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NUCLEAR POWER IN JAPAN AND THE USA

by

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## NUCLEAR POWER IN JAPAN

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Japan, one of Australia's major trading partners, comprises a densely settled series of islands having few natural resources of their own. In the post-war period Japan has developed a highly efficient and effective industrial complex allowing the nation to enjoy a high standard of living through massive export sales. Imported raw materials are converted into goods - motorcars, heavy machinery, ships, watches, electronic devices, to name a few - which are in great demand the world over. The essential ingredient to keep the wheels of industry turning, provide jobs and allow the nation to earn overseas and pay its way in the world is energy. Unfortunately for her, Japan has no significant indigenous energy resources of her own and is dependent on outside suppliers for 87.5 per cent of her needs. Imported oil and natural gas account for 75% of total energy needs and imported coal for 12.5%. Locally produced energy comes from coal - 3.5%, hydro-electric power - 4.5% and, in recent times, from nuclear power - 4.5%.

The Japanese economy therefore depends heavily on shipments of crude oil from the Persian Gulf by a highly tenuous and vulnerable shipping route. Not only could this lifeline be cut easily in war but, also, the economy is now at the mercy of rapidly increasing prices for imported oil. The ONLY source of energy which can relieve this critical dependence on imports is the nuclear source and this is why Japan is likely to become a large customer for Australian uranium in the near future.

Commercial nuclear power operations commenced in Japan in mid-1966 when the British built Gas cooled Magnox system (GCR) Tokai 1 plant began

feeding power into the grid. Thereafter a series of stations, based on the American Boiling Water (BWR) and Pressurised Water Reactor (PWR) systems, were built until, today, 18 plants are in operation with a generating capacity of 11,500 MWe representing some 10% of the gross power generating capacity of the nation (see Table and map).

This has been achieved in spite of the fact that Japan, at Hiroshima and Nagasaki, suffered the nuclear bombing which ended World War II. Anti-nuclear groups have attempted to use this to stir emotions and opposition to the peaceful application of nuclear power and ugly clashes have resulted. The Government, however, regards nuclear power as essential to the future and, over the next five years, new nuclear stations coming into use are expected to double installed capacity.

Further stations already authorised for building will complete the present programme in 1988 and additional developments, into the more distant future, are expected to be outlined shortly.

To facilitate this important national programme a very large internal industry has been established. Over the past 25 years public and private expenditure has exceeded \$26 billion and the Japanese nuclear industry now employs 53,000 persons.

The first wholly Japanese designed nuclear power plant went into operation in April 1978 and is a 165 MWe prototype. It is especially designed to burn a wide variety of fuels ranging from natural uranium, enriched uranium, mixtures of plutonium and uranium and even partially depleted uranium fuels. The intention is to expand the range of fuel options. A nuclear powered steel mill, expected to lower the costs of steel production and alleviate the need for imported coking coals, also is under design. A number of Japanese heavy industry groups are now able to supply and build complete nuclear plants or components for such plants. Already pressure vessels have been exported to the USA, containment

vessels to Taiwan and reactor core internal structures to Switzerland.

Japan is already reprocessing spent fuel from its nuclear stations in a 200 tonne per year capacity plant built at Tokai and commissioned in 1977. The bulk of the output, however, will be processed at the much bigger plants in England and France and contracts for that work have already been written. A pilot plant for uranium enrichment, using the centrifuge technique, is under construction and discussions have been held with Australian authorities to assess the possibility of building a full scale, jointly financed and operated plant here in Australia.

An experimental fast breeder reactor (Joyo) generating 50 MWth has been operating since 1977 and a much bigger electricity generating system, Monju, a 300 MWe fast breeder, was initiated in 1972; it is still to be completed.

Research also is in progress on radioactive waste treatment and ultimate disposal techniques against the day when there is sufficient waste material in storage to require action.

Nuclear power is seen by the responsible authorities in Japan as essential to give the nation energy independence and guarantee the industrial future. The bonuses that nuclear power is cheaper, environmentally much cleaner, and also safer than available alternatives (both for the workers in the industry as well as for the general public) are of great practical importance too. Finding suitable sites for the new power stations on the crowded islands of Japan is not easy and preliminary discussions on floating stations, or plants located on artificial islands built off-shore have begun. For Japan more than any other nation, nuclear power is not an option, it is a must.

NUCLEAR POWER PLANTS IN JAPAN AS AT JANUARY 1979

Already in Operation

| Power Plant   | Prefecture | MWe Gross            | Reactor type | Construction commenced | Start of operation |
|---------------|------------|----------------------|--------------|------------------------|--------------------|
| Tokai-1       | Ibaraki    | 166                  | GCR          | Jan. 1960              | Jul. 1966          |
| Tokai-2       | Ibaraki    | 1,100                | BWR          | Jun. 1973              | Nov. 1978          |
| Tsuruga-1     | Fukui      | 357                  | BWR          | Apr. 1966              | Mar. 1970          |
| Fukushima 1-1 | Fukushima  | 460                  | BWR          | Dec. 1966              | Mar. 1971          |
| Fukushima 1-2 | Fukushima  | 784                  | BWR          | May 1969               | Jul. 1974          |
| Fukushima 1-3 | Fukushima  | 784                  | BWR          | Oct. 1970              | Mar. 1976          |
| Fukushima 1-4 | Fukushima  | 784                  | BWR          | Sep. 1972              | Oct. 1978          |
| Fukushima 1-5 | Fukushima  | 784                  | BWR          | Dec. 1971              | Apr. 1978          |
| Hamaoka-1     | Shizuoka   | 540                  | BWR          | Mar. 1971              | Mar. 1976          |
| Hamaoka-2     | Shizuoka   | 840                  | BWR          | Mar. 1974              | Nov. 1978          |
| Mihama-1      | Fukui      | 340                  | PWR          | Dec. 1966              | Nov. 1970          |
| Mihama-2      | Fukui      | 500                  | PWR          | May 1968               | Jul. 1972          |
| Mihama-3      | Fukui      | 826                  | PWR          | Mar. 1972              | Dec. 1976          |
| Takahama-1    | Fukui      | 826                  | PWR          | Dec. 1969              | Nov. 1974          |
| Takahama-2    | Fukui      | 826                  | PWR          | Nov. 1970              | Nov. 1975          |
| Shimane-1     | Shimane    | 460                  | BWR          | Feb. 1970              | Mar. 1974          |
| Ikata-1       | Ehime      | 566                  | PWR          | Jun. 1973              | Sep. 1977          |
| Genkai-1      | Saga       | 559                  | PWR          | Dec. 1970              | Oct. 1975          |
| Total         | 18 units   | 11,502 MWe installed |              |                        |                    |

Under Construction

|                      |           |       |     |           |           |
|----------------------|-----------|-------|-----|-----------|-----------|
| Onagawa-1            | Miyagi    | 524   | BWR | Feb. 1979 | Mar. 1983 |
| Fukushima 1-6        | Fukushima | 1,100 | BWR | May 1973  | Oct. 1979 |
| Fukushima 11-1       | Fukushima | 1,100 | BWR | Nov. 1975 | May 1982  |
| Fukushima 11-2       | Fukushima | 1,100 | BWR | Jan. 1979 | Aug. 1983 |
| Kashiwazaki-Kariwa-1 | Nigata    | 1,100 | BWR | Dec. 1978 | Dec. 1984 |
| Ohi-1                | Fukui     | 1,175 | PWR | Oct. 1972 | Mar. 1979 |
| Ohi-2                | Fukui     | 1,175 | PWR | Nov. 1972 | Jun. 1979 |

Power Plants Under Construction (cont'd)

|          |           |           |     |           |           |
|----------|-----------|-----------|-----|-----------|-----------|
| Ikata-2  | Ehime     | 566       | PWR | Jan. 1978 | Mar. 1982 |
| Genkai-2 | Saga      | 559       | PWR | Jun. 1976 | Mar. 1981 |
| Sendai-1 | Kagoshima | 890       | PWR | Mar. 1979 | Jul. 1984 |
| Total    | 10 units  | 9,289 MWe |     |           |           |

Planned

(authorized by Electric Power Resources Development Coordination Council)

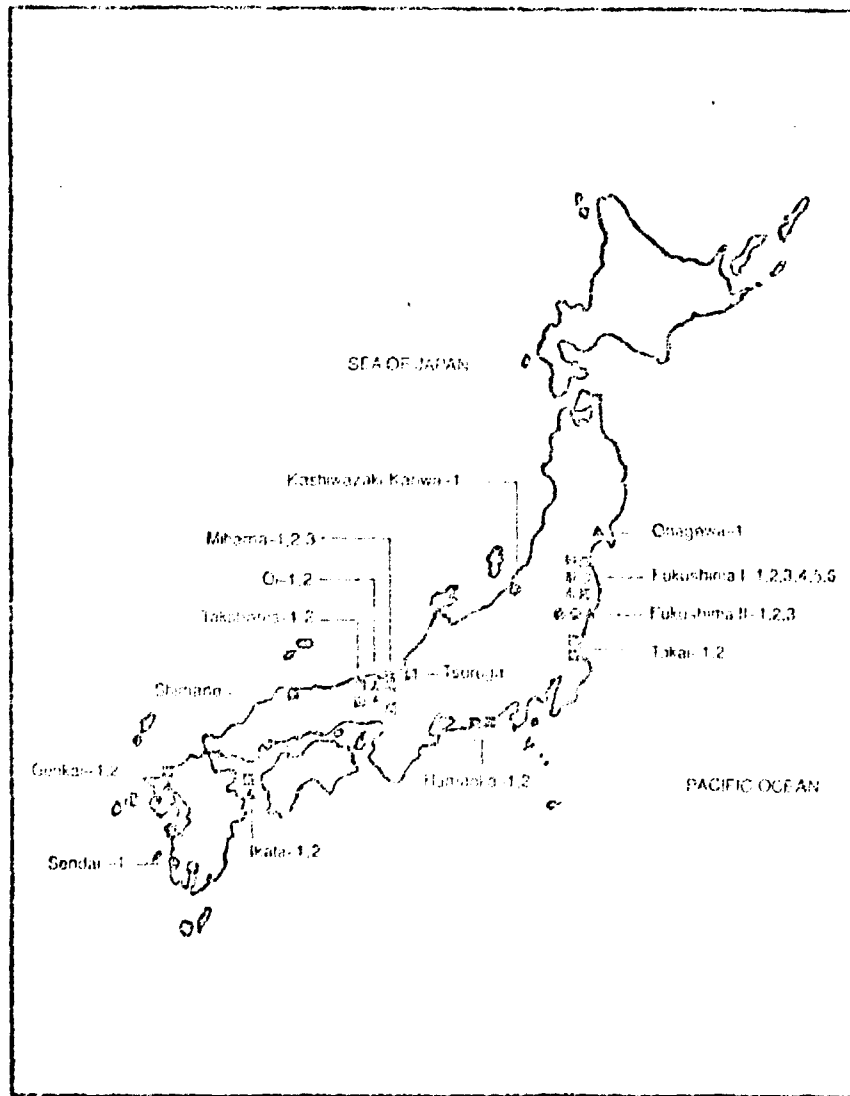
|                |           |           |     |           |           |
|----------------|-----------|-----------|-----|-----------|-----------|
| Tsuruga-2      | Fukui     | 1,160     | PWR | 1979      | Mar. 1986 |
| Fukushima 11-3 | Fukushima | 1,100     | BWR | Jul. 1979 | Aug. 1984 |
| Fukushima 11-4 | Fukushima | 1,100     | BWR | Apr. 1980 | Apr. 1985 |
| Hamaoka-3      | Shizuoka  | 1,100     | BWR | Aug. 1980 | Mar. 1985 |
| Takahama-3     | Fukui     | 870       | PWR | Jun. 1979 | Aug. 1983 |
| Takahama-4     | Fukui     | 870       | PWR | Jun. 1979 | Feb. 1984 |
| Sendai-2       | Kagoshima | 890       | PWR | Jan. 1980 | Oct. 1985 |
| Total          | 7 units   | 7,090 MWe |     |           |           |

Total installed capacity by 1986 - 27,881 MWe

GCR = gas cooled reactor

BWR = boiling water reactor

PWR = pressurised water reactor





NUCLEAR POWER IN THE USA

by

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The number of nuclear power stations operating in the USA is far higher than in any other nation. In the year ending December 31st, 1978 nuclear power production was nearly 12.6% of the total electrical output. If this energy had been produced by burning oil an additional 450 million barrels, costing well over \$6 billion, would have been required - more than double the quantity imported annually from Iran before the political upheaval there, which cut off supplies. The value of the nuclear industry to the US economy, with its strained balance of payments position, is therefore obvious.

Difficulties are already appearing within the country in the task of supplying all the energy the community demands for transportation, homes and industry. In the winter of 1977 a combination of a miners strike and an unusually severe winter showed how fragile the balance had become. There was enormous disruption to schools, transport and industry. The nuclear power industry scored significantly during the crisis.

New England, the state possessing most nuclear power stations escaped virtually unscathed and, indeed, was able to export excess nuclear electricity to neighbours who were suffering from the failure of their critical electricity supplies.

This lesson was not lost either on industry or the public at large and allied with the environmental and cost advantages of nuclear power (cheaper, safer, cleaner electricity) the next 10 years will see nuclear power capacity increase by rather more than three times.

At present there are 72 nuclear stations operating, 92 with construction permits, four with limited work authorisations and an additional 30 on order.

The planned development of the industry is set out in the table and the distribution of the plants is indicated on the accompanying map. It will be seen that by 1988 nuclear stations will represent over 20% of total capacity and will be generating some 27% of all electricity used.

This massive and expanding development of the nuclear power industry will surprise people who have read anti-nuclear propaganda that the American industry is on the point of collapse and "reeling for lack of orders". In fact, nuclear power capacity during 1978-88 will increase by nearly 220% while total electrical capacity increases by only 60%. It is now accepted that the nation, over the next two decades, will have to rely more and more on nuclear power and increased coal-powered electricity generation. Fortunately for it the USA has very good uranium reserves - actually bigger than the known Australian reserves - and is busy exploiting these to ensure supplies for the forward light water reactor programme.

The recent accident at a Harrisburg pressurised water reactor has led to a resurgence of anti-uranium demonstrations even though it produced not a single death or injury. Spearheaded by Ralph Nader, supported politically by California's Governor Jerry Brown and backed by strident activists including Jane Fonda, the movement is now making a major effort to whip up emotional fears. There is no doubt that over the years the continual obstruction from the anti-nuclear movement through litigation, demands for environmental enquiries and reports, strikes, marches and demonstrations has caused delays in issuing licences and getting stations once started built quickly and into production.

The capital cost of a nuclear power station in the USA today is actually near to twice the direct construction costs because of interest

charges, delays, contingencies, safety and environmental costs and other indirect costs. Delays especially, add enormously to costs - hence the anti's attempts to disrupt construction in any way possible. This of course, reacts against the consumers, the nation itself, who then have to pay higher power charges than would otherwise be necessary when the station eventually comes on line.

The near hysterical performance of the anti-uranium movement is now posing a serious problem for the Carter administration. The absolutely clear and pressing need for more nuclear power, for rapid development of power breeders (which opens the way for thousands upon thousands of years of abundant energy) is now apparent. This will have to be supported by the necessary reprocessing plants and the rapid development of strategies for the ultimate handling of nuclear wastes - areas where the USA lags badly behind Britain and Europe. There are signs that the President is waking up to the problem. Presenting a budget of \$1000 million for the 1980 nuclear programme President Carter said -

"The nuclear fission programme continues to be orientated towards the development of nuclear power as a safe, environmentally acceptable, economic source of electricity."

It is not clear that the nation heard these words above the cacophony of wild claims, threats and exaggerations still being generated by the anti-uranium movement.

NUCLEAR POWER IN THE USA

1978-1988

|      | No. of<br>Plants | Capacity<br>MWe | Plants<br>Added | Capacity<br>Added | Nuclear<br>% of<br>Total<br>Capacity | % of<br>Total<br>Electricity<br>Generated |
|------|------------------|-----------------|-----------------|-------------------|--------------------------------------|---|
| 1978 | 72               | 52,396          | 3               | 2,613             | 9.7                                  | 12.6                                      |
| 1979 | 79               | 60,006          | 7               | 7,610             | 10.7                                 | 13.8 est.                                 |
| 1980 | 89               | 70,243          | 10              | 10,237            | 11.9                                 | -   |
| 1981 | 101              | 83,729          | 12              | 13,486            | 13.6                                 | -   |
| 1982 | 112              | 95,754          | 11              | 12,025            | 14.8                                 | 20 est.                                   |
| 1983 | 123              | 107,983         | 11              | 12,229            | 15.9                                 | -   |
| 1984 | 141              | 127,616         | 18              | 19,633            | 18.0                                 | -   |
| 1985 | 151              | 139,407         | 10              | 11,791            | 18.8                                 | -   |
| 1986 | 163              | 152,230         | 12              | 12,823            | 19.7                                 | -   |
| 1987 | 172              | 162,329         | 9               | 10,099            | 20.2                                 | -   |
| 1988 | 182              | 173,746         | 10              | 11,417            | 20.4                                 | 27 est.                                   |

