5X-961009-CLN-01

TO: M ONO
FROM: C NEUMEYER
SUBJECT: REVISIONS TO CONSTRUCTION AND OPERATING COST ESTIMATES WITH NSTX AT D-SITE

This memo presents revised cost estimates for construction and operation of WBS5. The latter item is in response to the Chit #4 generated during the recent review of the D-site option.

Construction

As the result of an exercise to develop a resource loaded plan for the construction phase, including commissioning up to first plasma, additional costs were identified relating to the need for engineers and technicians to support the operation of the AC distribution system and MG system during commissioning and integrated system test of the integrated power system. Although no physical changes are anticipated to these systems (other than perhaps some new low voltage AC feeder circuits to miscellaneous plant equipment) there will be some level of support required, similar to that required during operations, since the equipment will be in use.

For now I assume that these costs must be borne by the construction budget.

The impact of this change is ≈ $400K, which brings the estimate for the D-site implementation to the same level (≈ $2.4M) for that at C-site. Since the D-site estimate was based on a very brief exercise the contingencies were set high. Perhaps when a more detailed conceptual design study is undertaken the costs and contingencies may be reduced, but for now such a reduction can only be hoped for.

Operations

For the operations estimate, I consider not only the number of operators who must be physically present during machine operations but also the staffing required to:

- administrate
- coordinate maintenance
- oversee the spare parts inventory
- operate the systems in case of absence of primary operators

I assume that NSTX will be the only machine operating at PPPL, so that only integer numbers of engineers and technicians can be considered.

I assume one eight hour shift.

The following table summarizes my view of the operating and staffing situation 1) at present, 2) if NSTX is at D-site, and 3) if NSTX is at C-site.

	Present Staffing Level	NSTX @ D-site		NSTX @ C-site	
		#Operators	Min Staff	#Operators	Min Staff
MG Engr	2	1	2		1
MG SM	1		1	1	1
MG TB	3	1	2	1	1
AC Engr	3		2		2
AC SM	3		2		2
AC TB					
FCPC Engr	2	1	2	1	2
FCPC SM	1		1		
FCPC TB	4	2	2	1	2

The differences in # operators between D- and C-site are as follows:

• at D-site an engineer must remain present or on call during MG operations, whereas at C-site a Senior Monthly (SM) suffices. The reasons are that the complexity, level of potential hazard, and equipment value at D-site exceeds that at C-site.

• at D-site two technicians must remain present during FCPC operations, whereas one suffices at C-site. The reasons are that the complexity, level of potential hazard, level of operator interaction, and physical plant size at D-site exceeds that at C-site. Although the complexity of D-site operations for NSTX would be less than that at TFTR (complex OH system not used, most capacitor banks not used, 22 of 78 rectifiers used), it still exceeds that at C-site (only 8 discrete rectifier compartments are involved at C-site).

For the minimum staffing levels I assume that, to account for the absence (illness, vacation, etc.) of an operator, a replacement must be available. Maybe these "extra" individuals will be able to charge time to other jobs when they are not directly involved in NSTX operations, but in this estimate it is assumed that their costs would be borne by NSTX. Practically speaking there will always be improvements and upgrades underway which they will be available to work on.

When NSTX is not operating, the operators can participate in the maintenance activity. In the case of MG, based on the detailed estimate of annual maintenance man-hours for the two sites (one MG set at D-site, and one shaft, four generators at C-site), roughly 2 FTE technicians are required in each case. Assuming that 3 months per year are available for maintenance, 8 technicians (including SM) would participate in the maintenance during this interval. I assume that the

shortfall (above and beyond the SM and TB who are part of the basic MG staffing) would come from other sources (e.g. other PPPL technicians or subcontract labor). So, when I calculate the cost for MG maintenace I only add in the cost of this other supplemental labor, plus an M&S allowance.

In the case of AC power, although operators are generally not required to be physically present or on call specifically for machine operations, they are needed for occasional troubleshooting and repairs, as well as maintenance.

A revised cost comparison table follows. The number of engineers and technicians shown is based on the above assumed staffing levels. I do not distinguish between SM and TB.

	D-site	C-site	
MG System			
#months/yr	9.00	9.00	mo
#days/month	15.00	15.00	day
#hrs/day	8.00	8.00	hrs
repetition period	5.00	5.00	min
#pulses/day	96.00	96.00	pulses
Idling Power	1.75	1.00	MW
Pulse Energy	100.00	100.00	MJ
Average Power	2.08	1.33	MW
Energy/Day	16.67	10.67	MW-hr
Energy Cost	0.08	0.08	$/kW-hr
Peak 15 min Avg Power	2.08	1.33	MW
Demand Cost	10.00	10.00	$/kW
Energy Cost/month	20000.00	12800.00	$
Demand Cost/month	20833.33	13333.33	$
Annual Electricity Costs	367500.00	235200.00	$
Annual Maintenance Cost	118145.25	133722.00	$
M&S	30000.00	30000.00	$
Subtotal	515645.25	398922.00	$
#Engineers	2.00	1.00	Engr
#Technicians	3.00	2.00	Tech
Engineer Cost/Day	868.00	868.00	$
Technician Cost/Day	414.00	414.00	$
Annual Operator Cost	658138.00	374816.00	$
Total	1173.78	773.74	$K
AC Power System			
#Engineers	2.00	2.00	Engr
#Technicians	2.00	2.00	Tech
Engineer Cost/Day	868.00	868.00	$
Technician Cost/Day	414.00	414.00	$
Annual Operator Cost	566644.00	566644.00	$
M&S	50000.00	50000.00	$
Total	616.64	616.64	$K

Rectifier System

#Engineers	2.00	2.00	Engr
#Technicians	3.00	2.00	Tech
Engineer Cost/Day	868.00	868.00	$
Technician Cost/Day	414.00	414.00	$
Annual Operator Cost	658138.00	566644.00	$
M&S	25000.00	25000.00	$
Total	683.14	591.64	$K
Grand Total	2473.57	1982.03	$K
Difference	491.54		

In summary, the above reflects my best estimate at this time, given the stated assumtions.

cc:

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NSTX File