L

From: "Dave Nicholls" <David.Nicholls@pbmr.co.za>
To: <WMB@nrc.gov> 'W. Beecher OPA
Date: Wed, Feb 21, 2001 4:53 AM
Subject: Re: Some Questions

Bill,

Sorry I am late answering.

1) You base the case for not needing containment on the fact that each fuel particle or element is itself encased in layers of containment material. What assurance do you have that the extraordinary quality control required to avoid significant radiation leakage can be achieved on the industrial scale that will be necessary? Is this based on the German experience, or have you already built an industrial sized fuel fabrication facility?

Answer:- The fuel performance is based principally on established German experience (we are following the German specifications and practices exactly - or as exactly as is possible, we have full technology transfer from them and the original German fuel manufacturer - Nukem - is involved in the fuel plant design). The German expereience is fully supported by the work done in Japan & China (who have qualified HTGR fuel for their new research reactors), UK (from the Dragon HTGR 1964-1977) and Russia (qualified for their planned HTGRs). The unfortunate US expereience on HTGR fuel is the "outlyer" of fuel experience. We have done lab scale work to date but have not yet got to testing fuel. (I attach a set of graphs on fuel testing)

2) You claim to need an EPZ of only 400 meters. Since some helium is bound to be vented and will carry radionuclides from some fuel leakers, how much radiation would you estimate under normal operating conditions venting from the confinement building, and how much at the site boundary? In millirem, please.

Answer :- The calculation of normal dose at site boundary for Koeberg (1000m) has not yet been calculated, but the accident dose at site boundary under the equivilant of a "Severe Accident" is about 1% of the regulatory limit for normal operation. The deterministic calaculation available to me now is that under "F category" weather at 2 m/s following a Severe Accident (loss of all system integrity, no control rods and no cooling) is 4.2 milliRem at 400m and 0.765 milliRem at 1.75km. (I attach a some data on the Geman calculations for their Modul at 100m - this is a slightly smaller plant than ours and they do not consider all the accidents that we do. We think they also use more benign weather.)

3) If I recall correctly, I think you said the thickness of the confinement building was four meters of concrete (to protect against aircraft crashes). Do I remember correctly?

Answer:- The current citadel around the reactor is 2.2m and the outer building wall is 1.5m. These are mainly for shielding and siesmic support of the reactor and main systems (design is for 0.4g)

4) Do you happen to know why the South African regulatory authority hasn't responded to the NRC's offer to help develop a technology-neutral regulatory approach to licensing construction and opertion of advanced reactors, such as the PBMR? (It's public information that the offer was made.)

Answer :- We believe that a letter for signature has been sent to the minister.

5) What sort of severe accident conditions are planned for testing the prototype reactor once it is in operation?

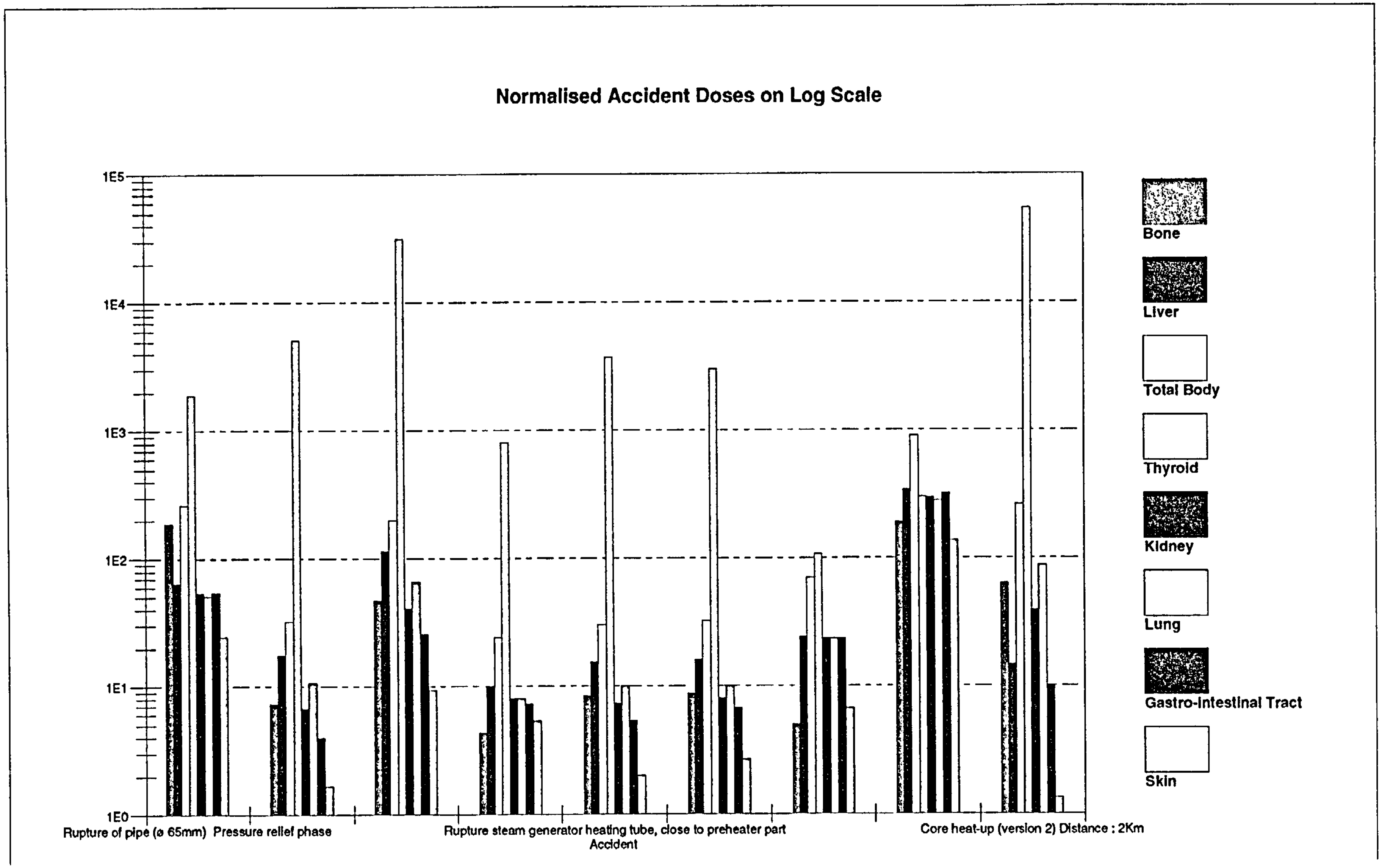
Answer :- We would expect to do a number of Depressurised Loss of Forced Cooling (this would be depressurising the helium in the circuit to close to atmospheric pressure from power without any forced cooling).

I hope these help.

Q/5

regards

David Nicholls
CEO
PBMR (Pty) Ltd
Tel: +27 12 677 9400/9531
Cell +27 83 800 2125
Fax: +27 12 663 3052



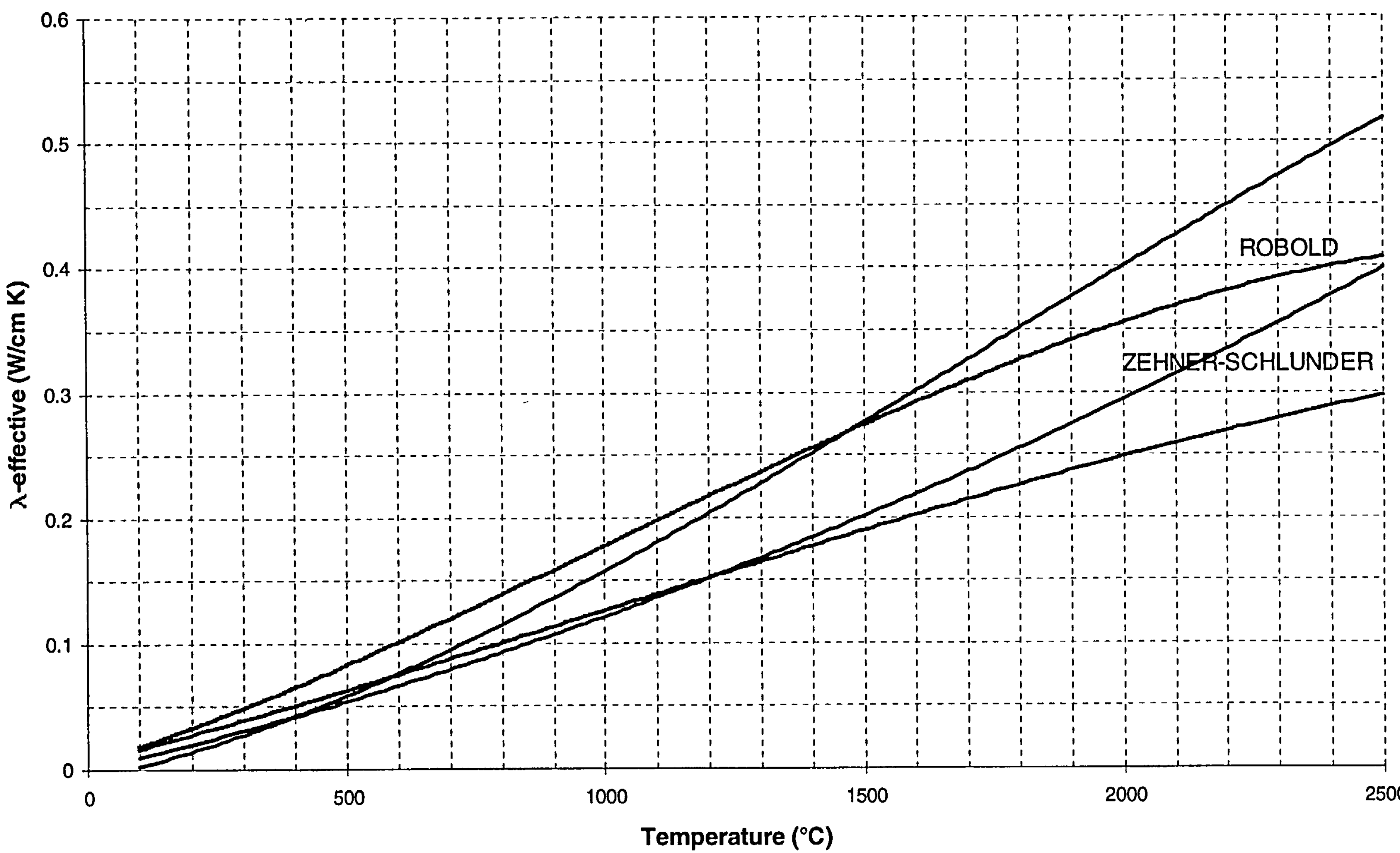
Normalised Accident Doses on Log Scale
1E5
1E4
1E3
1E2
1E1
1E0
Rupture of pipe (ø 65mm)
Pressure relief phase
Rupture steam generator heating tube, close to preheater part
Accident
Core heat-up (version 2) Distance : 2Km
Bone
Liver
Total Body
Thyroid
Kidney
Lung
Gastro-Intestinal Tract
Skin

Conservative Assumptions

- 2 σ deviations for:
  - Uncertainty of operation (5%)
  - Uncertainty in decay heat calculation (5%)
- EOL λ assumed for graphite
- Failure to SCRAM for DLOFC

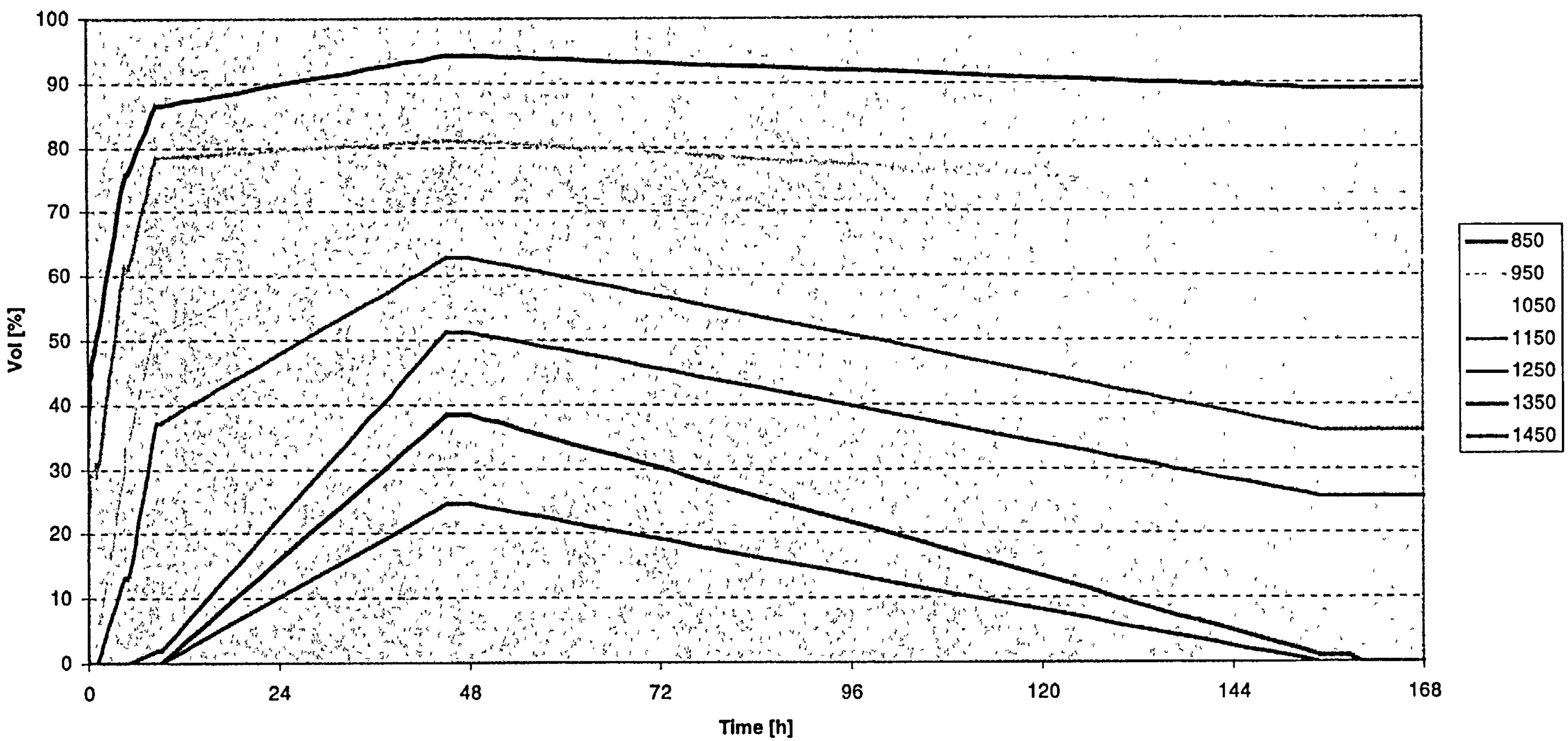
P B M R

Thermal conductivity in the Pebble Bed

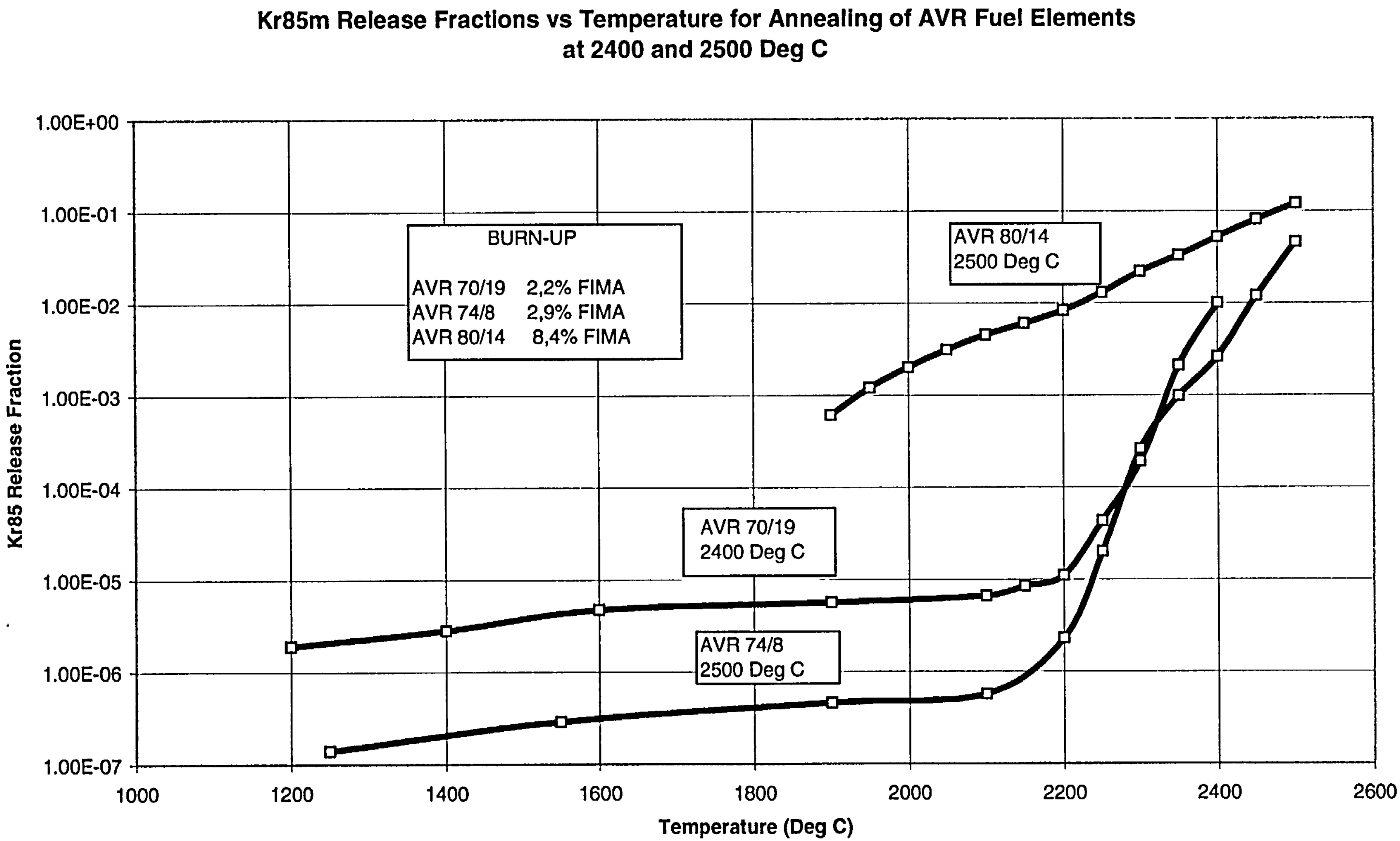


P B M R

268 MWth PBMR Layout: Temperature/Volume Analysis



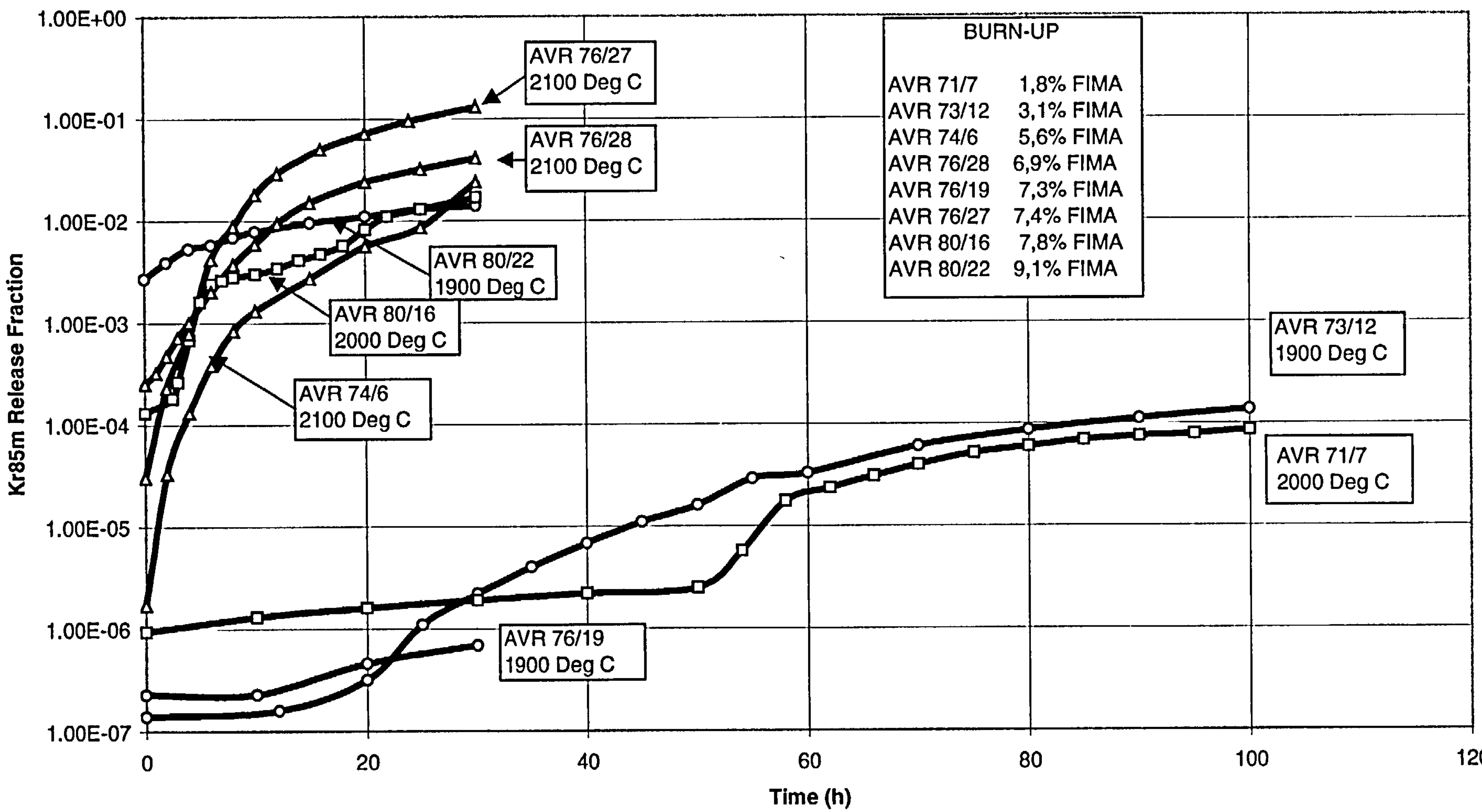
P B M R



Kr85m Release Fractions vs Temperature for Annealing of AVR Fuel Elements
at 2400 and 2500 Deg C
BURN-UP
AVR 70/19 2,2% FIMA
AVR 74/8 2,9% FIMA
AVR 80/14 8,4% FIMA
AVR 80/14
2500 Deg C
AVR 70/19
2400 Deg C
AVR 74/8
2500 Deg C
Kr85 Release Fraction
1.00E+00
1.00E-01
1.00E-02
1.00E-03
1.00E-04
1.00E-05
1.00E-06
1.00E-07
1000
1200
1400
1600
1800
2000
2200
2400
2600
Temperature (Deg C)

P B M R

Kr85m Release Fraction vs Annealing Time at Temperatures above 1800 Deg C



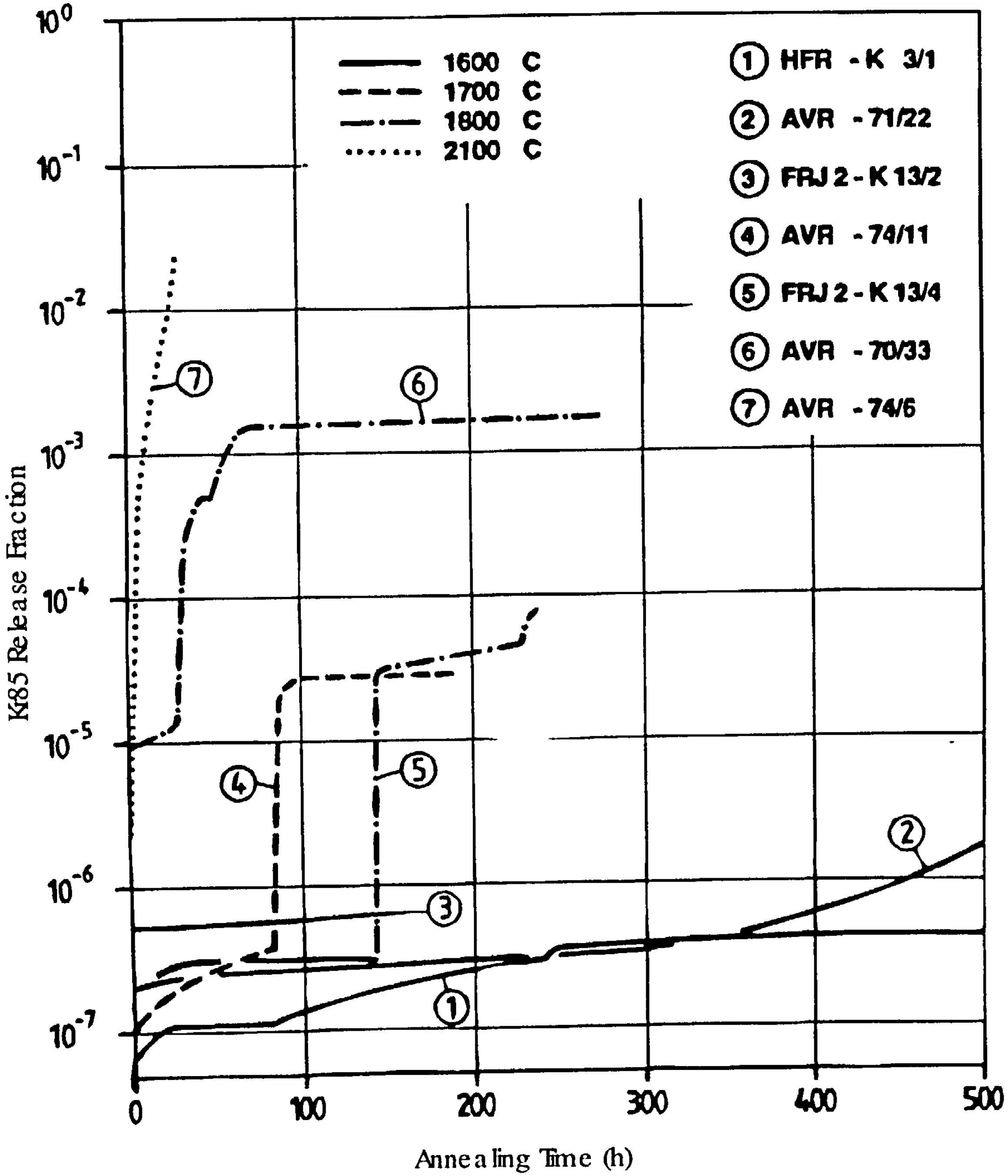
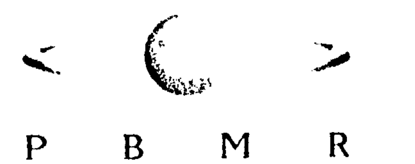


Figure 3: Kr85 Release Fraction as Function of Annealing Time



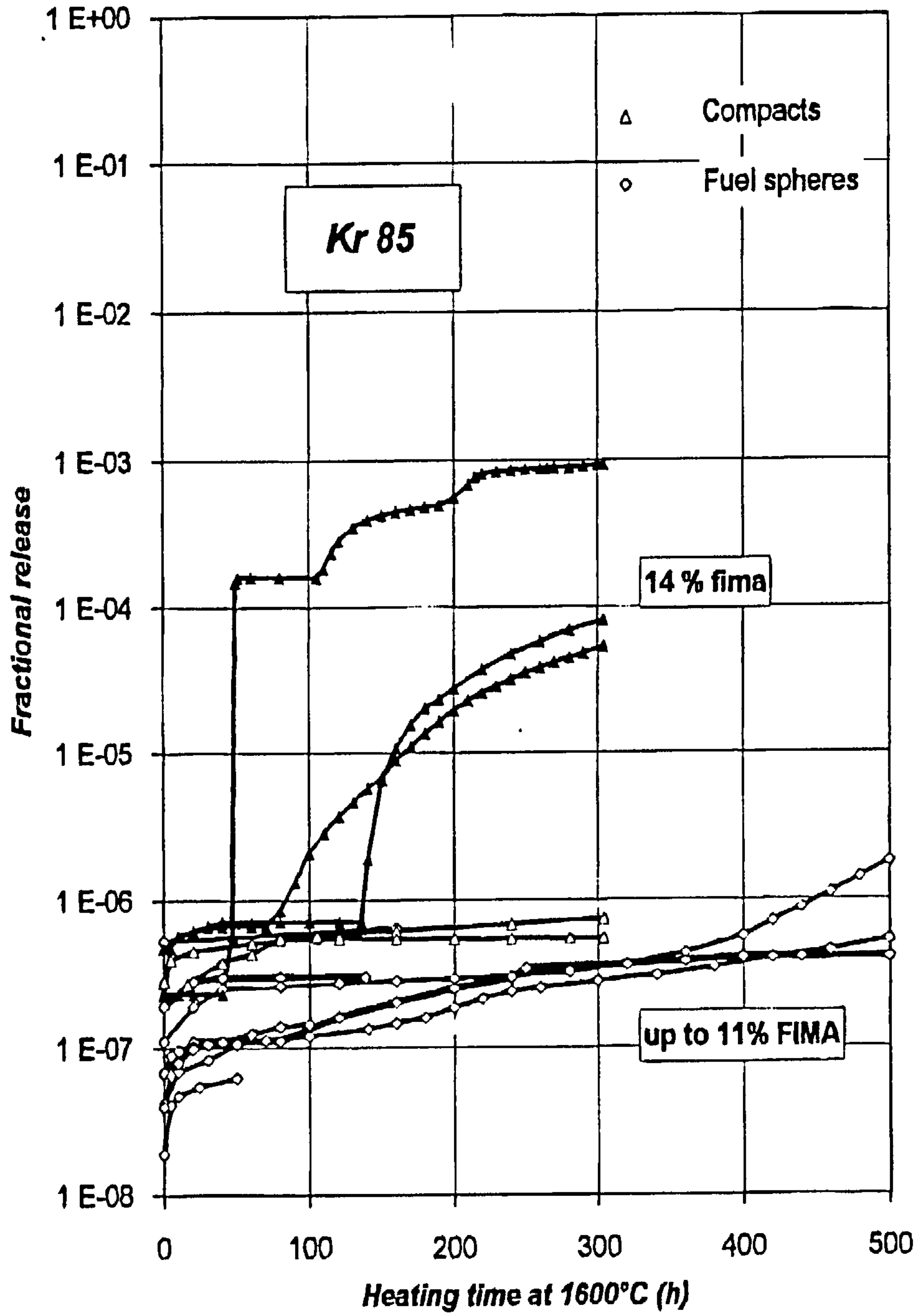


Fig. 4.6: ^{85}Kr release at 1600° C from compacts (10.7 to 13.9 % FIMA) and fuel spheres (3.5 to 9% FIMA)