

Procurement Options for Emergency Backup Power
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A. Research Objectives

The objectives of Phase One of this research are to:

- Identify the backup power needs for the Tren Urbano system
- Study strategies used to procure backup power for other relevant power systems
- Identify key lessons learned from these other backup power systems
- Propose options for the procurement of a backup power system for Tren Urbano
- Develop timeline for evaluating various procurement options
- Recommend procurement options based on time constraints
- Specify criteria and negotiation strategy for each procurement option

The first objective listed above was addressed by Frederic R. Harris, who identified much of the backup power requirements in the report *Tren Urbano Energy Strategy Plan* (October 1997). The main recommendation of the F. R. Harris report is to “install 20 MW of emergency backup power (two 5 MW diesel or gas turbine units located at the Bayamon Centro site; two 5 MW diesel or gas turbine units located at the Sagrado Corazon site).” Therefore, this project has used the F.R. Harris recommendations as a backdrop to research the remaining objectives.

The bulk of this report focuses on recommending options for the procurement of emergency backup power for Tren Urbano. This report will critically assess the options and present the top two alternatives. This will aid Tren Urbano in its decision-making process. Second, this report will arm the Puerto Rican Highway Transportation Authority with a negotiating strategy for each of the alternatives.

B. Motivation

The Frederic R. Harris report says, “the reliability, safety and comfort of the Tren Urbano system are paramount to its success in meeting the project goals as set forth by the Puerto Rican Highway Transportation Authority. Achieving these elements, especially during emergency situations, sets positive impressions in commuters’ minds that encourages them to use Tren Urbano over alternate forms of transportation, such as automobiles.” A reliable energy supply is a vital component in the delivery of these objectives. “Energy capacity shortfalls are currently being experienced in Puerto Rico. Proper availability and management of energy resources will allow Tren Urbano to overcome potential problems and take advantage of substantial opportunities. Therefore the development of an energy strategy that addresses these issues is critical.”

The ST³ contract assumes that Tren Urbano will rely on PREPA, the Puerto Rican Power Authority, for its main power supply. The contract specifies that 4 substations will connect Tren Urbano to PREPA. However, the contract does not specify plans for any emergency backup systems. Since the Tren Urbano must have power even during an unexpected power loss from the main supply, procuring a backup system is an important task.

According to F.R. Harris, "the current design does not include an emergency backup power strategy for either short or long term power outages". The contract does provide for an uninterruptable power supply (UPS) which would provide backup for lights, controls, and ventilation. The operation/maintenance facility at Torrimar and Las Lomas will have a small emergency backup generator to provide power to the main operation control center and restoration activities. The Harris report even goes so far as to say that under the current plan power outages will cause the train to stop, forcing stranded passengers to walk along the guideways to the nearest stations.

Figures 1-3 illustrate that PREPA is indeed improving in terms of duration and occurrences of power outages. However, the last diagram shows that an average outage could last over twenty minutes. Additionally, the Harris report says, "because of growth

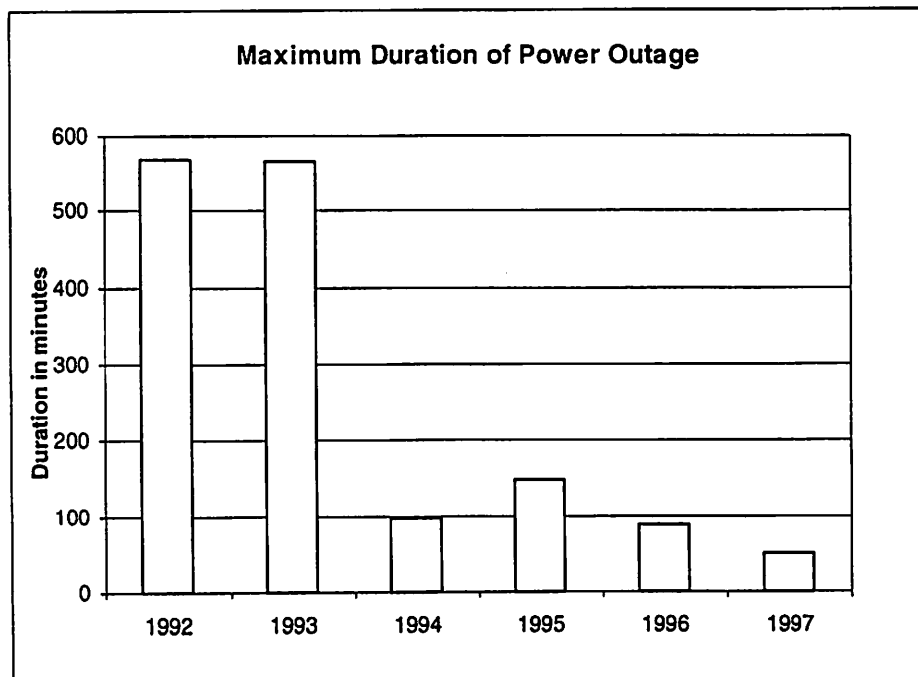


Figure 1: Maximum duration of power outages in the PREPA system, 1992-1997

in the San Juan area, PREPA's electric service is becoming progressively less reliable, as evidenced through frequent brownouts. PREPA is expected to have capacity shortfall problems by the opening of Tren Urbano." The San Juan Star reported on this in January of 1998 in its headlines, "PREPA May Be The Unable To Meet Projected Need For Electricity In 2001" (Gina Caballaro, p. 6)

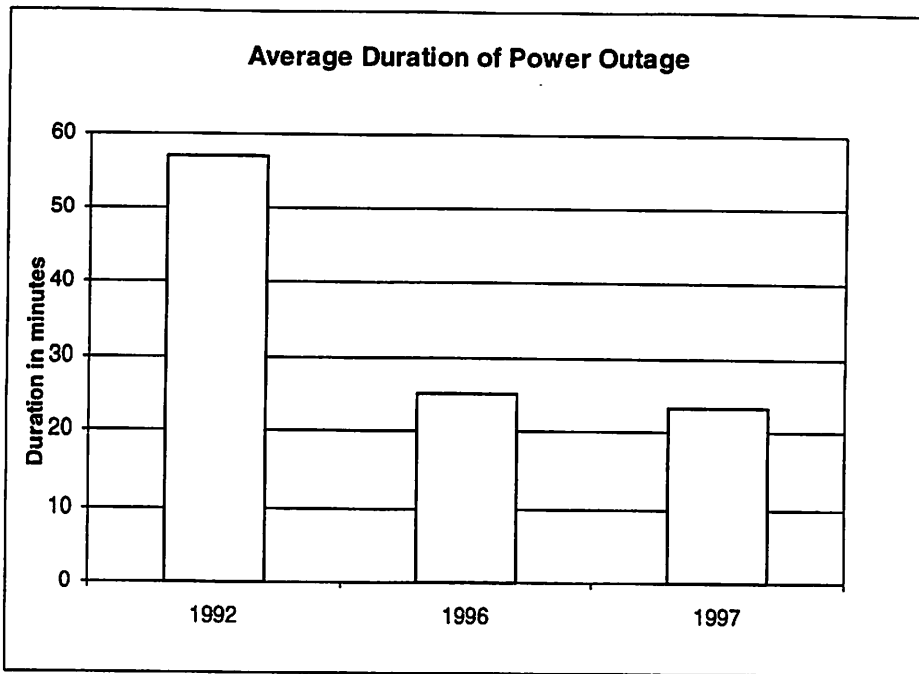


Figure 2: Average Duration of Power Outages in the PREPA system, 1992, 1996-97

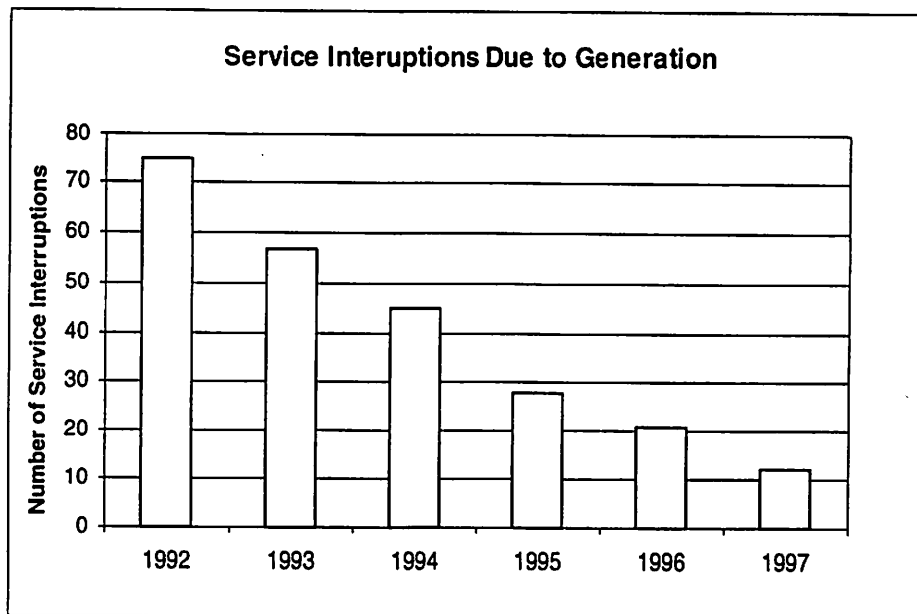


Figure 3: Number of Interruptions of Power Service in the PREPA system, 1992-97

Based on information in the Harris Energy Strategy Report, 20 MW of backup power will be split between two sites: Sagrado Corazon and Bayamon, each containing two 5 MW generator sets. Based on this recommendation, my study will focus on the procurement aspects, legal issues, and practicality of various procurement options. It is important to note that the 20 MW recommendation can be changed via input from the Siemens team or from the Tren Urbano authority. Regardless, the same decision process and same rigorous analysis can be used by the Tren Urbano Authority in deciding how to achieve their goals and procure what is needed.

C. Methodology

To understand the various procurement options for backup power used in different institutions, I consulted various experts in energy. I also prepared mini case studies of various organizations and institutions needing reliable main or backup power. These organizations offered valuable lessons on procurement issues. To better understand the political climate, legal context, and power issues of San Juan, I consulted with experts at Tren Urbano, Siemens, and experts such as newspaper reporters, professors, and energy consultants. Additionally, I familiarized myself with procurement strategies and delivery methods, especially the John B. Miller “quadrant” method (shown later in Figure 5).

In North America, the following organizations offered valuable lessons in various procurement strategies for reliable main or backup power:

- Disney World in FL: amusement park
- Harvard: educational institution
- Medical Area Total Energy Plant (MATEP): hospitals
- Massachusetts Bay Transportation Authority (MBTA): transit agency
- Massachusetts Institute of Technology (MIT): educational institution
- Massachusetts Water Resources Authority (MWRA): water and wastewater utility
- Partner's Health Care: hospital
- Other experts with knowledge about organizations, power, and power procurement

In Puerto Rico, the following contact people helped me understand power and reliability issues in San Juan as well as the current work regarding procurement of emergency backup power:

- Randy Altschuler: GMAEC consultant.
- Gerhard Aue, Manager, Siemens Systems Engineering.
- John Barber, Manager, Systems Coordinator: GMAEC consultant.
- Jane Chmielinski, Manager, Environmental: GMAEC consultant to spearhead the F.R.Harris report on energy strategy.
- Joe Ferretti, Manager Siemens Operations and Maintenance.
- Jorge Matesanz, Coordinator Operation and Maintenance: Siemens; Assists Joe Ferretti.
- Juan Requena, Partner at Juan Requena and Associates Electrica Engineers: Designs Electrical "grid" for Siemens.
- Jose Sanchez Ortiz, PE, Systems Coordinator: was employed at PREPA and now works for Tren Urbano.

After speaking with these various contacts, I was able to identify the organizations which had successfully incorporated redundancy and have improved reliability within their organization's power system. Using these organizations as a model, and taking into account the specific issues found in San Juan, I have been able to present Tren Urbano with the decision process by which to go by to most efficiently procure 20 MW of emergency backup power.

D. Findings

The following diagram is a graphical representation of the decision-making process used to narrow down the options for procuring 20 MW of backup power as recommended by the F. R. Harris Energy Strategy Report. To obtain 20 MW, I foresee two initial paths: first, initiating a procurement process from within Tren Urbano and second, relying on PREPA to supply a backup power strategy.

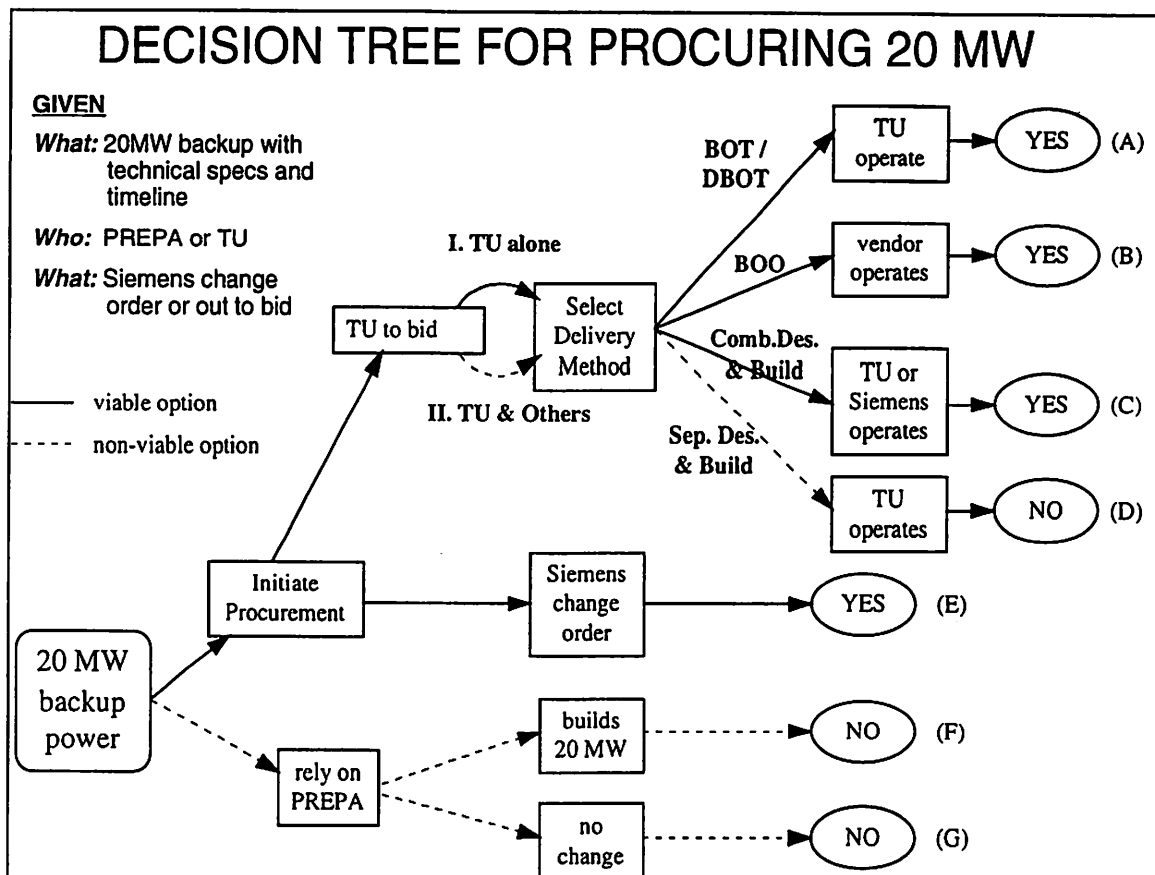


Figure 4: Decision tree

By relying on PREPA, Tren Urbano can either depend on current PREPA systems to provide reliable power (option G in Fig. 4) or ask PREPA to build a backup system specifically for Tren Urbano (F). As shown in Figures 1-3, the PREPA power supply has improved in the last few years and in the last year especially. However, relying on PREPA may increase Tren Urbano's risk and is therefore an unacceptable option. The second option, is to initiate negotiations with PREPA to design, supply, and build two 10 MW backup power generators in Sagrado Corazon and Bayamon, possibly partially financed by Tren Urbano. PREPA would have the option of taking over these two sites at a future date. However, from my discussions with Tren Urbano contacts who serve as intermediaries between Tren Urbano and PREPA, PREPA has no interest in this partnership. PREPA is currently working to build new power plants in the southern part of the islands and fighting battles with EPA over emissions from these plants (San Juan

Star, January 19, 1998). Additionally, PREPA has made great strides in improving reliability of its power supply throughout Puerto Rico. Building extra capacity specifically for Tren Urbano would be an indication that PREPA is unable to meet the increased demand from Tren Urbano in 2001. Politically, PREPA may fear a loss of prestige, or an admission of failure if it builds a backup system for Tren Urbano. Thus, relying on PREPA to build 20 MW of emergency backup power specifically for Tren Urbano is not a viable option.

If Tren Urbano wishes to initiate a procurement (options A-E in Fig. 4), the authority has two choices: provide the emergency backup power through a Siemens change order (E) or issue a request for proposals on which the private sector could bid (A-D). Both of these are viable options. In my research, I indicated that Tren Urbano could possibly form a consortium with others in the San Juan area who were in need of reliable backup power. The consortium could jointly issue an RFP and solicit bids (II in Fig. 4). At this final stage of my research, I would argue that the consortium is not possible for several reasons. First, the negotiations with potential consortium members will be difficult and would take longer than Tren Urbano has to make decisions on backup power. Second, even if the consortium was possible, a separate engineering study would have to be undertaken since F. R. Harris only already studied the demands and potential solutions for Tren Urbano acting alone. Third the prior behavior of potential consortium members including the University of Puerto Rico at Rio Piedras has presented some difficulty in terms of timely payments. Therefore, future conflicts may arise between Tren Urbano and potential consortium members on finances, priority, and siting. Last, my research indicates that it is illegal under Puerto Rican law to form a consortium and produce, sell, and buy power in competition with PREPA. (Puerto Rico is not subject to FERC wheeling rules and has a very large unionized lobby that opposes massive deregulation in Puerto Rico, although deregulation has affected most energy markets in North America).

Figure 5 summarizes how the common project delivery methods fit into an operational framework known as the "quadrants" developed by Professor John B. Miller of MIT. If Tren Urbano goes out to bid, I envision four possible delivery methods. The first is BOT/DBOT in which the vendor will design, build, and operate, but Tren Urbano will own (A in Fig 4). The second is BOO in which the third party vendor will perform all options (B). Third is a combined design and build in which a vendor will design and build the facility and hand it over to either Tren Urbano or Siemens to own and operate (C). The last option is a separate design and build, which is most common due to federal legislation (D). In my opinion, this option is not acceptable as the MBTA and the MWRA were forced to acquire their backup to a segmented design and build process. Both parties said explicitly that each would rather not go through the same procurement/delivery method if they had to do it over again. The separated design and build process also takes longer than a combine approach and therefore would not be suited to this fast-paced project.

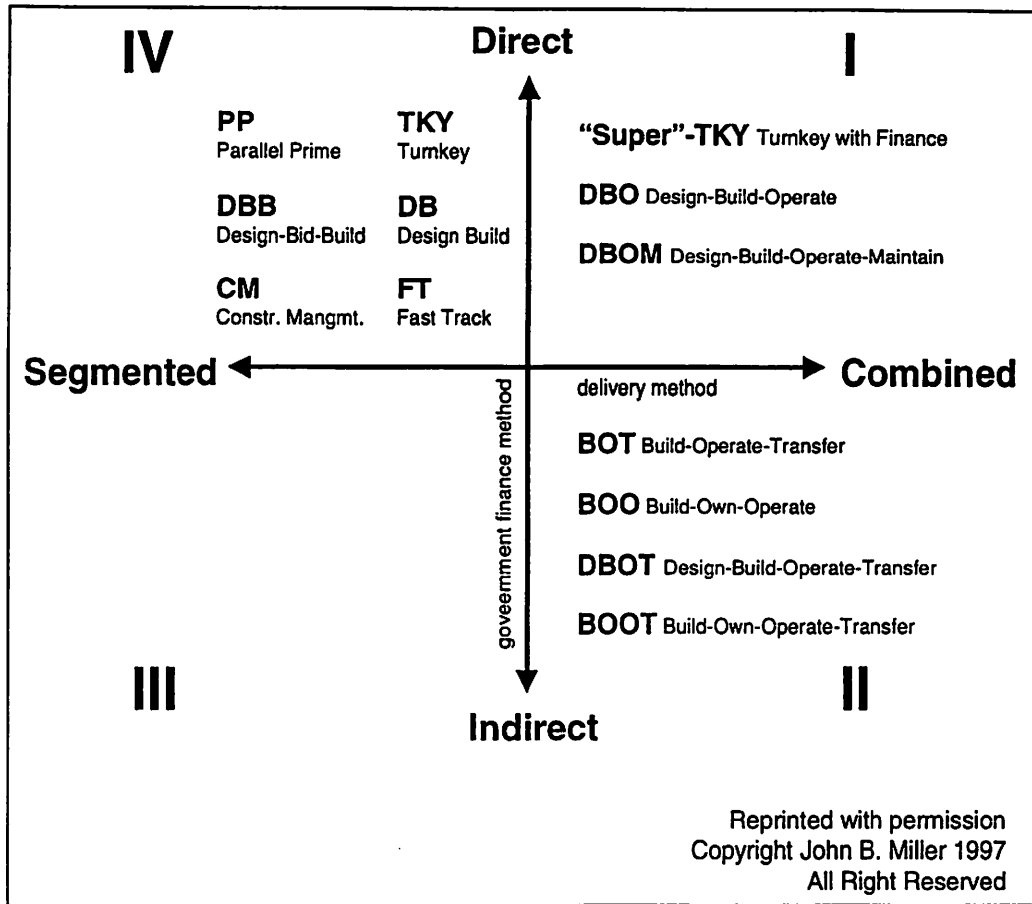


Figure 5: Quadrant framework of project delivery methods

If Tren Urbano wants to take advantage of the competitive power market to find the best quality and lowest price, I strongly recommend that Tren Urbano prepare itself to go out for bid. The power market is extremely competitive, based on my research it is possible to acquire 20 MW of backup power for 10 million dollars less than the capital costs estimated in the F. R. Harris report at \$700-\$800 per kW. If Tren Urbano decides to issue an RFP, the authority must swiftly decide, issue an RFP, solicit the bids, determine the winner, and a negotiate a contract. After this, the process of designing, permitting, ordering generator sets, construction, and testing is similar to what Siemens would have to do in a change order environment. However as shown in the next diagram, it is possible to solicit bids in the time remaining before the opening of the Tren Urbano in summer of 2001. There is a definite possibility Siemens may respond to the RFP with a good quality and competitive bid.

If the Authority cannot decide quickly and proceed with a competitive procurement process, Tren Urbano is by default committed to a Siemens change order. In this second scenario, the Authority must swiftly make a decision and then negotiate the contract. Siemens could immediately begin to design, place an order for the generator sets, and begin determining process before a backup power is constructed and tested.

The following diagram shows two scenarios: out-for-bid and change order; both concurring at a "start date" at which the contractor would begin to design, permit, order and construct. This diagram illustrates that there is time for both options and estimates how long each would take. Both options are possible, yet require slightly different times from the decision-date to the start date. Tren Urbano must decide on this decision date how much power is required for backup, how much it can afford, where the generating sites should be, and how many generators are required.

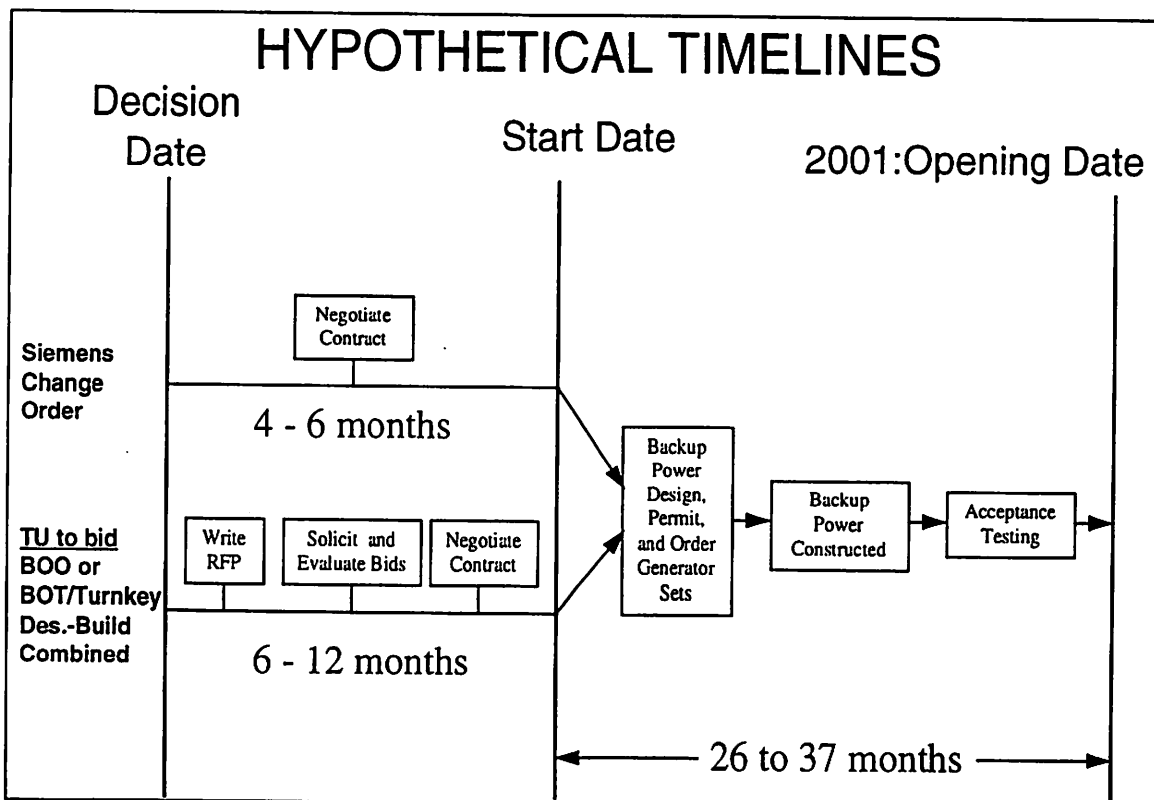


Figure 7: Timelines

In this last section, I will outline a negotiating strategy for the Authority in the two most promising scenarios: 1) if the authority goes out to bid 2) if the authority must rely on Siemens for change order.

Out to bid:

The Authority must work as efficiently as possible and elevate the procurement of backup power to a top priority within the organization. The Authority must solicit bids from the private sector and specify the exact engineering requirements i.e. diesel or natural

gas, required amount of backup power generating capacity, breakdown of MW (four 5 MW generators or three 3.3 MW) and judge the bids on various specific evaluation criteria: prior experience, cost, and a specific management plan for meeting time lines. Potential bidders include: Raytheon, Caterpillar, Siemens, GE, and Onan (a division of Cummings). I encourage Tren Urbano to explore all possibilities including diesel generators from decommissioned nuclear power plants (available through the following website: <http://www.powerplant.org/info/pp5mw.html>) and other lower cost options.

Siemens change order:

Siemens Power Corporation handles many different requests for power. Even if Tren Urbano does not have time to prepare an RFP and solicit bids, Tren Urbano must evaluate the market and collect data on cost estimates from the competitors mentioned above. Siemens will have the advantage if Tren Urbano runs out of time and has no other options. Siemens could then charge a very high price for its backup power system. If Tren Urbano can be armed with market research and competitive prices, the authority will be able to negotiate the fairest price from Siemens. I would encourage the Authority to re-evaluate the cost estimates in the F. R. Harris Report.

E. Research Plan

In Phase One of my research, I have relied on the Frederic R. Harris report for my fundamental assumptions. However in Phase Two of my research I would like to delve deeper into the solutions presented in the F. R. Harris report and explore alternatives to 20 MW of emergency backup power for the future extensions. In Phase II, I plan to:

- Examine sources of unreliability in the PREPA power grid (the F. R. Harris report and others assume that the problem is in capacity, but perhaps there are other problems along the alignment such as transmission or distribution which have not been studied yet).
- Investigate alternatives to the recommendations of the F. R. Harris Report for future extensions (both in the amount of emergency backup and other creative solutions: upgrading infrastructure, building a new transmission line, upgrading the interconnect between the two halves of the alignment bulk power sub stations).
- Outline ways for PREPA to improve reliability of service to TU (including using dedicated line or transmission/distribution upgrade) and outline areas of collaboration between the two government agencies.
- Examine Puerto Rican political climate and law regarding the setting up a dedicated Tren Urbano power plant as an alternative to PREPA in the future. Deregulation may affect Puerto Rico in the coming years and may allow future extensions of Tren Urbano to benefit from other methods of providing reliable power.
- Outline ways of structuring competition to maximize Tren Urbano's cost savings including a examination of lifecycle cost, O&M costs, and cost benchmarking.