ANUMUKTI

A JOURNAL DEVOTED TO NON-NUCLEAR INDIA

Vol. 1 No. 4 **February 1988**

'That *corpse you planted last year in your garden,*
**Has it begun to sprout ? Will it bloom this year ?*
'Or *has the sudden frost disturbed its bed* ?
'Oh *keep the dog far hence, that's friend to men,*
'Or with its nails he'll dig it up again
The Wasteland *T. S. Eliot*

A reader, Shri. R. K. Patil of Nagpur has written in to ask, "Is it possible to dispose radioactive waste in a manner non hazardous to human health ?'' The answer in one word it *NO*. The answer preferred by the nu:lcar establishments is 'not yet' with the stress on yet. Thus the dispute is not about the *fact* that there is no known way of getting rid of the large piles of these hazardous substances. Now can there be much disagreement about the seriousness of the danger posed by these intractable and highly toxic pollutants. The newspapers have *been* full of stories which highlight this aspect—from the Brazilian tragedy where ignorance, exuberance and a mere 100 gnu. of Cesium-137 combined to make pariahs of the one million residents of Goiania to the West Germ in scandal where old fashioned bribery has played havoc with the supposedly 'foolproof full-scope safeguards and one finds hundreds of bombs' worth of plutonium and uranium simply 'missing'. Reports speak of its appearance in Libya and Pakistan—but that is all old hat. In the nuclear age of 'plenty' for everyone, the question is—do the PLO, LTTE, GNLF, XYZ...have the Bomb ?

The only point of controversy then is about the timeframe in which a solution might be found. Nucleocrats usually claim that a solution is just round the corner. With touching faith they assert that technology itself shall solve (as it always has) the problem it has spawned. All they ask for is a little forbearance. Some more time to do mote 'research.'

In a trivial sense the solution to the problem of radioactive wastes has always been known. It is just to wait and do nothing. Radioactivity is the result of energy 'shedding' by unstable nuclei of atoms. Over time these nuclei naturally decay and the activity of given mass decreases. However, since radioactivity is a nuclear property and has nothing to do with the electronic configurations of the atoms (on which chemistry depends) there are no chemical means to speed up the process of radioactive decay. Thus the problem of 'disposal' of radioactive wastes becomes one of how to isolate the

waste and keep it from contanianating the environment for the millenia it takes for the man-made radionuclides to naturally decay.

'solution' which just two drendes ago looked very promising now appear dangerous. In face, greater knowledge has made the problem more and not less intractable. Recent developments in applied mathematics seem to suggest that "some forms of environmental unpredictability are intrinsic and hence incurable." The irresistable force of scientific omnipotence has met its irremovable object—dangerous objects which won't stay put.

In the meantime; scientists research, nucleocrats bring out new public relations gimmicks an*d* antinukes protest : while the wastes pile up day by day.

Surendra Gadekar

Anumukti deeply mourns the death of Dr. A. K. Ganguly who was a friend, teacher and a valuable ally to many voluntary environmentalist organisations in the country. A pioneering environmentalist, it was he who established the discipline of Health Physics in India. The courage he displayed in refusing to compromise his rigourous stand on safety no matter what the pressures, whether political as in the case of Narora, or from peers as in the case of radiation exposures at Tarapur was indeed exemplary.

LETTER BOX

Anumukti, I assume is addressed not only to a small circle of experts or those who have been interested in the topic for a long thru. Therefore it would be important to have an introduction to technical terms at least in one issue of the journal. An introduction to the scientific and technical background of the subject would help newcomers to understand the subject matter. With such a basis a wider cirle of readers could be addressed. Secondly, informartion about and analysis of the connection between nuclear energy and nuclear arms is important. In addition to this a discission of the alternatives is absolutely neccesary. Reports about activities concerning solar, wind or hydro-energy should be included in the journal as a constuctive criticism of atomic energy.

Markus Schuetterle
Matara, Sri Lanka

It was a welcome surprise coming across the article "Save the Western Ghats—March" in Anuraukti vol t no 3. With succeeding Indian Governments accelarating our suicidal take for technological parity with so called 'developed' nations, the quality of human life now and in the future stands threatended from various angles. Nuclear power is just one of these, and if a movement against it does not interrelate with other similar movements, a united forum of protest cannot be forged.

Another sad fact is that the lack of a proper communication system enables the people in power to proceed in blithe disregard of public interest and public opinion fails to get properly mobilized. Movements like 'Chipko' stand out as beacons of encouragement for other movements. The lesson is that with perseverence, motivation and the involvement of the common people (whom these projects hurt most), the voice of reason can be conveyed loud enough for those in power to take note.

I hope that Anumukti not being a journal only devoted to a non nuclear India, will continue to include similar articles and news-reports of protest movements and help to bridge the communication gap that exists.

Abhijit Das
Varanasi

DEADLY CROP IN THE TANK FARM

The safe storge of radidatire wastes is not a problem of mere academic interest. It effects us all Below we present a shortened summary and some of the conclusions of a no *page report prepared by Dr. Arjun Makhijani, Robert Alvarez and Dr. Brent Blackwelder for the Environmental Policy Institute. The report is based on official documents obtained through requests under the Freedom of Information Act. The report describes the operation of an existing nuclear facility in South Carolina. It contain. many lessons for us in India.*

Eight hundred trillion curies *of* deadly high-level radioactive wastes are stored in the Savannah River Plant (SRP). Although 27 million gallons of these wastes constitute about one third of the total volume of military high-level radioactive wastes in the U.S., they contain about 78 percent of the total radioactivity in all U.S. military high-level wastes. SRP's high-level wastes pose a serious threat to the plant's workers, to the people who live in substantial portions of South Carolina and Georgia, to future generations and to the environment. The rates of radiation-related cancers among workers are already significantly higher than expected. The plant site borders the Savannah River and sits atop the Tuscaloosa aquifer, one of the most prolific and used sources of fresh water in the eastern United States. The 300 square mile site and the shallow aquifers above the Tuscaloosa are so severly contaminated that it is reasonable to conclude that it has been treated by the federal government as a national sacrifice area for the U.S. nuclear weapons program.

The high-level radioactive wastes which continue to build up at the Savannah River Plant result from the production of radionuclides for the U.S. nuclear weapons program. In particular most of the wastes come from the production of plutonium in nuclear reactors and the subsequent reprocessing of the reactor fuel rods in chemical separations plants. The SRP is owned by the *U.S.* Department of Energy (DOE) and operated under contract by E.l. du Pont de Nemours and Company (DuPont). Most of the major equipment - such as the reactors and reprocessing punts, as well as many of the tanks, date back to the 1950s. This is a field in which technological change and safety standards have changed rapidly. Yet in recent years the basic approach to watte management at the Savannah River Plant Tank Farm has changed but little. In fact. the operating record of the obsolete facility shows that its very design basis was faulty and dangerous.

There is also substantial evidence that these problems have been compounded by unsatisfactory management in many areas crucial to safety. Both Dupont and DOE appear to be more anxious to minimize any adverse consequences and thus allay public fears than to address operating problems and risks from accidents in a scientific and technically responsible manner.

We summarize the issuse under the following four headings :

- o Routine Environmental Contamination
- o Accidents and Risks
- o Worker Exposures and Cancer Risks
- o Long-Term Management

Routine Environmental Contamination

The design of the Savannah River Plant assumed that radioactive wastes could be routinely discharged into the soil because the soil would trap them and prevent them from contaminating water supplies, particularly in the case of some of the more deadly materials like plutonium and ccsium-137. Little thought appears to have been given to pollutants from non-radioactive toxic materials and less to interactions between the two kinds of pollution.

Time has shown both the design premise and the omissions to be serious errors. Radioactive materials and non-radioactive toxics have contaminated the shallow aquifers beneath SRP. Interaction between solvents and plutonium has caused it to migrate into the groundwater in twenty years-compared to a predicted time of hundreds of thousands of years. Despite repeated internal and external efforts to stop these dangerous and technically obsolete and erroneous practices, Du Pont and DOE continue routine discharges of toxic materials into the soil.

lf tho SRP site is not to become a permanent national sacrifice area, a massive clean-up of the site will be required. DOE has estimated that the first seepage basin cleanup would require a billion dollars. The problem of clean-up is bound to be severely complicated by a lack of data and unreliability of such data as there is.

We have two widely differing estimates for plutonium in the high-level waste tanks. Data in DuPont Safety Analysis Report (issued in 1978) yields, an estimate of about 170 Kilograms of plutonium containing 300,000 curies of radioactivity, for 1980. However, in 1980 DuPont supplied an estimate of 1 million curies of plutoium - about 400 Kilograms - to the National Academy *of* Sciences. This enormous discrepancy, serious both for plutonium accounting from the security point of view, and for its potential environmental consequences, is unexplained.

Accidents and Risks

Some of the most technically difficult aspects of waste management at SRP have to do with the problems associated with accidents and risks to the public and to future generations.

Consider, for example, the question of hydrogen build-up in the high-level waste tanks due to the action of radiation on hydrogen-containing chemical compounds in the waste. A build-up of hydrogen to high enough levels, due to partial or total failure of tank ventilation systems for example, could cause an explosion severe enough to destroy the tank and send millions of curies of radioactive waste spewing into the air and onto the land. Such an accident could cause up to 20.000 cancer cases in addition to genetic damage and other ill-health effects. In addition, a very large area of land would have to be written off essentially for ever. It would also have unpredictable repercussions, possibly very severe, for groundwater contamination.

The DOE and DuPont approach to such accidents irresponsibly assumes that groundwater contamination can be ignored as "insignificant" because the soil will retain the radioactive wastes. This assumption has been shown to be invalid by SRP's own operating experience and has been criticized by the U.S Geological Survey, DOE and DuFont-also-assume that water me patterns and many other. factors will not change significantly *fat* a hundred years or more. This is not merely arbitrary, It is contrary to evidence. Water use patterns have changed immensely in the past few decades with DOE and irrigation being major contributors to that change. Indeed, in other reports, DOE plans on continuing to contribute to signifiant increases in water use.

SRP was not designed to withstand severe earthquakes. In the last few years, howcvcr,both the U.S. Geological Survey and the Nuclear Regulatory Commission have concluded that severec earthquakes, comparable to the one in Mexico City in 1985, cannot be ruled out. The Nuclear Regulatory Commission has criticized the SRP assumptions of moderate earthquakes at most, to "contain a strong element of speculation." A severe earthquake could cause millions of curies of radioactive wastes to contaminate the air, soil, and water of the area. Even using the non-conservative assumptions of DuPont and DOE, it would cause from IT,OOO to 230,000 excess cancers and up to 2,500 genetic defects in future generations. The direct cost, moderately estimated, would be from 5800 million to $14 billion-excluding the cost arising from writing off of large areas of land, from contamination of water supplies, from property, agricultural, and business losses.

Current law specifies maximum DOE liability as $500 million. DuPont is exempt from liability to the public in the event of accidents, earthquakes, and other catastrophic events. It exempts contractors from liabilities arising even from their own negligence.

Worker Exposures and Cancer Risks

Workers at SRP receive considerable doses of radiation just by being on the site because of routine emissions and radiation from site contamination. These doses averaged about 150% more than the doses received off-site from background sources. In addition, various types of work involve additional exposures.

The external radiation doses to SRP workers alone can be expected to cause between *16* and 330 excess cancers among SRP workers, with more than half of these expected among, waste and reprocessing area workers. Already there are definite indications at SRP and at

other DOE owned nuclear facilities around the country that workers are contracting and dying from radiation related cancers. Some examples :

- o At SRP, the incidence of myloid leukemia has been more than double the expected number (6 occurred versus less than 3 expected.) :
- o At the DOE owned Oak Ridge Gaseous Diffusion Plant, a study found "excess deaths due to lung and brain cancers and respiratory disease..."
- o A study of 2,509 DOE workers exposed to more than 5 rems between 1947 and 1978 showed a rate of cancer of the rectum at three times the national average among them.

The emergence of an alarming pattern of excess cancers has elicited a curious response from DuPont. An internal 1976 study by DuPont found "evidence...that lung cancer and leukemia were significantly increased..." among workers. Instead of publishing the study, DuPont attempted to erase the significance of its findings through statistical manipulations. Even an adisory committee to DOE found these manipulations "inappropriate," and recommended that the data be reanalyzed by a non-DOE/DuPont group.

The data themselves are not in good shape. One of the principal sources of data-the computerized Data Bank for accidents and non-routine maintenance is missing thousands to tens of thousands of entries. Moreover, there is very little data on interal radiation exposure-through inhalation, ingestion and wounds. Most of the reported data is gathered by obsolete and discredited methods. This is a crucial area for evaluation of safety practices, and liability, since internal exposures are emerging as a principal cause of radiation related cancers. The records of DOE are particularly poor in this regard,

Long-Term Problems

Little attention was paid to the problem of long-term waste management when the plant was designed. In the early years, it was simply assumed, without significant geologic or other systematic scientific investigation, that the wastes could be safely pumped into the bedrock underneath the plant site, and below the much used Tuscaloosa aquifer. Pending such long term disposal, it was decided to store the wastes in carbon-steel tanks which were much cheaper than stainless steel tanks. However , this required the neutralization of the highly acidic wastes discharged from the SRP reprocessing plants, so that the acid would not corrode the carbon-steel. This created a much larger volume of waste, including sludge which is difficult to handle.

Eight of the first sixteen tanks developed leaks in the primary containment in about a decade. This has required much more handling and moving of the wastes than planned - which in turn causes more equipment and process problems, worker exposures and environmental contamination.

The plan to dispose of the wastes into the bedrock under the plant has been abandoned in favor of solidifying the wastes by encapsulating them in glass. Solidification of the liquid wastes is urgently needed.

However, the current glassification plans, which arc being implemented, also face some serious problems.

The operating record does not bode well for the proposed waste vitrification facility at SRP called the Defense Waste Processing Facility. This will require much waste movement and remote operation. If heavy maintenance and repair arc required, worker exposures may increase. Further, there is no operating experience even at the pilot plant level for vitrification of radioactive sludge, which has been the source of considerable handling problems. Unanticipated breakdowns or failure of the plant to operate as predicted could result in costly delays in the implementation of long-term waste management, while at the same time-leaving the wastes in the current dangerous liquid form.

DOE also plans to dump very large quantities of "low level" wastes, solidified in concrete, as part of its program. This will increase the radioactivity in the low-level burial grounds many fold. It almost certainly will contaminate the groundwater with very much larger quantities of radionuclides than are already present. In particular, it will increase plutonium-238 contamination by about 100 *times*, and that by iodine-129 and technicium-99 by *several*

million times over the amounts that have been discharged already as "low-level" wastes into the seepage basins.

Some General Recommendations

- o The Department of Energy should not be allowed to continue to regulate itself or its contractors.
- o Current legal limits on DOE liabilities should be lifted. Further, DOE contractors should be held financially accountable for major accidents stemming from their negligence. Both would be great incentives for safety.
- o Independent studies on various aspects of the plant such as health and safety, decommissioning and long-term disposition of the site should be initiated. All documents relating to these matters should be made public.
- o The Savannah River Plant should be barred from producing any more high-level liquid radioactive waste until the long-term questions are satisfactorily resolved.

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Nuclear Seas

There are approximately 900 nuclear reactors in the world, with 374 in operation on land and over 500 at sea, powering USA, UK, French Soviet Chinese, and now Indian vessels. Reactors at sea operate without any regulations covering radioactive discharges or accident reporting. They are a continuous, moving source of radioactive pollution, and frequently break international law by travelling submerged within territorial waters of other countries.

The 500+ reactors at sea frequently operate in hazardous conditions and have regularly run aground, sunk, suffered fires, floods, mechanical breakdowns, and have collided with fishing boats, tankers and other warships. In the past ten years there have been over 200 accidents with Soviet subs alone, including the sinking of 3 subs complete with reactors and warheads. Two US subs have also sunk, and between 1965 and 1985 the US navy has had 628 "incidents" and two "accidents" involving nuclear weapons. It is impossible to calculate the risk of a major nuclear accident at sea because of the secrecy surrounding their operation and records.

Ireland is in the frontline of much nuclear activity with the Irish sea containig up to 15% of the US nuclear arsenal at any time and Warsaw Pact vessels on surveillance at either end. Both NATO and Warsaw Pact nuclear submarines travel underwater within Ireland's three mile limit, staying within the warm coastal waters to avoid infra-red detection by satellite. Nuclear subs can also carry up to 160 nuclear warheads. Thus these vessels not only pose a threat in themselves but they arc also a target in the event of war and have the capacity to initiate a nuclear war.

Since the oceans are an essential part of life and provide protein for much of the world's population, it is imperative that the non-nuclear communities of the world unite against the continuation of the unacceptable contamination and threat to the seas. Earth watch, Irish CND, and Greenpeace-UK have plans to step up the campaign to denuclearise the Irish Sea, as part of the recently launched Greenpeace International campaign to Disarm the Seas.

Editors Note : This ought to be read in conjunction with newsreports about India's acquisition on lease of a Soviet nuclear powered submarine which would give the Indian Navy 'deep strike' capability. Those newsreports should be read together with other newsreports about India's sudden 'desire' to buy two nuclear power plants from the Russians and giving the go-bye to the much flaunted self reliance in the nuclear field.

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Nevada Wins the Booby Prize

Thirty years of debate and uncertainty have been brought to an abrupt end by a sudden decision by the U.S. congress to name Yucca Mountain, Nevada as the site of the United States first repository for high level nuclear waste. The decision throws out the scientific site selection process laid out in the 1982 Nuclear Waste Disposal Act.

The 'honour' of being the site of the repository for high level-waste had originally been conferred on an abandoned salt mine in Lyons. The project was, however, cancelled in 1972 after two severe technical problems had become apparent. The area in which the proposed site was to be located was literally riddled with drill holes and cavities from numerous previous mining activities. If all the holes could not be detected and sealed -which was likely- the long term integrity of the site could not be guaranteed. The other discovery was of small pockets of brine in the salt. It was found that brine migrated towards the emplaced source of heat (the simulated waste) and corroded the metal canisters.

The congressional decision was greeted by howls of fury in Nevada. Governer Bryan attacked the decision as a "legislative atrocity" that "blatantly rejects the law of the land" and promised a "nuclear nightmare for the congress." The state will fight in the courts and through "whatever other avenues needed."

The selection process abandoned in the now legislation would have required the preparation of a short-list of *6* sites - 3 each west and cast of Mississippi - and each stable enough to store radioactive waste for 10000 years. A site would then have been chosen first in the west-less population density but far from the waste producing reactor sites thus entailing longer transportation - and some years later in the relatively more crowded east. But the process proved unworkable, despite many years of debate. In May '87 the department of energy tried to take a short cut by announcing three sites in the west (among them Yucca Mountain) and giving up the search for sites in the east. But the resulting uproar from the west quickly lead to demands to restart the whole process. Given the level of opposition everywhere, it became apparent that it might take decades to complete the assesment of even three sites. Earlier this year there was a proposal that a 100 million-a-year incentive be paid to any state willing to open up the first high level nuclear waste dump. But no state was found mercenary enough to commit suicide.

Now Nevada seems saddled with the dump. The great advantage of Yucca Mountain, a 1500 foot high ridge of volcanic rock, is that it lies well above the water table. A shallow storage area, 1200 feet underground would seem to permit easy access while avoiding possible groundwater leaching of wastes. Yucca Mountain is in a corner of the Nevada nuclear test range and far from human habitation. But state geologists argue that the site lies near an active fault and that a major earthquake or volcanic eruption may split it open. More immediately, the local tourist industry would suffer as visitors start sharing roads with waste bearing trucks. All these fears would have to be addressed in the ensuing site investigation, and if they turn out to be well founded, then the whole process will have to begin again at a new site with a delay of many years.

That site selection is no easy matter is clear from recent tevelations concerning U.S.'s first permanent site for low level waste, near Carlsbad, New Mexico. 700 million dollars have alredy been spent on a vast network of tunnels and storage rooms burrowed 2000 feet into thick salt deposits. Back in 1957. salt deposits were considered as the best repositories since the very pretence of salt indicated that there had been no groundwater incursions. However in just thirty years attitudes have had a sea change and it is now felt that "the area was selected in haste."

Sources : Nature 330, 682 24/31 December 1967
R.Pohl's stricle, "Will at busy Put" ia "Nuclears POWER—Both Sides" by M Kakus and J. Tcainer.

Editor's Note : There is *evidence of continuous human habitation for 10000 years of the Nevada Test Sit*. Nuclear activities the world over seem to have a special attraction for lands of tribals-politicaly the weakest section of society.*

Another Pyrrhic Victory

Pyrrhus, king of Epirus (318-272 B.C.) fought a war with the Romans in 280 B.C. on the bank of Siris at Heraclea and defeated them. But the victory was won at too great a cost. "Another such victory and we are lost", he is supposed to have reflected (Geddie 1966). Problems of nuclear waste disposal have brought us on the threshold of another Pyrrhic victory.

Radioactivity was discovered only in 1896 A.D. but existed prior to its discovery too. Around 1500A.D. miners in Saxony and Bohemia died, after working on pitchblend excavation for about 5-10 years, of what was merely called lung disease. It is now deduced that the concentration of Radon (222) and its radioactive daughter products was at 10 to 20 times what arc now considered safe working levels, and it was the cause of those deaths. (Morgan 1976a). But as radioactivity was then not formally discovered, these deaths could be attributed to ignorance and regretted. Decades after the lethal effects of radioactivity were known, 60 uranium miners died of lung carcinoma because they were required to work at high risk levels. "It needed a unilateral rectitudmous action on the part of one individual in direct opposition to three powerful agencies, which could not be suspected to be innocent, to reduce the maximum permissible exposure level (Morgan 1976a) to a value recommended by the International Commission of Radiological Protection." The death toll and the incidence of radiation-caused cancer have in the meanwhile followed an inexorable but a sad course (Morgan 1976a). The lesson obviously is that there is a strong nuclear lobby and few deaths would not deter them to deviate from the disastrous direction they have opted for.

It was initially thought that the resiliency of the natural environment to absorb pollutants was large and could be depended upon to dispose the pollutants off. As a result, even in 1943, it was considered reasonable to discharge radioactive waste in the White Oak lake (Morgan 1976a). The policy was that of "dilution and dispersal" (Morgan 1976b). There was pressure to accept occupational tolerance level which was 3.6×10^7 times as high as what is now considered accetable, Even when that pressure was not succumbed to, the level was still 36000 times the current recommendations (Morgan 1976a).

The Reality

Some of the radionuclides that can adversely affect health are among others tritium, strontium-90, cesium-137 and the transuranics. Typical halflives are 12 yrs, 30 yrs, 30 yrs and 25,000 yrs for tritium, ccsium-137, strontium-90 and plutonium-239 respectively. That the waste containment should last for 20 half-lives is a widely accepted thumb rule (Karam 1976). This figure would come to 250 yrs, 600 yrs and 500,000 yrs for the four elements above. It is important to note that these periods span a large number of human generations and it is ludicrous for any one to premise responsible and accident proof containment of these dangerous materials. As the total quantitly of nuclear waste to be disposed off increases over years, the thumb rule of containment for 20 half-lives may have to be revised upwards.

The ill effects of the radionuclides include radiation caused cancers and genetic mutations. (Mills 1976). It is well-understood by experts that the damage done is cumulative and irreversible, and the threshold theory is untenable in the light of the experimental evidence. Morgan 1976a) also the sections of society that benefit from the nuclar power and the group that suffers the hazards could be totally different (Peele 1976). Therefore economic cost-benefit analysis is highly improper.

But the issues are normally obfuscated wilfully. The terms such as MPE or MPD (maximum permissible exposure or dose) suggest that below that level, there are 110 risles : at least a layman would thick so. Subjecting unsuspecting population to unwarranted hazards violates the ethical principle of 'informed consent' which the medical profession is supposed to follow. The whole population has now become guinea-pigs in an experiment which hat potentials of endangering life, human and otherwise, on this planet. It has even

been suggested that nuclear power is incom patible with indefinite sustenance and perpetuation of life on earth in time (Gofman 1976)

The protagonists of nuclear power tend to be callous in this regard. There is even a case of a scientist, who researched on carcinogenic toxicity of plutonium and voiced concern, being removed from job by a prestigious laboratory (Gofman 1976). Thus there is a deliberate attempt to deemphasize the problems. Secondly, there is a naive belief that safety procedures could take care of the problem. The fact, that human record *of* following any procedure scrupulously over long periods is dismal, is discounted. Recently, there was a report (Bhatia 1986) about radioactive parcels lying unattended with the other cargo at Delhi airport for more than 3 weeks, in direct and gross contravention of the pious rules.

In-plant retention of the hazardous material (Oakley and Logsdon 1976) which has been considered, must be ruled out as a solution due to the certainty of evertual human negligence or what can be cupomistically called act of God.

Discharge of nuclear waste in large water bodies, such as lakes and seas is dangerous. It was based on the presumption that the density of the pollutants would get diluted due to convection. This is a blind physical view. There arc many living organismns 111 the wattr bodies. Among them, autotrophic organisms absorb, requisite chemical elements for their sustenance directly from inar imate environment. Heterotrophic organisms live on nourishment they get from other organisms. Autotrophic organisms and an hierarcly of heterotrophic organisms comprise food chains or trophic chains (Lapo 1982) through which elements can be concentrated. Concentration of manganese, iron, vanadium and silver in some microorganisms can be by factors of 1.2×10^6, 6.5×10^5, 4.2×10^1 and 2.4×10^5 respectively (Lapo 1982). It is known that all the elements in periodic table can be used as constituents of living matter, and hence can be concentrated by living organisms. Acantharia use strontium to build their skeleton. Some plants also concenttrace various elements. In fact, the vegetation cover on the earth every year concentrates mineral matter in quantities that can be compared to those of most of the elements in lithospheric reserves, which have taken a geological time for accumulation (Lapo 1982). Not just the single species but whole ecosystems may be involved in concentration of elements. Many nitrogen-containing substances are eventually excreted by the animals. Many other elements after food-chain transport may be concentrated in the excreta of the animals. Uranium is one such element. On the sea coast of Peru the guano has uranium content higher by a factor of 10^4 ascomparcd to the sea water (Lapo 1982).

Apart from concentration of elements through food chains, living matter also performs vertical transport of matter against gravity (Lapo 1982) so that nothing can be assumed to be safely deposited at the bottom of the water bodies permanently and forgotten. The consequences of this role of the organisms arc very dramatic. DDT and radio-nuclides arc found ubiquitously in the tissues of organisms. Even the Antarctic penguins have not missed these in spite of neither DDT nor nuclear power being introduced there and the penguins being fightless. This is because trophic chains engulf the whole worlds' food supply (Willard 1976). Thus radionuclides have already polluted all the food chains. View this in conjunction with the fact that due to his omnivorous character, most, if not all, food chains converge in man, and the true ghastly nature of nuclear pollution of water bodies or for that matter, any corner of the biosphere, would be obvious.

How Many Grains of Salt ?

The present strategy of nuclear waste disposal *is* 'concentration and confinement' (Morgan 1976b). The Atomic Energy Commission (US) report in 1972 stipulates that the high-level radioactive waste be solidified and transferred to a repository owned by the government Karam 1970). A repository is supposed to be completely isolated from the biosphere so that the pollutants cannot percolate into any food chain. Further it is supposed to be a permanent storage facility, so that once the pollutants are deposited there, no more surveillance should be needed. According to one estimate soon about 1000 acres of land per year would be needed to bury radioactive polhartants (Karam 1976).

It was propoded in 1971 by the Committee on Atomic Energy (US) that the radioactive waste be buried in salt mines near Lyon, Kansas. The Atomic Energy Commission was to buy 200 acres of exhausted salt mines plus 800 acres of adjacent salt formations. Thus the scale of the problem is utterly underestimated. AEC regarded salt to be the *most economical encasement* for nuclear waste. It believed that as the temperature rises due to radioactivity, the salt would melt and fill the existing and prospective cracks in the surrounding rocks, providing good isolation. But the U. S. Geological Survey has criticized these conclusions (Hicks 1975). They have argued that all the boreholes in that area cannot be satisfactorily plugged, that subsurface water has been leaking, into the salt formations in that area, that the AEC model considered rock sections to be compounded of sand and shale as against laminated salt and shale which is the actual structure, that the compound effect of subsidence, heat flow, thermal expansion, etc, could break the seal of rock above, facilitating the surface and subsurface water to leak (Hicks 1975).

Number of inferences can be drawn from this controversy. (Firstly, the proponents of nuclear power arc committed to claiming that waste disposal is no problem. They will not tell us that a 1000 megawatt reactor produces more radioactive strontium, cesium and iodine than all the nuclear bomb tests conducted so far, or that the radionuclides generated during the production of one Kilowatt of nuclear power have the potential to kill 2,000,000 persons (Hicks 1975). They would rather tell us that our share of nuclear pollutants could be merely a fraction of a teaspoon (Gofman 1976) or that there are 500,000 square miles of salt in the U.S. alone (Riordan 1981) as if storing radioactive waste is the only utility of salt deposits.

Secondly, they are worshippers of economism. They would seek not a safe, but an economical solution to the problem of waste disposal. They would conduct an 'objective* cost benefit analysis to prove their point. Lost human life is merely so much monetary cost for them. Thirdly, they would not hesitate to suppress or falsify facts (Riordan 1981). "A half-truth is like a half-brick - it travels further", could be their motto (Mark Twain quoted in Hicks 1975). Fourthly, they have a limited temporal vision. If they can obfuscate issues over their life-time, they would be happy. 'Trusteeship of future generations' etc, arc not the notions that can appeal to them. That plutonium-239 has to be stored safely for 500,000 yrs is not an unsettling fact for them. Fifthly, in the present political set-up they arc allied with the rulers, so that no amount of popular resentment can really come in their way. Russell (1931) has written that Leonardo and Archimedes were permitted "to add to human knowledge on condition that (they) subtracted from human life". One wonders whether the governments and the nuclear protagonists have some such understanding !

Conclusion

Nuclear power is a fait accompli. The solution to the problem of nuclear waste disposal discussed in the section above should be thoroughly criticized from the geophysical viewpoint taking into account all the aspects such as thermal considerations, subsidence, tectonism, seismicity, volcanism, ground water flow, etc. Exploration geophysics deals with discovering minerals and structures conducive to the accumulation of minerals so that they can be mined. In the present context, it should study the structures where lethal pollutants can be hidden and isolated for long periods of the order of 500,000 yrs and judge whether proposed structures are, in fact, appropriate for the purpose. It may be remembered here that a committee with geologists, hydrologists, mining and petroleum engineers constituted by the National Academy of Science (US) had recommended that no waste disposal practice should be initiated merely because it is safe today unless it is guaranteed to be safe in future also when the waste production would be significantly larger (Hicks 1975).

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The Fission Connection

Recent events in W. Germany have confirmed the worst fears of antinuclear groups regarding safe handling of wastes. A bribery scandal linked to the illegal shipment and storage of nuclear waste has dealt a severe blow to the image of the nuclear power industry.

The scandal came to light in early December '87 when bribery charges were brought against employees of the nuclear waste transport firm Transnuklear, located in the city of Han au. One of the employees commtted suicide in prison after admitting his guilt. On 17th December it was revealed that Transnuklear had shipped more than 350 barrels of radioactive waste under false labels to temporary storage sites in W. Germany. The waste was intended to be processed in a Belgian reprocessing plant at Mol, and returned.

Mislabelled barrels besan turning all over the country and the numbers grew day after day, throughout the Christmas holidays. More than 1900 barrels were found and it was discovered that 321 barrels were contaminated with traces of plutonium and cobalt-60. Prosecutors are investigating why and to whom millions of marks bribes were paid by Transnuklear.

The next episode in this saga was of reports that bomb-grade fissionable material both plutnium and enriched uranium had been smuggled from W. Germany and Belgium to Pakistan and Libya. One report also talked of Britain and Holland being in on the deal which had allowed Pakistan to acquire 45 kg. of enriched uranium.

All these facilities in W. Germany and Belgium arc under fullscope safeguards. This means that they are under continuous inspection by inspectors of the International Atomic Energy Agency (IAEA) and the European agency (Euratom). The main objective of the inspections is precisely to prevent diversion of fissonable material to 'other' uses from nuclear facilities.

The latest in this continuing drama were allegations in the German magazine *Der Spiegel* that IAEA had great trouble in monitoring significant quantities of nuclear material. These allegations were based on an internal report prepared by the IAEA itself. The magazine said that in March 1986, the IAEA did not know the whereabouts of 188 significant quantities (SQ) of Fissionable Material which were to nave been transported from one nuclear facility to another. One SQ is the amount needed to build one atomic bomb.

The IAEA director Or Hans Blix has ordered a departmental inquiry into W. German nuclear industry's possible vioations of safeguard procedures.

Glasnost in the DAE ?

A few weeks ago, the department of atomic energy (DAE) did something unusual. It actually agreed to allow its senior officials to participate in a public debate which included a few critics of the country's atomic energy programme.

Five top officials—including the DAE secretary and chairman of the Atomic Energy Commission (AEC), Dr M.R. Srinivasan, and the director of the Bhabha Atomic Research Centre (BARC), Dr. P.K. Iyengar—took part in a panel discussion on "Issues in Nuclear Technology" organised by the BARC Officers' Association in Trombay. Ranged against these scientocrats were five "outsiders" with unequal access to information but with arguments at least as strong as theirs. They included Ivan Fera of *The Illustrated Weekly*, Amalendu Dasgupta, formerly of *The Statesman*, G.S. Bhargava, formerly of *The Indian Express*, Dr Dhirendra Sharma of the Jawaharlal Nehru University and myself.

The debate, structured with a bias in favour of the DAE officials, ranged, over four hours and a number of questions, from safety of nuclear energy, weaknesses in the management of the Indian programme, the nature of nuclear decision-making, the adverse economics of atomic erergy, the inappropriateness and limitations of nuclear power in the Indian context, and alternative sources of energy and their future.

It would not be an exaggeration to say that critics gave the worthies of the establishment a run for their money. The DAE was throughout on the defensive, although the discussion was organised in such a way that it was allotted much more time and nearly always had the last word on every issue.

The discussion also showed up many chinks in the DAE's armour, not excluding the ignorance of some of its officials about a number of issues : the energy scenario, the generic problems of nuclear, safety, the severe limitations of the perspective of "electrification" (centralised power generation and distribution) on which the case for nuclear power is founded, and the economics of atomic energy as well as renewable energy sources.

It also revealed that more than anything else, it is sheer faith, irrational faith, in nuclear fission as an ideal source of bulk electricity that underlies most DAE officials' case for ' atomic power.

Iyengar attempted a rather creative interpretation of the process of debate which showed up so many anomalies in the Indian nuclear programme. He announced that *glasnost* (openness) had been launched in the department—thus inadvertently admitting that all these years the DAE has remained closed, top-heavy and bureaucratic—a case that was, or course, ably argued by the critics.

The one-day discussion had several interesting features. It saw Srinivasan admitting publicly—for the first time that any AEC chairman has done so—that renewable energy sources do have a bright future and that nuclear power is *not* the sole future source of energy in a world where fossil fuels arc running out. This represents a marked improvement over the obnoxiously dogmatic and arrogant "nuclear energy only" positions adopted by AEC chairmen in the past.

Srinivasan also emerged as the ablest, indeed the only able, defender of the nuclear programme among DAE bigwigs, to the extent that the peogramme can be defended at all. Iyengar did not even address himself to the question and chose instead to glorify nuclear fission and the bomb as the "greatest scientific achievement" of mankind. He then proceeded to speak of the Madhava cult saints and the deep foundations of Indian scientific tradition !

A. K. De of the Atomic Energy Regulatory Board—that toothless safety agency which is subordinate to the AEC and does not even pretend to be independent of it-emerged as an uncritical supporter of the DAE. Ho had nothing to say about the "instructions" that the AERB is entitled to issue to the DAE in respect of safety' and its refusal to grant clearance to the latter's projects .and practices. With AERB as servile as it is to the DAE, remarked a panelist, the public can expect nothing from it.

S.L. Kati of the Nuclear Power Corporation asserted, without producing any evidence in support, that the DAE is capable of designing and building a 500 MW reactor. He then went to ask if solar cell-based electricity would not occupy too much space creating in effect a solar cell umbrella over our heads 1 (in fact, a one-watt cell occupies an area of only 1 cm^2; hence a 500 MW solar station will not occupy more than a fraction of the hundreds of hectares of land that the DAE takes over for even the smaller of its projects.) But that is another matter.

M.H. P. RAO, who has just retired from the Nuclear Power Board, conceded that the economics of nuclear power is partly a question of subjective choices and the values imputed to various components of costs.

The critics kept up their fire on several grounds : problems of decommissioning and waste storage (disposal being a virtual impossibility); the high costs of heavy water and of nuclear power; the failure of a centralised bulk power generating system to meet the real needs of the mass of the Indian population; the attractiveness of the alternative renewable energy sources and their safe environmentally benign nature; the weaknesses in the indigenous effort and the resulting dependence on foreign sources of design and supply; and, of course, the serious problems of nuclear safety at each stage of the so-called fuel cycle (better called fuel-spiral).

Compounding these are the disturbing features—callous neglect of safety, overexposure of employees to radiation and unconscionable secrecy—that characterise the Indian nuclear programme.

Srinivasan promised to be forthcoming with more information on "every aspect of the nuclear power programme" and to make public disclosures on many programmes hitherto considered to be out of the scope of public scrutiny. He stressed that he is as concerned as the public about safety, site selection and exposure limits and believes in sharing the necessary information.

However, when pressed to answer if he would agree to associating independent environmentalists, experts, health and safety specialists and other scientists, as well as members of the public liable to be affected by nucler projects, with the process of decision-making and review of site selection, emergency procedures, safety standards, etc., he maintained a studied silence.

Evidently, *glasnoss* does not go far enough in the DAE. But one can only hope that it will make some progress and that public scrutiny and evaluation of the department will be institutionalised so that the empire of the atom becomes accountable to the people so long as it exists.

Praful Bidivai

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NOTICE BOARD

ANN Newsletter : Anti Nuclear Network, an organisation based in Bombay was formed as a consequence of the visit of Dr. Helen Caldicott to India last year. They have brought out a newsletter -the first issue of which is a four page cyclostyled sheet. They intend to bring out six issues a year. The subscription price at Rs 25/ycar appears to be somewhat somewhat stiff but I suppose the same might be said of *Anumukti*.

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The scarcity of antinuclear material in Hindi has been a great weakness. Specially now that the rumblings of an antinuclear movement have begun at Narora, this weakness is all the more keenly felt. Dr. Dhirendra Sharma is writing a book in Hindi trying to fill this gap. The book will be about 150 pages in length and will be priced around Rs. 15. Commitments of prepublication sales would greatly help.

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An essay competition is being conducted by Philosophy & Social Action on the theme Nuclear Free World : Nuclear Power and Weapons. The last date for submission of essays to the organisers is 31st May 1988. There are awards of Rs 750, Rs 500 and two each of Rs 250 for essays judged best on grounds of original research, futuristic outlook and creative suggestions for restructuring a pose-nuclear social order.

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THE WINDSCALE ILL WIND

Politicians and scientocrats have always had a very cozy relationship. The shared vision of 'power' and 'progress' have enabled them to ride roughshod over the publics' right to know. The following story documents some of the facts of the Windscale fire of 1957 *and shows how the facts were suppressed in the interest of promoting nuclear power.*

A chilling picture of management incompetence is described in secret papers on the 1957 Windscale fire released by the British Public Record's Office.

The papers reveal there was no basic operating manual, that temperature gauges were in the wrong positions, and that the laboratory where milk samples were tested was out of action at a critical time.

The operators of Britain's first plant built in a hurry to make plutonium for nuclear bombs were close to panic as the fuel temperature rose to 1,300C. In an attempt to contain the damage, fuel channels were dislodged by what one senior manager described as "brute force".

These papers were released on 1. 1. '88 under the (British) rule which allows public access to government documents after 30 years.

But there is one significant omission among the hundreds of papers made available : the evidence of individual witnesses to the committee of inquiry into the fire has been withheld for a futher 20 years.

The Windscale fire remains the most serious nuclear accident in the West, worse than the meltdown at Three Mile Island in the US 20 years later.

Windscale was a military facility producing plutonium for the British nuclear tests of the 1950's. On 7th of October 1957, Pile no I was shut down for a routine fuel element change. However, certain physical processes resulted in an unexpected build up of heat which caused the cladding surrounding the uranium fuel to catch fire. This lead to the oxidation of uranium which in turn caused the graphite block containing the fuel elements to ignite, The ensuing fire raged for three days. The Windscale piles were cooled by air blown through fuel holes which was subsequently discharged into the atmosphere through two 125m chimneys. In spite of the fact that these chimneys were fitted with filters, a huge amount of radioactivity was released, spreading fallout over the UK, Ireland and much of western Europe.

Because of the military nature of the reactor, publicity about the fire and efforts to counteract the fall-out were kept to an absolute minimum. It was not until 13th October that local farmers were told that they would have to destroy milk, by which time the early phase of the radioactive cloud had passed over England.

A meeting of the top management at the Atomic Energy Authority agreed that the publication of a report on the disaster drawn up by the inquiry under Sir William Penney, "would severely shake public confidence in the authority's competence to undertake the tasks entrusted to them and would inevitably provide ammunition for all those who had doubts of one kind or another about the development and the future of nuclear power."

But it was not the authority which wanted to suppress the report, nor the chief scientist on defence, Sir Frederick Brundrett, who said there was "no security objection" to its publication.

Papers declassified show that it was the Prime minister, Harord Macmillan, who was determined to suppress the full damning picture.

Macmillan told his colleagues that the Penney report was "a highly technical document." He had come to the conclusion that "it would not be in the public interest to publish it."

Macmillan's real reasons were geopolitical and had nothing to do with public health and safety. He did not want to jeopardize U.S. transfer of nuclear technology to Britain and secondly he did not want to disclose details of military plutonium production at Windscale,

The fire burst cartridges containing uranium and possibly, it was said at the time, some containing lithium magnesium, material for the trigger mechanism of a nuclear bomb,

The report by Lord Penney—the AEA number responsible for weapons research and development— recorded that "a major technical defect contributing to the accident was inadequacy of instrumentation for safe and proper operation. The absence of an operating manual must, it said, be regarded as "a serious defect". The brief instructions that were available were "clearly inadequate".

It was frequently necessary, the report said, for people in charge of the operation to climb 70 feet to the roof to inspect temperature gauges, which in the event were wrongly set. There was no lift.

There was "uncertainty" about who was responsable for making technical decisions and these were not comminicated to those who should have been told. "In our view," the connittee of inquiry said, "one of the lessons of the accident is that the Windscale organisation is not strong enough to carry the heavy responsibilities at present laid upon it."

It added on the health implications : "It appears to us untisfactory that tolerance levels in respect of several of the possible hazards should have had to be worked out in haste after the accident had happened."

Some of the these criticism were included in a white piper 01 the accident published on November '8 1957. But the white paper contained "reassuring paragraphs on public well-being," which were demanded by tord Mills, the minister of power.

In an annex attached to the white paper, the Medical Research Council said it was satisfied that *"it* is in the highest degree unlikely that any harm has been done to the health of anybody, whether a worker in the Windscale plant or a member of the general public. The secret reports, the papers released show, also reflect this assumption even though it was recognised publicly that no work had been done on calculating the effects of sudden short-term exposure to radioactive fall-out.

A report on the "Health physics aspects of the emergency", released, refers to "nigh contamination" on the early afternoon of October 10, 1957 ,the time of the start of the fire. By 2.30 pm, it says, a stack monitor reading, of 520 curies was recorded, compared to a normal reading of 10-20 curies.

One scientist at Windscale, Frank Leslie, the papers disclose, was unhappy about the handling of the accident. He wrote to the *Minchester Guardian* criticising the AEA for not warning people to remain indoors. Macmillan's response was, "Dr Leslie must be an opinionated ass."

30 years later, the pipers reveal Macmillan himself as both pig-headed and callous.

Sources : Richard Norton-Taylor in Sunday Mail (10.1/88)
WISE News Communique 282.2845.

HATCH REACTOR ACCIDENT

The Elwin Hitch nuclear power plant near Baxley, Goegia ha; experienced what has been discribed as the worst accident at a temporary facility for high-level radioactive waste in US commercial nuclear power history.

Approximately 141,000 gallons of radioactive water leaked out of storage pools, containing spent nuclear furl rois from the plant (levels of radioactivity are several times higher in the Hatch fuel pool than they are in the plant itself). An estimated 84,000 gallons passed through storm drains into a wetlands area located on plant property near the Altamla river. But .it has not been concluded how serious a health threat it may pose to the 50,000 inhabitants who live downstream.

The leak was discovered December 3, 1986. The radioactive waste continued flowing from the spent fuel storage pool for over eleven hours and water levels in the pool eventually dropped five feet. The accident occurred when several safety systems including the leak alarm system failed. This lead to a series of events earlier deemed highly unlikely, if not impossible, by the Nuclear Regulatory Commission (NRC). It also appears that operators had failed to repair a key safety valve they previously knew to be broken. This failure, along with other operator errors, caused the leak.

Source t WISE News Communique : 266.2237

Editors Note : Though this news is more than a year old, we are publishing it firstly slaces it did not make the Indian ~~new~~spapers tad secondly because it provides an illustraction of the dangers posed to surroudings by temporary storage of radioactive wants as nuclear plant sites as is also the practics in India.

Down's Syndrome: A Result Of The Windscale Accident ?

Research by Dr Patricia Sheehan, a specialist on Down's Syndrome from Dublin, Ireland, has Connected Down's Syndrome to radioactive contamination. Dr. Sheehan detected this relationship through a coincidence when, in 1974, a young mother with a Down's Syndrome baby came to her office. While the child was being examined, the young mother mentioned that babies with Down's Syndrome had also been born to some of her school friends.

Down's Syndrome, also known as Trisomy 21, is called after Langdon Pown, who over a hundred years ago first described the classical symptoms. Professor Lefebvre in Paris discovered that the disease is characterised by the presence of an extra chromosome. The cause of the extra chromosome is not fully understood It is considered that the age of the mother is important, as it occurs more frequently when the mother is over the age of 40 yean. Thus Dr. Sheehan felt the remark of the young mother was reason to make contact with other pupils of the school she had attended.

As it turned out, babies with Down's Syndrome were born to six out of the 213 women who had attended the school at the same time as Dr. Sheenan's client. The young women were then 12-18 years of age. Of this group, 53 were married when the study began in 1974. Of the 53. six of them were found to be infertile. The remaining 47 fertile women had a total of 142 pregnancies between them, resulting in 121 normal births, two neonatal deaths due to congenital heart disease, two cases of spina bifida (a genetic problem which causes babies to be born with cleavage of the some), three miscarriages, nine spontaneous abortions, one case of cystic fibrosis and the six cases of Down's Syndrome. Six cases of Down's Syndrome occurring in 142 pregnancies, is an incidence of one in 24 and is significantly higher than the accepted overall incidence of one in 600. This is unlikely to have occurred by chance.

The mothers lived in different areas, and the babies were all born at different times. The only thing the mothers bad in common was the fact that they had all attended boarding school together in Dundalk, on the east coast of the Republic of Ireland, during the school year 1957-1958. It was during this period, in October 1957, that the fire in the Windscale reprocessing plant occurred. Meteorological records show heavy rainfall during that period in. Dundalk. Also, in October of 1957, an outbreak of an illness, similar to influenza, occurred in the school.

When Dr. Sheehan began her study, she was looking for, a possible infective cause in the closed community of the boarding school. However, the possible connection with radioactity and with the Windscale accident could hardly be ignored in view of the coincidence in timing and the relevant information from the meteorological office's records.

This is not the only report of a connection between radioactive contamination and Down's Syndrome. Last year, the West German Institute for Human Genetics detected a significant increase of Down's Syndrome m children born in January 1987 in West Berlin. Researchers early on suspected a direct association with the Chernobyl accident as it had occurred in April of 1986, nine months prior to the increase in cases of Down's Syndrome. The study area was then extended to include the whole of West Germany. The author of the resulting report denied a connection, but in the view of other scientists who later examined the material, 'the significantly higher number of Trisomy 21 cases m children conceived shortly before Chernobyl bore out such a. connection.

Soures: WISE NC 284.2871. 14 December 1987

PRINTED MATTER BOOK POST

Manuscripts, queries etc. should be addressed to :
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K F.I RajghatVaranasi-221 001.
Subscriptions, donations, enquiries regarding circulation etc. should be addressed to :
Editor Anumukti,
Sampoorna Kranti Vidyalaya,
Vedebhi, Via Valod.
District: Surat 394 641.
Editor: Surendra Gadekar
Printed at:
Bhargava Bhushan Press, Vara nasi.-6/2-88