have sufficed to discredit synoptic rationality and to show that incremental decision making cannot deal with the special characteristics of nuclear power. While Collingridge makes passing references to other inflexible systems, such as ports, airports and freeway systems, no such areas are analysed.

A difficulty in writing about nuclear power is maintaining one's credibility to a particular audience. Collingridge has set out to make intellectual points concerning theories of decision-making, and he has also presented a damning picture of nuclear power within the parameters of analysis he has chosen. But he has cut his analysis off, both in style and content, from the more open opponents of nuclear power. The dry style is complemented by a lack of reference to similar points made about nuclear power, such as the critique of the inflexibility of nuclear power made by Amory Lovins. Another important concept used by Collingridge, entrenchment — the adjustment by social institutions to a technology, so that reversing a mistaken choice becomes virtually impossible — has been a standard argument in the anti-nuclear movement for many years, but Collingridge does not connect his analysis with this critique.

A more fundamental problem is Collingridge's basic reliance on rationality in policy-making. He seems to imply that once the problem of inflexible technology is recognised, then such technologies will be avoided and the process of mutual partisan adjustment can proceed satisfactorily dealing with incremental changes. The difficulty here is that the reason why decision-makers originally introduced and pursued nuclear power was not their lack of awareness of its tecnological inflexibilty. Indeed, quite the contrary: the characteristics which make nuclear power inflexible are among those which made it attractive to states in the first place. The large size and capital intensiveness of nuclear power suit it for centralised control by states. The dependence on expertise and extensive infrastructure of nuclear power make it attractive to nuclear experts and administrators, since it promises a continued demand for their services.

Thus the inflexibilty of nuclear power is central to policy making about it in more ways than Collingridge discusses. He gives a good argument, from the viewpoint of rational policy making within existing planning agencies, as to why nuclear power *should* be controlled. But this is far short of dealing with the problem of the actual political control of nuclear power.

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Australia's Role in the Nuclear Fuel Cycle — *Report by the Australian Science and Technology Council (ASTEC)*
(AGPS, Canberra, 1984) pp. viii + 312, ISBN: 0-644-03382-7

This ASTEC report was written by leaders of industry and by prominent academics, professors of economics, engineering and natural science. This narrow technocratic statement is a paradigm of instrumental reason, hedged with careful ambiguities, devoid of moral depth, and committed to simplistic technical and bureaucratic solutions to the problems of radioactive waste disposal and the dangers of nuclear war. It suffers especially by comparison

with the Ranger Report, which heard views from all sides and at least tried to place the evidence in a broad and human context. ASTEC reaches more definite pronuclear conclusions than did Ranger, but objectively it has less reason to reach any conclusions at all.

Readers of the Report will find no reservations about waste disposal, nor any indication that careful and dispassionate experts do not always share the authors' lack of concern. The Report is categorical: the disposal problem has been solved and the methods available are said to be more than adequate now. There is no recognition that the dark forces in human nature may eventually combine with growing technical knowledge and accumulating sensitive materials to produce an unprecedented conflagration in the world. The safeguards system is admitted to be not perfect, but it is the 'best technical approach' and we have the dubious assurance of ASTEC that the diversion of civil nuclear materials to warheads does not occur. The usual gloss is put on the economics of uranium. Readers who tease out the figures will find that sales expectations for Australian uranium are a multiple of what NUEXCO anticipates — Australia is supposed to be able to sell annually 13,000 tonnes — and that unbeknown to most, uranium prices are bound to rise. Evidently these conclusions do not need justification, because they come from discussions with the mining companies concerned.

The arguments for uranium export are embraced whether they are consistent or not. The Report says that Australian uranium would not encourage a nuclear war because there are plenty of other sources of supply (2.2.8); yet it also says that Australia should sell uranium because of the importance to buyers of diversity of supply and political reliability (2.1.10). The Report is therefore trying to have it both ways. It even says that there is no connection between nuclear energy and nuclear war (2.2.9), when the whole thrust of the Report is that Australian participation in the nuclear fuel cycle would help to defuse the dangerous connection between nuclear energy and nuclear war. To make the conclusions of the Report tangible, ASTEC is recommending that Australia should develop at least two nuclear industries, presumably with assistance from Europe and Japan. One is uranium enrichment and the other is the reprocessing of spent fuel. There are then two comments to be made immediately, since economics and the strategic interactions of nuclear industries are not recognised in the Report. One is that there are definite military implications with these industries. The other is that previous Australian governments have tried to establish them and have failed.

The military implications arise because any nation which had an enrichment facility and to some extent a reprocessing facility could become a nuclear weapons state virtually overnight. The same delivery system which carries conventional weapons can also carry nuclear warheads. The same facility which enriches uranium to 3 per cent U235 for reactor fuel use could also enrich uranium to 90 per cent for nuclear warheads. Alternatively the same reprocessing facility which separates plutonium from waste fuel could separate the plutonium for military use, though the separation of the plutonium isotopes would improve effectiveness and yield. A nation with a nuclear program including enrichment facilities in particular would be independent, except to the extent that it needed a uranium supply.

ASTEC rejects the military connection. It says (correctly) that the cheapest way to produce a nuclear weapon is not through a civil nuclear energy

program but via a dedicated facility. However, it says that we should 'not impugn the motives' of those countries with civil nuclear energy programs. This overlooks that the historical reason why the US, Britain, France and probably the Soviet Union first promoted nuclear energy was in large part because of its military advantages, and that Argentina, Brazil and Pakistan see the same connection now. Admittedly the Ranger Report overstressed the civil-military connection, because it overlooked the role which a research reactor could play in developing atomic bombs. However ASTEC is being deliberately simplistic in playing the connection down. Nations do not separate their economic and military strategies in the way which ASTEC implies. How, for example, do we explain why Indonesia should embark on an ambitious nuclear energy program when it has a long run surplus of oil?

The military potential and strategic reasons were why Australia wanted an enrichment facility in the first place. The Uranium Advisory Council (UAC) was less coy when it nominated prestige as the rationale for an Australian facility. The source of this prestige the UAC did not elaborate, but it is not difficult to draw out. A minimum sized centrifuge export facility would probably have a capacity of about one million SWU's (separative work units), which would be sufficient to produce about 250 of 20kg atomic warheads per year, the first of which could possibly roll off within weeks once the facility was operational. Though it did not produce a single bomb, Australia would be in an advantageous position compared to those medium Asian nations which even in an emergency would have access only to plutonium waste mixed with the nonfissionable dross of Pu240. An Australian enrichment plant would be interpretable as a military declaration, in an area where the US has only with difficulty dissuaded several powers from becoming nuclear weapons states. It is reckless and foolhardy for ASTEC to endorse an enrichment facility without even considering what the strategic repercussions might be.

Because it plays down the military connection, ASTEC is able to ignore the central feature of the economics of nuclear industries, which is that they are uneconomic and would need heavy subsidies to be established. Even so they might not obtain the export markets which they require. The ASTEC argument for a nuclear fuel cycle is presented as 'moral', and the Report does not concern itself with costs or economics of even the most rudimentary sort. This is no small point, since the capital cost of nuclear processing industries on an export scale would be anywhere up to two billion dollars.

Australia does not have a domestic market for enriched uranium because it has no nuclear reactors and no prospects of acquiring any on a significant enough scale. However because of the civil-military connection there has been and will remain a large global overhang of excess capacity for enriched uranium production. For this reason South Africa and Brazil have had to abandon their nuclear export ambitions, and the policy of the Fraser government to establish an Australian enrichment plant could not be implemented despite strong determination. In particular a market for Australian enriched uranium could not be established in Japan, which seemed the only untied and significant potential customer with a shortfall of enrichment capacity. Therefore one must read between the lines for the new element which ASTEC believes would make the old policy still work. It then becomes manifest that this is the disposal of (especially) US and Japanese nuclear waste. Despite ASTEC's view that the waste problem has been

substantially solved, most countries with nuclear programs do not know what to do with the long lived radioactive wastes which keep pouring out of the back end. This is the only section of the fuel cycle which does not have excess capacity but rather the reverse. ASTEC says that ocean dumping is wrong and that some countries do not have the geological prerequisites for successful disposal. International co-operation is desirable but Australia has no moral obligation to accept back uranium waste from its own yellowcake. These are the only qualifications in a uniquely pronuclear report. Could a deal be struck, in which Australia offers disposal sites for long lived radioactive waste, in return for assistance in establishing nuclear processing export industries and guaranteed export markets?

Such a deal is commonly advocated informally amongst Australia's nuclear hawks, and the US has reportedly pressed Australia to provide a radioactive waste repository. However the ASTEC Report nowhere puts the question; it simply states the facts:

1. We need to have nuclear industries (of course).
2. Other countries need a repository for nuclear waste.
3. We may each have what the other wants and co-operation is good.

This is the technological logic which is said to be irresistible. Then if Australia accepts radioactive waste for disposal, the reprocessing plant begins to make sense. If this interpretation is correct the whole plan hinges upon ASTEC's exceptional optimism concerning waste disposal, i.e. its belief that it can find an Australian site for radioactive waste disposal that is not affected by the movement of groundwater.

Within the circle of its own limited logic ASTEC can ignore the economic and strategic effects of a nuclear Australia because its plan would promote world peace — 'It is only by active involvement that we can expect to be able to influence the future course of events'. The justification for applying this approach to matters of state policy is to strengthen the position of bureaucratic technostructure. Australia could be represented on the Board of Governors of the International Atomic Energy Association (IAEA), and have 'an effective participation in all important negotiations and discussions' because Australians would have these influential positions with the IAEA. Yet what a price could be paid for so little achieved! If the number of influential Australian positions at the IAEA were divided by billions of dollars necessary to establish the necessary nuclear industries, and this multiplied by the consequent advantages, then the returns would be minimal indeed.

This Report draws upon a false and undesirable notion of what science and technology are. True science is tentative in two ways. It recognises that its conclusions can never be conclusively confirmed and may always be rejected as wrong; and it recognises that its predictions depend upon a complex state of nature which can never be adequately known. There is also a proper limit to the role of technology in human affairs. While technology influences values it cannot ever establish them, because values draw upon wisdom and insight as well as demonstrable experiment. The ASTEC Report violates all of these limits, in that it represents science as authoritative and it creates values and policies out of technology alone. These tendencies associated with Big Science should be uncompromisingly resisted, not to advocate any particular uranium

policy but in the name of truth. They are symptoms of that scientific and technological ***hubris*** which threatens to subvert the meaning of human purpose in the post-industrial world.

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Information Economics and Policy in the United States *by Michael R. Rubin* (Libraries Unlimited, Littleton, Colorado, USA, 1983), pp. xiv + 335, $US35.00. ISBN: 0-87287-378-1

Information economics might appear to be of recent origin because it was officially recognised by the American Economic Association in 1976 by award of a category in the Association's Classification System for Articles and Abstracts. Such an interpretation of its history fits the popular but erroneous view that information economics is simply a reflection of the spectacular advent of intelligent electronics with its greatly enhanced capacities for communication, computation, and control. The view is erroneous because all societies have been information societies and have employed information technologies. What has been changing in response not only to computers and satellites but also to recognition of the deficiencies of economic theory and failures of government and business policies, is the role assigned to information in economic analysis. Greater concern with the present and its problems rather than long-run equilibrium has led to information activities being seen as cause of disequilibrium and means to equilibrium; as endogenous rather than exogenous. This shift of emphasis has been most obvious in the case of technology, which is perhaps the most important and potentially beneficial kind of information.

A decade ago those interested in information matters still emphasised the need to incorporate a role for information in economic models because of its bearing upon market performance. Pioneers like Jacob Marschak and Fritz Machlup had already done much to shape the pattern of development of information economics. Marschak had initiated true theoretical work and established a link with the study of organisation as an information-handling decision system. Machlup had provided a detailed statistical account of information activities. The radical thought that is only now emerging with increasing clarity is that organisational change as well as technological change is fundamentally important and can be analysed in economic terms.

Information and the information-handling mechanisms we call organisations are now to be treated as resources. But it seems that generations will have passed before the full implications are understood. Put in the simplest terms possible, organisation is now to be a variable, as the product was made a variable in the exciting days of imperfect and monopolistic competition theory. There can be great advantages in co-operating with others in information-handling, i.e. forming an organisation. This calls for creation of information channels, the building up of a stock of information, and the