UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

December 19, 1979

MEMORANDUM FOR: Chairman Ahearne

FROM: Edward J. Hanrahan

SUBJECT: ANSWERS TO FOLLOW-UP QUESTIONS (AHEARNE MEMO 11/14) ON INITIATIVES TO RESPOND TO POTENTIAL OIL SHORTAGES

Attached are answers to the questions forward in your memo of November 14. NRR supplied the answers to questions (1): on plant status and possible startup dates; (3): methods for restricting new reactors to 50 percent power; and (4): the paper discussing safety advantages by operating at various reduced power levels.

Attachment:
As stated

cc: Commissioner Gilinsky
Commissioner Kennedy
Commissioner Hendrie
Commissioner Bradford
Leonard Bickwit
Sam Chilk
Lee V. Gossick
Harold Denton

Contact:
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Question 1: Concerning Table 2, what is the exact status of each of these plants (operating license hearing suspended, licensing board decision issued, etc.)?

1. Sequoyah 1 — Applicant estimates construction to be complete January 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is also January 1980.

   There is no Board for Sequoyah 1.

   The NRC staff has previously met with the ACRS on three occasions. The NRC staff has recently received a letter concerning low power operation of this unit.

2. Salem 2 — Applicant estimates construction to be complete January 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is also for January 1980.

   There is no Board for Salem 2.

   An ACRS letter dated August 14, 1979 (Fraley to Gossick) stated that the Committee concludes that it had no objection to issuance of an OL provided that the same Lessons Learned Task Force recommendations be applied to Salem 2 as are applied to plants which have already been issued OL's.

3. Diablo Canyon 1 — Applicant estimates construction to be complete January 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is also January 1980.

   The Board issued a partial initial decision September 27, 1979. This included a favorable conclusion on the aircraft missile impact, seismic design and security. The Joint Intervenors filed a motion on May 9, 1979 to reopen the hearing in light of TMI-2. The Board issued an order on June 5, 1979 deferring it's ruling until it gets the staff's report on TMI-2 effects.

   The NRC staff has previously met with the ACRS on several occasions. We anticipate meeting again with the ACRS to discuss additional seismic issues in early 1980.

4. North Anna Unit 2 — Applicant estimates construction to be complete January 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is also January 1980.

   The Appeal Board for Unit 1 and 2 still maintains jurisdiction for two matters - (1) pump house settlement and (2) turbine missiles. The record is closed, however the Board has not issued it's decision.

An ACRS letter dated August 14, 1979 (Fraley to Gossick stated that the Committee concludes that it had no objection to issuance of an OL provided that the same Lessons Learned Task Force recommendations be applied to Salem 2 as are applied to plants which have already been issued OL's.

5. LaSalle 1 — Applicant estimates construction to be complete June 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is also June 1980.

There is no Board for LaSalle 1.

We anticipate meeting with the ACRS in the spring of 1980.

6. McGuire 1 — Applicant estimates construction to be complete May 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is August 1980.

There is a McGuire Board. The hearing is complete and an Initial Decision was issued April 18, 1979.

A favorable ACRS letter was issued.

7. Zimmer 1 — Applicant estimates construction to be complete July 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is also July 1980.

A Public Hearing is in process. All non-Three Mile Island issues have been litigated. Resumption of Hearing is dependent upon resolution of the Three Mile Island related contentions.

ACRS letter received pre-Three Mile Island accident.

8. Farley 2 — Applicant estimates construction to be complete June 20, 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is July 1980.

There is no hearing required.

Favorable ACRS letter for Unit 2 was received in 1975. Need for an additional ACRS meeting is not certain.

9. San Onofre 2 — Applicant estimates construction to be complete November 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is May 1981.

There is a San Onofre 2 Board. We anticipate an extended hearing (primarily seismic).

We anticipate meeting with the ACRS in September 1980.

10. Shoreham 1 — The applicant estimates construction to be complete November 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is also November 1980.

There is a Shoreham Board. We anticipate an extended hearing with several intervenors and many contentions. The hearing may not be completed by November 1980.

We anticipate meeting with the ACRS in May 1980.

11. Summer 1 — Applicant estimates construction to be complete July 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is December 1980.

There is a Summer Board. The start of the hearing is uncertain.

We anticipate meeting with the ACRS in September 1980.

12. Watts Bar 1 — Applicant estimates construction to be completed September 1980 (including TMI Short Term Lessons Learned). The NRC staff estimate is December 1980.

No safety hearing is required.

An ACRS meeting will be required and is unscheduled at this time.

Question 2:

If each plant in Table 2 were to receive permission to operate at no more than 50 percent power until further notice, starting when ready for load fuel, what is the total oil saving that could be accomplished in CY 1980?

Answer:

Based upon more recent information obtained from NRR about startup schedules, OPE has revised Table 2: Electric Energy Generation by Units during 1980. In addition, NRR indicated that power ascension for the first four reactors ready for startup early in 1980 (Sequoyah 1, Salem 2, Diablo Canyon 1, and North Anna 2) would go to a 10 percent power level at the end of five months; they would subsequently increase power to 50 percent (maximum per Ahearne memo) at the end of the eighth month. This assumed prolonged power ascension cycle (presumably based on TMI-related considerations) is shown in Figure 1. Other reactors which are scheduled for later startup are assumed to increase power to 50 percent at the end of six months, as shown in Figure 1. Based on these assumptions, the total energy generated during calendar year 1980 is about 12 million MWhr, which on an energy basis is equivalent to 23.6 millions of barrels of oil (assumes 1.8 bbl oil/ MWhr).

As noted in OPE's November 13 memo to Carlyle Hystad of DOE, it should be stressed that this upper limit for oil displacement is not likely to be fully realized because in a number of service areas nuclear generation may substitute for that of coal-fired plants. DOE's Economic Regulatory Administration has been examining this question taking into account fuel use patterns within electric regions as well as transmission interties. Their analysis will be completed shortly and will likely show much smaller potential oil displacements. (See attached news item from Inside DOE.)

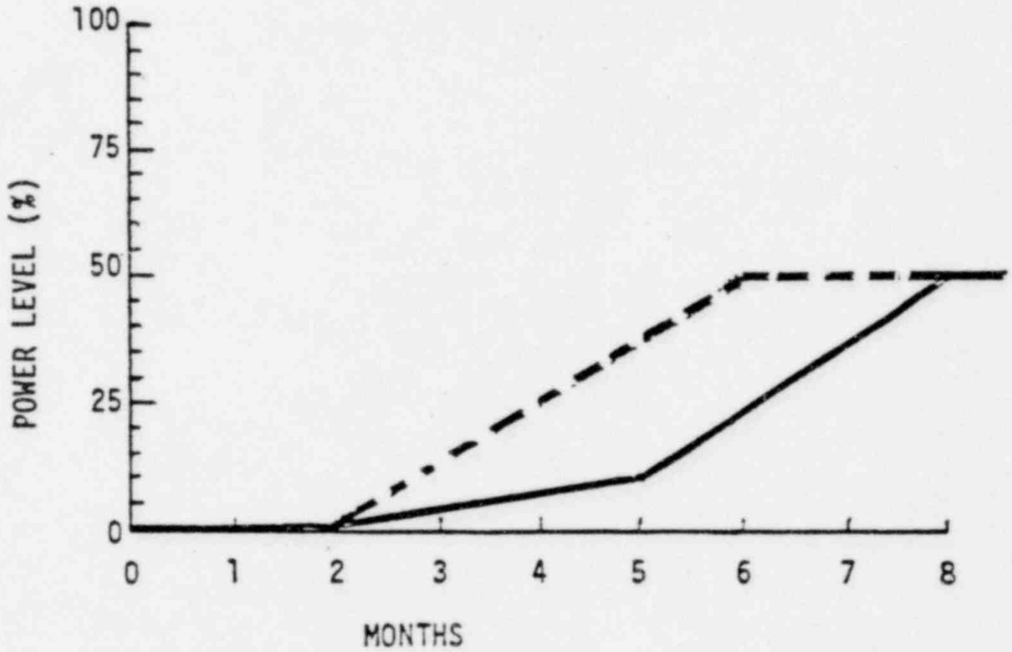
Where oil savings do occur, it is useful to have some idea of the consequences which are likely to result with respect to oil imports and availability of other petroleum products. OPE staff has talked to various experts in refinery operations at DOE as well as a consultant to DOE on refineries. Relevant observations are:

-- The East Coast uses some 60 percent of the residual fuel oil consumed in the U.S. of which (roughly) two-thirds is imported. More than half of the residual fuel oil used on the East Coast is burned in oil-fired electric generation. For these reasons the experts expect that reduction of residual oil consumption on the East Coast would in turn reduce residual oil imports.

-- In the short run in which refinery capacity is fixed, reduction in domestic consumption of residual fuel oil is unlikely to lead to any appreciable additional domestic supplies of lighter weight petroleum products (e.g. refined output such as gasoline, kerosene, home heating oils, etc.). While there is some underutilization of distillate refining capacity, there is a U.S. and worldwide shortage of conversion facilities (e.g. hydro-cracking, catalytic cracking and coking) which would be needed to increase the yield of lighter weight petroleum products from the residual fuel oil not consumed in electric generation. In the longer run, additional refining capacity can be constructed (lead-time: around three years) for conversion of the residual to lighter weight products.

Figure 1

ASSUMED POWER ASCENSION DURING STARTUP



Solid line: Assumed power ascension for units starting operation before June 1980. During first two months testing is conducted without appreciable power generation. Power ascends to 10% during next three months and then to 50% during following three months.

Broken line: Assumed power ascension for units starting operation in June 1980 or after. Power ascends to 50% between second and sixth month after startup.

TABLE 2

ELECTRIC ENERY GENERATION BY
UNITS STARTING UP IN 1980
ASSUMING ASCENSION AS IN FIG. 1

Month (1980)	Units beginning startup cycle on first of month	Average capacity during month* (MWe)	Energy generated during month** (10^6 MWhr)
January	Sequoyah 1 Salam 2 Diablo Canyon 1 North Anna 2 (4254 MWe)	0	0
February	None	0	0
March	None	71	0.051
April	None	213	0.153
May	None	354	0.255
June	LaSalle 1 (1078 MWe)	710	0.511
July	Zimmer 1 Farley 2 (1639 MWe)	1276	0.918
August	McGuire 1 (1180 MWe)	1909	1.37
September	None	2431	1.75
October	None	2845	2.05
November	Shoreham (819 MWe)	3287	2.37
December	Summer 1 Watts Bar 1 (2077 MWe)	3752	2.70
		TOTAL	12.1×10^6

* See Figure 1a for startup cycle

** 30-day (720 hour) months assumed.

Question 3: How would the NRC accomplish step (2), i.e., restricting to 50% power, (license condition, order by Director, NRR)?

A full power license could be issued with a condition that power operation above 50 percent power would be prohibited until certain requirements are met.

or

A full power license would be issued with conditions which restrict the power level at various intervals. Before a licensee is authorized to proceed to the next power level the licensee must meet certain requirements and receive NRC approval.

or

A 50 percent power license could be issued without any restrictions.

Question 4: Working with NRR, please provide a separate short paper discussing what additional safety advantages are achieved by operating at various reduced power levels.

SAFETY ADVANTAGES GAINED THROUGH OPERATION AT REDUCED POWER LEVELS

Operation of a LWR at a significant power level, but reduced with respect to full power (i.e., 50-75% of full power), necessarily involves essentially the same average core temperature and pressure as does full power operation. Hot leg temperature is only slightly reduced. Therefore, the stored energy in the reactor coolant at reduced power is essentially the same as for full power operation and the probability of a serious Loss-of-Coolant Accident (LOCA) or a depressurization accident is not significantly reduced. It has been observed that for certain LOCA sequences in which the Emergency Core Cooling System (ECCS) was not quite adequate to maintain projected clad temperatures below 2000 F, operation at a slightly reduced power satisfactorily resolved the problem (i.e., if the ECCS was required to function, there was not expected to be any threat to containment nor any threat of a radiological release beyond the design basis). Also, at reduced power levels the required heat removal capacity is lower, and the number of systems and methods available to remove decay heat from core are thus increased.

The effect of operation at reduced power levels on more serious accident sequences in which the containment is actually threatened by undissipated decay heat or by hydrogen, is more complicated. The number of short-lived fission products and the associated short-term decay heat level is reduced in proportion to the reduced operating power level. Thus, the threat to containment from those accident sequences in which short-term heat generation is the governing factor is delayed. However, long-term decay heat level is not similarly reduced, especially in a core that is near end-of-life; so that the advantage is less for those accident sequences dominated by long-term decay heat effects. If the long-lived fission products were eventually released to the environment, the quantities would be as great as if the reactor had been operating at full power.

It is helpful to consider a parameter that can be directly related to the time scale on which various key events occur following an accident. The total integrated decay power up to a given time is such a parameter, and it governs the time lapse between the key events in many, but not all scenarios. It is our general conclusion, based on a variety of calculations, that the total integrated decay heat will reach a value sufficient to achieve a given key event (e.g., melting through the vessel or melting through the basemat) on a time scale that varies inversely with the reduced power level. Reduction to 50% power operation seems to extend the time at which various levels of integrated decay heat are reached by factors of two to three. In the accident scenarios governed by this parameter, a significant extension in the allowable time for operator actions or civil defense actions is provided by operation at reduced power levels. If the time elapsed extends past the half lives of the intermediate-lived isotopes, a substantial reduction in dose can be realized since intermediate-lived isotopes are a major contributor to radiological dose levels. However, this advantage is not applicable to all accident scenarios. If preliminary signals do not properly inform the operator, or if the operator does not interpret them correctly, there may be no more advance warning of required actions in the reduced power case than in the full power case.

In accidents where the threat to containment is dominated by hydrogen generation, a reduced decay heat level may be less of a delaying factor. Once the fuel cladding has reached the temperature at which oxidation proceeds rapidly, the hydrogen generating chemical reaction is self-sustaining and requires no additional energy from the decay heat source.

In summary, if safety is measured by the increase in permissible operator reaction time, the safety enhancement attributed to 50% operation is a factor of two or more for some scenarios. However, qualitative consider-actions suggest that the increment in safety, as measured by the total curies available, is smaller than the decrement in power operation. We are unable to identify any accident scenario for which reduced power operation results in the decrease of any safety margin.

The situation is of course different with respect to reactor operation at insignificant power levels. Here the reactor could be operated for training or checkout purposes without building up sufficient decay heat to constitute a threat to containment. Valuable operator familiarization could be obtained and equipment and procedures debugged so that when full approval was finally given, the ascent to full power operation could be carried out expeditiously, saving a certain amount of equivalent (oil fueled) power at that time. Although the exact level of such inherently safer operation is not known, it is probably no higher than about 10-15% of rated full power.