--|
| Beam Tubes | NDE, Materials Investigation | NRAD, NDIFF, SANS |
| In-Core Standard Devices | Isotope Production | ^{99}Mo , ^{125}I , ^{131}I , ^{35}S , ^{32}P , ^{90}Y , ^{192}Ir |
| Hydraulic Transfer Systems | Isotope Production | Selectively as above |
| Pneumatic Transfer Systems | Activation Analysis | Personnel monitoring, geology, minerals research |
| Pool Side Facility | Large objects, Material modification | Neutron Transmutation Doping, |
| Storage Pool Facilities | NDT, Gamma irradiation, materials investigation | Testing/calibration of radiation measuring devices |
| Dry Gamma Facility | NDT, Gamma irradiation, materials investigation | Sterilisation, pest control research |
| Hot Cells | Maintenance / inspection of radioactive components, Transfer of RA materials. | Reactor components and products Sources from other facilities |

^{99}Mo Target Plates & Holder



Silicon Ingots



Functional Experimental Facilities



Neutron Radiography

**SANS:
UNDER DEVELOPMENT**

- Neutron Diffraction



3: OPERATIONAL STRATEGY

SAFARI-1 OPERATING SCHEDULE 2007

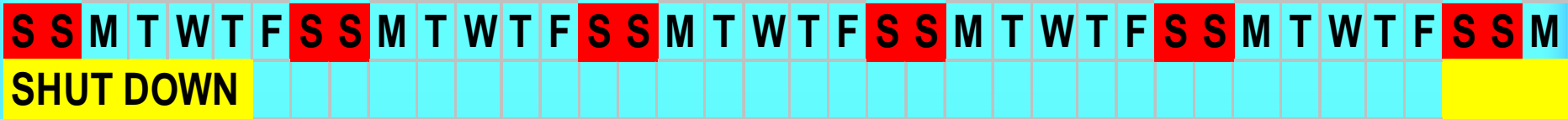
| | January | February | March | April | May | June | July | August | September | October | November | December |
|-----|------------|-----------|--------------|---------------|-----------|-----------|-----------|-----------|-------------|----------|----------|-------------|
| Wed | | | | | | | | 1 | | | | |
| Thu | | 1 | 1 | | | | | 2 | | | 1 | |
| Fri | | 2 W2 | 2 W1 | | | 1 W1 | | 3 W1 | | | 2 W4 | |
| Sat | | 3 | 3 | | | 2 | | 4 | 1 | | 3 | 1 |
| Sun | | 4 | 4 | 1 | | 3 | 1 | 5 | 2 | | 4 | 2 |
| Mon | 1 New Year | 5 | 5 | 2 | | 4 | 2 | 6 | 3 | 1 | 5 | 3 |
| Tue | 2 | 6 | 6 | 3 | 1 MayDay | 5 | 3 | 7 | 4 | 2 | 6 | 4 |
| Wed | 3 | 7 | 7 | 4 | 2 | 6 | 4 | 8 | 5 | 3 | 7 | 5 |
| Thu | 4 | 8 | 8 | 5 | 3 | 7 | 5 | 9 Woman's | 6 0708-1 | 4 0709-1 | 8 0710-1 | 6 |
| Fri | 5 W3 | 9 W3 | 9 W2 | 6 Good Friday | 4 W1 | 8 W2 | 6 W2 | 10 W2 | 7 | 5 | 9 | 7 W4 |
| Sat | 6 | 10 | 10 | 7 | 5 | 9 | 7 | 11 | 8 | 6 | 10 | 8 |
| Sun | 7 | 11 | 11 | 8 | 6 | 10 | 8 | 12 | 9 | 7 | 11 | 9 |
| Mon | 8 | 12 | 12 | 9 Family | 7 | 11 | 9 | 13 | 10 | 8 | 12 | 10 |
| Tue | 9 | 13 | 13 | 10 | 8 | 12 | 10 | 14 | 11 | 9 | 13 | 11 |
| Wed | 10 | 14 | 14 | 11 | 9 | 13 | 11 | 15 | 12 | 10 | 14 | 12 |
| Thu | 11 | 15 | 15 | 12 | 10 | 14 | 12 | 16 | 13 | 11 | 15 | 13 0711-1 |
| Fri | 12 W4 | 16 W4 | 16 W3 | 13 W2 | 11 W2 | 15 W3 | 13 W3 | 17 W3 | 14 W1 | 12 W1 | 16 W1 | 14 |
| Sat | 13 | 17 | 17 | 14 | 12 | 16 Youth | 14 | 18 | 15 | 13 | 17 | 15 |
| Sun | 14 | 18 | 18 | 15 | 13 | 17 | 15 | 19 | 16 | 14 | 18 | 16 Reconcil |
| Mon | 15 | 19 | 19 | 16 | 14 | 18 | 16 | 20 | 17 | 15 | 19 | 17 |
| Tue | 16 | 20 | 20 | 17 | 15 | 19 | 17 | 21 | 18 | 16 | 20 | 18 |
| Wed | 17 | 21 | 21 Human Rts | 18 | 16 | 20 | 18 | 22 | 19 | 17 | 21 | 19 |
| Thu | 18 0701-1 | 22 0702-1 | 22 | 19 | 17 | 21 0706-1 | 19 | 23 | 20 | 18 | 22 | 20 |
| Fri | 19 | 23 | 23 W4 | 20 W3 | 18 W3 | 22 | 20 W4 | 24 W4 | 21 W2 | 19 W2 | 23 W2 | 21 W1 |
| Sat | 20 | 24 | 24 | 21 | 19 | 23 | 21 | 25 | 22 | 20 | 24 | 22 |
| Sun | 21 | 25 | 25 | 22 | 20 | 24 | 22 | 26 | 23 | 21 | 25 | 23 |
| Mon | 22 | 26 | 26 | 23 | 21 | 25 | 23 | 27 | 24 Heritage | 22 | 26 | 24 |
| Tue | 23 | 27 | 27 | 24 | 22 | 26 | 24 | 28 | 25 | 23 | 27 | 25 Xmas |
| Wed | 24 | 28 | 28 | 25 | 23 | 27 | 25 | 29 | 26 | 24 | 28 | 26 Goodwill |
| Thu | 25 | 29 | 29 0703-1 | 26 0704-1 | 24 0705-1 | 28 | 26 0707-1 | 30 | 27 | 25 | 29 | 27 |
| Fri | 26 W1 | 30 | 30 | 27 Freedom | 25 | 29 W1 | 27 | 31 | 28 W3 | 26 W3 | 30 W3 | 28 W2 |
| Sat | 27 | 31 | 31 | 28 W4 | 26 | 30 | 28 | | 29 | 27 | | 29 |
| Sun | 28 | | | 29 | 27 | | 29 | | 30 | 28 | | 30 |
| Mon | 29 | | | 30 | 28 | | 30 | | | 29 | | 31 |
| Tue | 30 | | | | 29 | | 31 | | | 30 | | |
| Wed | 31 | | | | 30 | | | | | 31 | | |
| Thu | | | | | 31 | | | | | | | |

SHUTDOWN

OPERATING

RRFM/IGORR 2007: 11-15 March 2007, Lyon, France.

OPERATING CYCLE



- 35 DAY CYCLE
 - 30 DAYS AT POWER
 - ~5 DAYS SHUT DOWN:

(SATURDAY 07:00 TO THURSDAY 08:00)

- ~312 - 317 FPDs.

4: POSTULATED CONVERSION

Phase I: Manufacturing Ability

- From HEU (UAL) to LEU (USi)
- Development program initiated ~2002
- Fuel: 300g-²³⁵U loading in UAL
= 340g-²³⁵U in USi (4.8gm/cm³)
- Test & Qualification (LTAs) by end 2007.....

Phase II: Proceeding with SAFARI-1 Conversion

Core management demonstration:

- Impact of systematic addition of LEU to core
- Verification of codes (SAFI and OSCAR) - flux validation

Benchmark (2 imported LTAs) - commenced Jan '06

- LTAs have completed 6-8 irradiation cycles each (>60% BU)
- LTAs Visually inspected between each cycle
- Selective channel gap-measurements
- Conformance with regulatory restrictions

Contingency

- Reload (760) LEU USi fuel plates received ex AREVA-CERCA
- Assembled with SA components locally (4 Hybrid Elements)
- Qualified - to be inserted in SAFARI-1 by 2nd $\frac{1}{4}$ of 2007
- Selective addition of local and combined fuel assemblies.

Expectations

Impacts

- RR Conversions - Generally OK (HFR)
- SAFARI-1:
 - Optimise utilisation of HEU
 - Continuous Quality Service (Isotopes)
 - Matched inventory for core readiness
- Regulatory
 - Demo irradiation of 2 AREVA-CERCA LTAs
 - Follow-up irradiation:
 - SA Assembled LTAs with imported plates (Hybrid)
 - SA LTAs (when qualified elements are available)
 - Systematic Conversion to LEU core: ~3 years
 - Implications - revising SAR with RA and TH.

5: CONCLUSION

SUMMARY

- **Conversion (SAFARI-1 & SA Fuel)**
 - Manufacture Initiated
- **Delays in Fuel Qualification**
 - Expected by end 2007
- **Imported LTAs (2) in-core**
 - 8th Irradiation Cycle - successfully completed
- **Purchase of fuel plates (AREVA-CERCA)**
 - 760 LEU USi plates - 4 Hybrid elements ready
- **Licence and SAR**
 - Selective revision (RA and TH Transients) required.

THANK YOU

necsa

We're in your world



SAFARI-1 Research Reactor