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REVIEW OF JAPANESE SOURCED PAPERS ON DECOMMISSIONING

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ABSTRACT

This paper reviews the Japanese sourced papers on decommissioning cited in the previous note M3069-A1 of 5 October 2001.

The Japanese decommissioning strategy closely adheres to the same stages or scope of defuelling and dismantling activities as that proposed by Magnox Electric, that is with three distinct stages that are the equivalent to Magnox's *Care & Maintenance* preparation period and its final *Dismantling & Site Clearance* stage. Unlike the Magnox Electric strategy, the Japanese decommissioning of the Tokai Magnox power plant be completed by 2017 with just 7 years allocated to the complete dismantlement of the reactor core, RPV and biological shield leaving the site completely clear of all above ground structures – there is no deferral or equivalent *'Safestore'* period intervening between the *Care & Maintenance* and *Site Clearance* stages.

The dismantling programme for Tokai, scheduled to commence in December 2001, is ambitious, particularly in that there is virtually no cross linkage and dependency upon the availability of a radioactive waste management facility being in place to receive the large volumes of 3rd stage wastes which are generated from about 2010. Unless Japan is able to develop an adequate radioactive waste repository it, like the Italians (see R30969-A6), may have to call a halt to decommissioning of Tokai once that it has completed the *Care & Maintenance* stage. To a large extent nuclear power developments (and decommissioning) in Japan is controlled by the local Prefecture which, being political in nature could also bring about marked changes in the Tokai decommissioning programme at any time.

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REVIEW OF JAPANESE SOURCED PAPERS ON DECOMMISSIONING

Origins of Japan's Decommissioning Policy

The roots of Japan's decommissioning policy were initiated in 1981 by the Japan Atomic Energy Research Institute with a two phase programme of, first, developing the technology of reactor decommissioning and, second, actually undertaking lead decommissioning of a prototype test reactor. In advance of this second phase, the Japan Nuclear Safety Commission (the nuclear regulator) published a guideline for decommissioning in 1985.

The national policy in Japan was amended in 1994 and prescribed immediate decommissioning following final shutdown of the nuclear facility, applied to all nuclear plants, including fuel facilities and nuclear power stations. The basic decommissioning strategy, issued by the Atomic Energy Commission in 1994, includes the following salient directives:-

"...

- Decommissioning shall proceed in cooperation with the local community whilst ensuring safety
- The technology for decommissioning shall be carried forward (ie developed and proven in advance of the dismantling)
- nuclear power plant be dismantled and removed as soon as possible after its operation is terminated for effective use of the site for future energy generation

..."

It is this latter requirement that the nuclear plant shall be removed as soon as possible so that the site may be used for energy generation that distinguishes the Japanese decommissioning strategy from that of the UK Magnox programme. Unlike the recently announced Liabilities Management Agency scheme in the UK, the Japanese nuclear operator (JAPC) is to directly undertake the actual decommissioning and dismantling of the power station.

Nuclear Power Plant Experience in Japan

The lead nuclear power reactor for decommissioning was chosen to be the relatively small Tokai boiling water reactor (BWR) JPDR of 45/90 MWe with a steel pressure vessel of 2m diameter by 8m height commissioned in 1963 and shut down in 1976. This is a very small power reactor at 45 (uprated to 90) MW compared to ~600MWe for each of the Wylfa Magnox reactor.

The Magnox gas-cooled reactor (Tokai CGR), the first of Japan's commercial nuclear power plants, was commissioned in 1966 and shut down in 1998. Tokai CGR is a

single reactor clone of the UK's Bradwell Magnox nuclear power station (twin 130MW (derated) reactors commissioned in 1961-2).

Planning and implementation of the JPDR project was conducted as an integrated test and optimisation of available decontamination and decommissioning technologies and included the development of several new technologies. This 'driver' project together with the requirement to decommission in the shortest of possible timescales (18 years) has resulted in a flurry of decommissioning research and development work on decommissioning technology, particularly centred on the JPDR.

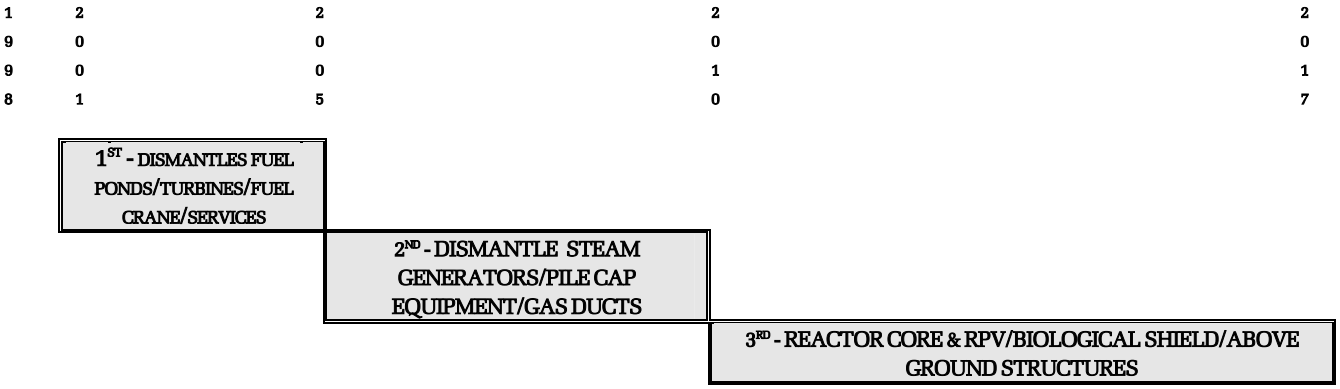
Decommissioning and the Law in Japan

To progress decommissioning of a nuclear power station, Japanese law requires

- prior to starting decommissioning, the operator is required to submit a decommissioning plan to the competent ministry
- the plan must define
  - the decommissioning methods and programme
  - the means of treatment of nuclear fuel and nuclear waste
- the competent ministry shall require
  - measures to be taken to ensure the complete shut down of the reactor
  - maintenance of the reactor during decommissioning
  - reduction of radiation exposure to the public and workers
  - treatment of radioactive waste
  - verification for completion of decommissioning
  - safety evaluation

Decommissioning Relating to Tokai Nuclear Power Plant (Bradwell clone)

The most recent proposal for decommissioning the Magnox Tokai power station cites the following key dates



The reactor closed down in 1998 and over the last three to four years it has been defuelled with most, if not all, of the spent fuel being transferred from the station fuel ponds to Sellafield. This three to four year period coincides with that adopted by Magnox Electric for its twin reactor plants.

The three stages of dismantling are determined by the classification of i) the generating system and ii) the contamination type:-

i) GENERATING SYSTEM

1) the primary cooling system – the circuits contaminated with dust (oxides, graphite, etc) containing radionuclide sources

2) the liquid waste streams – liquids contaminated from the spent fuel ponds

ii) CONTAMINATION TYPE

1) directly (radio)activated – RPV components, fuel clad, etc

2) indirectly contaminated – vinyl, chloride, rubber etc

3) Gas filters etc

1ST STAGE DISMANTLING – 4 TO 5 YEARS

The 1st stage of dismantling involves active working in the fuel ponds as these are decontaminated and demolished – overall the scope of the 1st stage work is equivalent to that of Magnox Electric. The Japanese proposal is to complete most of the *Care & Maintenance Preparation* activity in 5 years compared to 10 years for the Magnox Electric programme.

The 1st stage also includes for the establishment of on-site decontamination, radioactive waste treatment and packaging, and waste storage facilities

2ND STAGE DISMANTLING – 5 YEARS

The 2nd stage runs directly on from completion of Stage 1 and includes for steam generator removal. Like Magnox Electric the steam generators are not to be dismantled but capped and sealed to remain on site as Level 2 radioactive waste.*

Combined, the Japanese 1st and 2nd stage activities are equivalent in both scope of work and time scale to the Magnox Electric *Care & Maintenance Preparation* period of 10 years (following but with some activities in parallel with defuelling).

3RD STAGE DISMANTLING – 7 YEARS

The 3rd stage runs directly on from 2nd stage completion, commencing about 2010 and scheduled for completion in 7 years.

This 3rd stage is the major departure from the Magnox Electric strategy in that, first, there is no deferral (*Safestore*) period of about 100 years, and, second, that the entire 3rd stage dismantling is schedule to occupy just 7 years compared the ~10 years allocated for this by Magnox Electric. Like the Magnox Electric proposal, the Japanese intend to leave uncontaminated substructures (foundations, etc) in situ beyond the 3rd stage.

Considering a single reactor, Bradwell comparisons with the Tokai and Latina (Italy) single reactor Magnox clones is as follows:

* The Japanese Nuclear Safety Commission sets five levels of radioactive wastes, all defined by the specific activity and not by nuclide species and/or persistence (half-life). The lower two levels are Level 4 Clearance Level which requires no special packaging, etc by virtue of its low radioactivity and Level 5 which is not radioactive at all. Essentially, at dismantling the reactor core is considered Level 1, the RPV and space within the biological shield (including the inner surfaces of the shield), fuel pond and innards of the steam generators are all Level 2, and the remainder of the reactor building and services (ducts, etc) arte Level 3.

TASK, ETC	BRADWELL	TOKAI	LATINA	COMMENTS
SHUT DOWN YEAR	~2002	1998	1987	
DEFUEL PERIOD - YEARS	3-4	3-4	3-4	
CARE & MAINTENANCE OPS	10	5+5	BY 2009	1ST & 2ND STAGES – LATINA HAS BEEN UNDERWAY SINCE 1987
DEFERRAL *SAFESTORE* PERIOD	~100	0	0 (WAS 40)	RECENT CHANGE OF STRATEGY AT LATINA TO 'PROMPT' DECOMMISSIONING
DISMANTLING PERIOD - YEARS	10	7	11-12	BRADWELL EQUIVALENT OF 1 REACTOR MIGHT BE SHORTER
TOTAL WASTE VOLUME - M^3	14000	NOT GIVEN	6783 - 12000	WASTE VOLUMES FOR LATINA REVISED UPWARDS BY x2 IN FEBRUARY 2001 – BRADWELL MAY BE SLIGHTLY HIGHER
REPOSITORY AVAILABILITY	+2025	NOT GIVEN	2009 TARGET	
WORKER DISMANTLING DOSE RPV CIRCUIT – 5600 MHOURS OPERATIONAL WASTE RECOVERY	TOTAL DOSE BURDEN NOT GIVEN	TOTAL DOSE BURDEN NOT GIVEN	0.38 SV 0.2 SV	JUST DECOMMISSIONING AND NOT WASTE STORAGE IN LONGER TERM – LATINA DOES FOR 40 YEAR DWELL
PUBLIC DISCHARGE DOSE	TOTAL DOSE BURDEN NOT GIVEN	TOTAL DOSE BURDEN NOT GIVEN	TOTAL DOSE BURDEN NOT GIVEN	