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

January 16, 1979

File
XSNM-1222

MEMORANDUM FOR: Chairman Hendrie
Commissioner Gilinsky
Commissioner Kennedy
Commissioner Bradford
Commissioner Ahearne

FROM: Ken Pedersen

SUBJECT: TARAPUR REACTORS - FUEL REQUIREMENTS

I am providing for your information an analysis of the fuel requirements for the Tarapur Reactors, TAPS I and II, which updates our earlier analysis of April 3, 1978. The present analysis is based on more detailed and current information in that it reflects the data the State Department obtained from India in response to my questions regarding fuel requirements and schedules during the past two years, future refueling plans, and the current inventory of fuel available in India.

CONCLUSIONS

1. Based on an average of recent fuel usage -- 56 subassemblies per refueling -- the current supply of fuel in India is probably adequate for four more refuelings. This would permit scheduled operation of TAPS II to August 1981 and TAPS I to February 1982.

2. The additional fuel that would be provided in the pending export, XSNM-1222, would probably allow one more refueling each for TAPS I and II. It appears that operation of TAPS II could then extend to November 1982 with TAPS I running until May 1983. (Assuming normal operation and based on same average fuel consumption as in 1.)

3. If significantly higher fuel consumption were experienced, for example an average of 70 subassemblies per refueling*, the last dates for TAPS I operation would occur earlier, but the TAPS II dates would be unchanged. Thus, with only the fuel on hand, TAPS I

* 70 subassemblies correspond to about one-half the normal annual output of the fuel fabrication facility; refuelings of reactors are sequenced roughly 6 months apart.

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could probably operate to November 1980; with XSNM-1222, TAPS I probably could go to February 1982. TAPS II capability remains the same as in 1 and 2 above -- August 1981 (only fuel on hand) and November 1982 (with XSNM-1222).

4. Allowing 12 months for delivery and fabrication, XSNM-1222 would probably need to be shipped by November 1979 (high fuel usage rate of 70) or August 1980 (fuel usage rate of 56) in order to allow for continued operation of TAPS I and II under the assumptions used here.

5. The above schedules of fuel supply and usage may not allow adequate operational contingency in case of a major problem (e.g., high leakage rate of fuel in a reactor).

DISCUSSION

During 1977 and 1978, the following average usage and schedules have been experienced at the Tarapur reactors:

- Fifty-six subassemblies of fresh fuel have been required for each refueling;
- The reactor operating period between refuelings has been approximately 12 months; and,
- The refueling outage period has been approximately 2½ months.

The schedules for future refuelings are apparently based on 12 months of operations, with a 3 month refueling outage. Table 1 below gives the full pattern of this cycle, based on extrapolation of the information from the State Department (December 18, 1978 Telegram). Figure 1 gives the results of the OPE analysis, with the method of calculation given in the Appendix. Two average fuel consumption rates have been used, 56 and 70 subassemblies (S/A) per refueling. The dates at which each reactor will no longer have adequate fuel to permit each of the assumed average refueling rates (56 or 70) are denoted by the end points of each bar chart. The projected date for the start of each refueling is shown by the arrows.

TABLE 1

TAPS I & II
REFUELING SCHEDULE

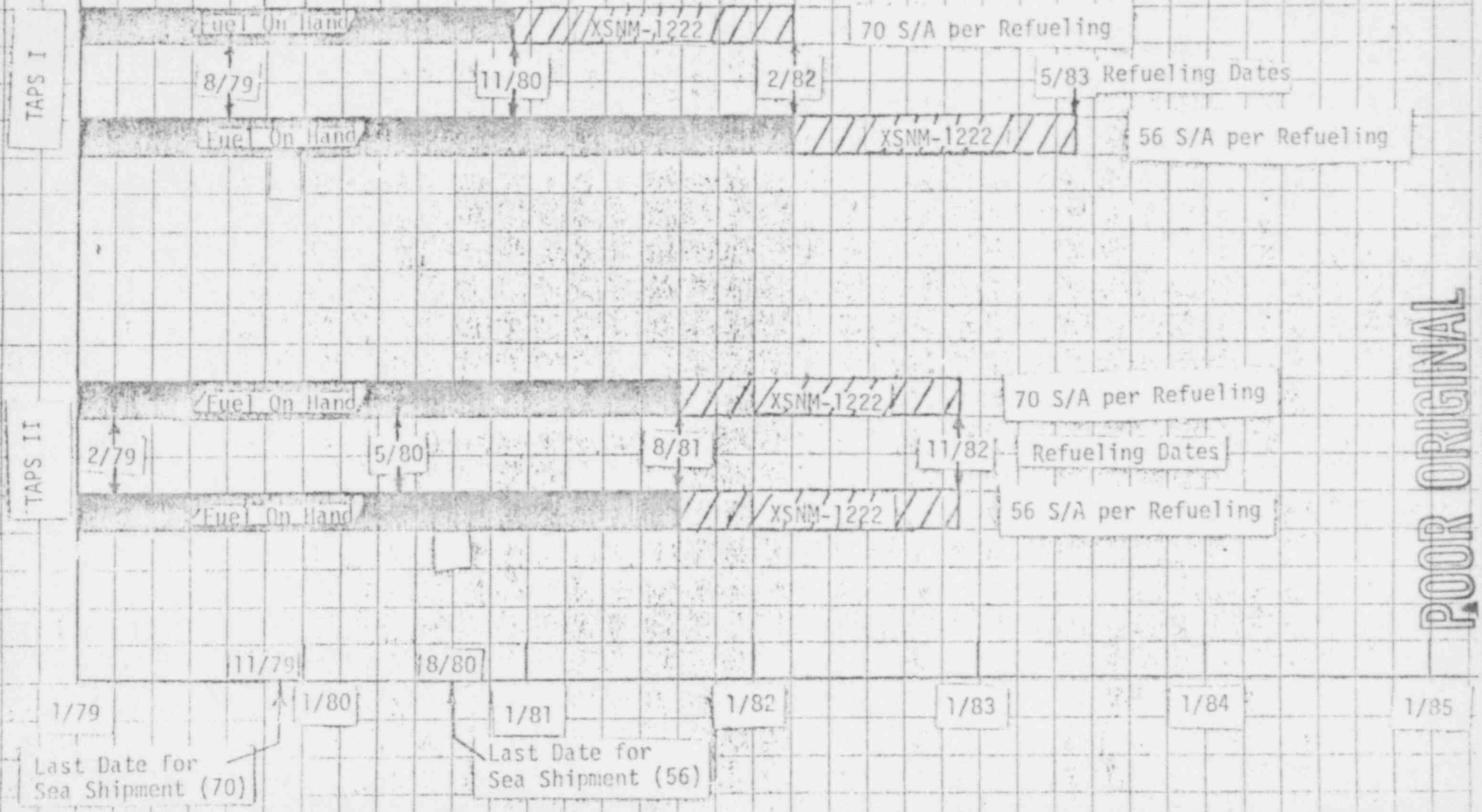
Refueling Cycle	TAPS I or II	Approx. Date for Start of Refueling
1	II	2/79
2	I	8/79
3	II	5/80
4	I	11/80
5	II	8/81
6	I	2/82
7	II	11/82
8	I	5/83

Refueling Outage = 3 months
Operating Period = 12 months

FIGURE 1

PROJECTED OPERATING SCHEDULE FOR TARAPUR REACTORS*

*Assumes 12 month operating cycle and 3 month refueling outage.



If on the average 56 S/A are loaded, then TAPS I probably can operate until February 1982 (with only fuel on hand) or until May 1983 (with XSNM-1222 added to the fuel on hand). TAPS II can operate until August 1981 (only fuel on hand) or until November 1982 (fuel on hand plus XSNM-1222). If the higher average requirement of 70 S/A per refueling is assumed, only TAPS I is affected since for either fuel usage rate, TAPS II is refueled in May 1980 with fuel on hand. With a fuel requirement of 70 S/A, TAPS I can probably operate until November 1980 (only fuel on hand) or until February 1982 (fuel on hand plus XSNM-1222).

With sea shipments* (about 2 months) and considering customs clearances, overland transportation (about 1 month) and fabrication time of about 9 months, fuel must be shipped about 12 months before it is needed for refueling. Two shipment dates are shown at the bottom of Figure 1. Under pessimistic assumptions, i.e., 70 S/A per refueling and sea shipment, it appears that XSNM-1222 could be shipped in November 1979, without impacting the planned refueling schedules. With the lower usage rate, but still assuming sea shipment, XSNM-1222 could probably be shipped in August 1980 without impacting operations.

One of the issues you may wish to consider is whether the U.S. obligation for fuel supply encompasses an obligation to ensure optimum operation of the entire fuel cycle (fabrication facility and TAPS I, II) or whether the obligation is only for the reactors. The State Department has previously taken the position (June 15, 1978 letter from Joseph Nye to Senator John Glenn) that efficient operation of the fuel fabrication facility (apart from efficient operation of TAPS) is a factor to be considered. In the Nye letter regarding continued fuel supply, he states:

> "However, operation of the Nuclear Fuel Complex (NFC) where the TAPS fuel is fabricated has been severly disrupted since March 1978, when its supply of fresh uranium feed was exhausted. . .
>
> . . .We interpret the amount of material needed for operation to be the amount required to sustain normal operation of the Nuclear Fuel Complex at Hyderabad for the production of TAPS fuel, consistent with the usual method of operating this facility."

However, it is relevant to note that Article I.C. of the Agreement for Cooperation is concerned only with ". . .efficient and continuous operation of the Tarapur Atomic Power Station."

The foregoing analysis is directed at reactor operations and not necessarily at assuring optimal operations at the fuel fabrication facility. The most

*Recent shipments have required air shipment, saving about 2 months.

efficient use of the fuel fabrication facility results when operations do not need to be interrupted to process different uranium enrichments in short runs. Also, recycle of scrap materials (which has been assumed in this analysis) proceeds at a much reduced rate relative to processing of fresh fuel -- recent information from State is that scrap is processed at only 20% the rate for fresh fuel. Thus, for optimal operations the fuel facility should have on hand a backlog of fresh feed material.

I trust this information will be useful to you. Please let me know if you have any questions on the above, or if you want additional information.

Attachment:
As Stated

cc: James Kelley
Sam Chilk
Lee V. Gossick
James R. Shea

Appendix - Method of Calculating Fuel Requirements

One TAPS subassembly consists of:

No. Rods	U-Enrichment	Kg.U
22 (2 with GdO_2)	2.66%	85.6
11	2.1 %	42.8
3	1.66%	11.6
Totals 36		140

Total unfabricated fuel material available with export: (Kg.)

U-Enrichment	In-process*	Scrap*	XSNM-1222**	Kg. Total
2.66%	11,970	1,195	9,120	22,285
2.1 %	1,444	910	6,080	16,434
1.66%	1,195	708	1,520	3,423

* Data from State Telegram, December 18, 1978

** In the State submission of January 5, 1979, they indicate that 115 finished subassemblies may be fabricated from XSNM-1222. Based on somewhat more detailed analysis, only 106 subassemblies may be obtained, since the 2.66% U enrichment is limiting, viz. 9,120/85.6 = 106. This has been discussed with State. Since all available uranium of like enrichments would be combined to maximize the number of full subassemblies, the above procedure has been used to add together uranium available from all sources (in process, scrap, and XSNM-1222) for each of the three enrichments.

No. Subassemblies which can be fabricated from fuel material available:
(ignores small processing losses)

U-enrichment	Subassemblies
2.66%	22,285/85.6 = 260 (limiting)
2.1 %	16,434/42.8 = 384
1.6 %	3,423/11.6 = 295

Conclusion:

The available 2.66% U material limits the number of complete subassemblies to 260.

Additional completed subassemblies on hand (per State 12-19-78 Telegram) is 97.

Total subassemblies: 260 + 97 = 357

Consider two rates of usage per refueling:

(1) 56 subassemblies (average of refueling requirements last two years)

357/56 = 6.4 i.e. 6 refuelings with 21 spare subassemblies

(2) 70 subassemblies

357/70 = 5.1 i.e. 5 refuelings with 7 spare subassemblies