

uproot the teaching, training programmes taking us back to 16th century (rather than 21st century).

It is rather hard to believe that when the entire world is engaged in finding solutions to problems like scarcity of human tissue by advocating xeno-transplantation, we are going backwards in an attempt to take extra care of animals. Performing experiments on animals without acquiring necessary skills is more inhumane than handling of animals by a skillful researcher.

The production and use of transgenic animals has enhanced the number of scientific experiments and procedures performed on laboratory animals all over the world. It cannot be denied that the transgenic technology could provide significant benefits, for example, in the manufacture of biopharmaceuticals. It may be noted that animals involved in

these experiments are given good care. Scientific ambition and commercial opportunism are likely to overwhelm every other kind of consideration in the use of animals. Thus in this changing scenario it is difficult to stop animal experimentation and go backwards when we are ready to take a leap into the 21st century.

The clause in the notification about applying for written permission with the exact number of animals required, complete experimental design and acquiring sanction from the funding agency seems impractical and ridiculous. The authoritarian approach of various Government agencies, lack of expert manpower with technical knowledge on the various individual projects and 'swift movement' of sanction papers will not allow the scientist/researcher to perform his work in the

optimum time frame. This seems to be a potential problem in obtaining sanction for the use of animals.

With a lot of atrocities and whimsical myths displayed in the notification, one wonders whether we are interested in promoting good scientific culture and ethos or promoting a culture of inefficiency. Probably, Indian scientists will never be able to generate a 'Dolly' and would still be proud of it because as Indian scientists we have started loving our animals more.

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## Nuclear breeders

Here are some comments on the paper 'India's Nuclear Breeders: Technology, Viability and Options' by Rahul Tongia and V. S. Arunachalam (*Curr. Sci.*, 1998, 75, 549-558).

1. Projections of the power generation capacity and the efficacy of proposed strategies are strongly dependent on the assumptions. Optimistic assumptions would naturally lead to a rosy picture and conservatism to a pessimistic one. It is not always easy to strike a proper balance. As a result, a close examination of the assumptions for realism as well as completeness is essential for a proper assessment of the projections and strategies.
2. The authors of the above paper have concluded that the three stages of the previously enunciated plan for nuclear power in India appear non-realizable even in a fifty-year time span. It is obvious that they have in mind the first half of the next century. They recommend commissioning of a substantial number of heavy water reactors as well as light water reactors, to enable a reasonable growth in nuclear power contribution in the immediate term. For some time now, the plans of the Department of

Atomic Energy have also provided for such a mix of reactor types.

3. Taking the conclusions of the paper further, let us examine the scenario. The paper projects a total installed capacity in the country of about 600 GWe over the next fifty years<sup>1</sup>. If nuclear power based on light water reactors were to contribute even a modest 10% of this, 60 such reactors (each of one GWe rating) would need to be built<sup>2</sup>. To realize this in fifty years, four parallel teams would need to be deployed, each working on a 2 GWe station and taking seven years for its completion before moving on to the next similar project.
4. Natural uranium requirements for 60 such reactors over a forty-year working life amount to about 290,000 tonnes. This is about four times the size of the indigenous uranium resources. If the technology and the fuel materials for LWRs were indeed procurable from outside sources, the strategy would tremendously supplement Indian fuel resources. But, unless arrangements are possible for recycling the plutonium produced in these reactors, the dependence on outside sources would be perpetual. However, such recy-

cling in this same type of reactors could at best help maintain power generation at the same level.

5. A noteworthy result arrived at by the authors is that starting with plutonium accumulated only from PHWRs operating on indigenous uranium, it is possible for nuclear power to grow to as much as about 240 GWe (30% of a total capacity of 800 GWe as indicated in Figure 5 of the paper) in a matter of fifty years, providing that we build fast breeder reactors designed to operate on fuel in metallic form and select a dry process for recycling the fuel. This growth rate, it should be noted, is based on rather conservative assumptions by the authors. Fast breeder reactor systems of the kind mentioned above were advocated in DAE quite sometime ago<sup>3</sup>. Theoretical analyses were made and laboratory scale studies on the techniques of reprocessing are going on. What, in effect, this paper now points to, but does not mention, is that earnest efforts should begin right away for indigenous development of the required FBR technology, to be able to benefit from it later.
6. The current proposal to build a PFBR, which is to operate on oxide

- fuel, would help acquire valuable experience in fabrication and performance testing of large-sized subsystems and components for operation with sodium<sup>4</sup>. Simultaneously, efforts need to be mounted for development of techniques for dry reprocessing of metallic fuel and for remote refabrication of the recycled plutonium. As India may be alone in undertaking such efforts, a fifty-year time frame for perfecting the technology is not unrealistic.
7. Sodium-cooled fast reactors produce better quality steam at higher temperatures (~500°C) compared to water reactors, yielding a higher thermodynamic efficiency (~40%) and reducing waste heat rejection to the environment. System pressures are low leading to lower amounts of stored energy in the coolant. Boiling point of sodium being high (about 900°C), heat removal from the fuel is possible over a wider range of temperatures, which considerably lowers the probability of fuel melt-down. These are noteworthy safety features.
  8. There is also recognition among Indian analysts that the choice of fast reactor systems with metal fuel along with adoption of dry reprocessing method for recycling of fuel, yield

- other important advantages<sup>5</sup>. These systems obviate separation of plutonium in pure form, thus allaying fears of parties obsessed by prospects of plutonium falling in wrong hands. Further, the dry reprocessing technique considerably mitigates the issues concerning radioactive wastes, as it generates waste in smaller quantities and in forms much better suited for long-term storage.
9. It is also important to bear in mind the difficulties associated with large-scale mining of coal in the country. It is believed that doubling of the coal output in the eighties from about 100 million tonnes to 200 million tonnes was possible because of resort to the simpler surface mining operations. As we turn to mining from depths, the operations grow more challenging. Moreover, too great a reliance on fossil fuels brings in the question of carbon dioxide releases and raises apprehensions about global warming. In sum, it is clear that India cannot afford to ignore the potential of nuclear energy, but will have to choose thermal reactors for the immediate term with fast reactors for the longer term, and move quickly towards implementation of the plans.

1. This amounts to a six-fold increase from the present capacity with a doubling time of about 20 years, which appears conservative. However, this same projection would seem optimistic if one reckons on the basis of the largest additions achieved so far in any one year, of around five Gigawatts, which if sustained leads to a total of only about 350 GWe in fifty years.
2. In comparison, PHWR programme based on indigenous uranium (about 70,000 tonnes) could permit a peak capacity about 15 Gigawatts.
3. Paranjpe, S. R., in Seminar on Indian Fast Reactor Program organized by FOPSAK, Kalpakkam, 1992.
4. The capacity build up based on oxide fuel systems is comparatively slow according to the authors, barely rising to 30 GWe or so in fifty years (Figure 5 of the paper) as doubling time for oxide fueled breeders is quite long.
5. Saha, B., Sundararajan, A. R. and Krishnan, L. V., *Prog. Nucl. Eng.*, 1995, 29, 125-132.

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## Author's travails

I submitted a manuscript to this journal sometime ago. It is more than 8 months since then. There was no response to a couple of enquiries by email. I have now received the referee's report which simply says that it is not suitable for *Current Science* because it deals with an ambiguous area.

This raises some important questions:

1. Why does one submit a paper to *Current Science* if it takes more than 8 months to communicate referee's report? I can understand that sometimes certain referees could have genuine difficulty. The editors then should have alternatives, particularly for a Letters submission. Anything more than 6 weeks would be bad. It is, moreover the responsibility of the editorial office to keep the author informed of the status, or in the least to respond to his enquiries.

2. I would expect that the editors should themselves deliberate on the referee's report which expresses only opinion about the paper being of general interest or interesting enough. For instance, in this case the referee seems to have missed the whole point of the paper. Even if by using something which is not unambiguous, if one obtains something of understanding and insight, it deserves attention and publication.
3. I would seriously ask for tightening up the processing system. Once earlier too, a paper took 4 months, and a couple of enquiries to get the decision. The only difference at that time was that the report was late but positive. Of course, this is my experience which may not be representative: may be accidentally I seem to fall into the preferred bin of statistics!

Since the whole charm of the paper is lost by the inordinate delay, I would urge the journal to set its house in order.

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### Editor's Note

*While every effort is being made to process manuscripts quickly, instances like this are a reminder that editorial housecleaning must be a constant process. We can only apologize. In addition to editorial penitence, we might like to urge reviewers and editorial board members to help us speed the decision-making process. Authors may also help by suggesting names of referees to allow us to expand our pool of referees.*