Planning and Procurement of an Urban People Mover System in Doha, West-Bay

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Abstract

Doha, the capital of the State of Qatar is experiencing an unprecedented growth and development, and the need to move people quickly and efficiently in the West Bay area, site of major hotels, residential and office towers as well as a Convention Center and a major shopping mall, has become a pressing need. A modern underground Automated People Mover (APM) system has been selected to facilitate passenger movement.

Procurement of the APM will follow a conventional design-build competitive procurement for the Operating System, while the civil portion (tunnel, stations and M&SF) will either be awarded to a nominated Contractor or advertised for competitive procurement.

The APM system will consist in 10,000 m of dual track underground tunnel and 19 stations. Cars will generally be configured into three-car consists. A car will be dedicated to VIPs and family, while the rest of the cars will be dedicated to other passengers. This paper provides an overview of the APM system and discusses its key planning, design, implementation and procurement elements.

Introduction

The state of Qatar, and its capital Doha, is experiencing a phenomenal growth spurred by natural resources wealth as well as judicious investment worldwide. In order to support a sustainable economic growth, the state of Qatar has commissioned an Integrated Railway Project (QIRP) that has resulted in the planning of a Metro Network for Doha, the Capital City, as well as other regional or international high speed railway lines. The Metro network under planning consists of four lines: Red, Blue, Green and Golden lines. The common point of these transportation modes is in the heart of Doha, i.e.: the West Bay District. In addition, an APM has been planned in order to relieve congestion and increase mobility and accessibility to the main attraction poles in West Bay. The APM will connect the Barwa Financial District, hotels, embassies and multiple residential and business towers in West Bay, and will serve as a feeder to the future metro and rail lines. The APM will share a common underground, multi-level station with a future metro system that is planned between the City of Lusail and Doha International Airport, a regional rail line and a high speed rail connection to Bahrain. Qatar Railways Corporation (the Employer), a newly established entity, has been mandated by the Qatari government to oversee the planning and construction of the APM system.

Lea+Elliott Team[1] have performed preliminary engineering and preparation of tender documents for the APM Operating System. This includes design of the APM Operating System and establishment of the infrastructure interfaces and requirements. This paper includes updates to a previous publication that provided technical details on ridership, soil geology, power distribution etc. (Kamel Mokhtech et al., 2009).

West Bay

Figure 1 illustrates the West Bay district, including an identification of the major commercial and entertainment sites and transportation arteries, as well as the main shopping mall in the West Bay District. Figure 2 illustrates the location of the Park site, presently an open air parking. Figure 3 illustrates the surroundings that include a convention center site and several multi-storey towers.

[1] Lea+Elliott Team include Lea+Elliott Inc, the Dynamic Management Group (DMG) and other subcontractors.

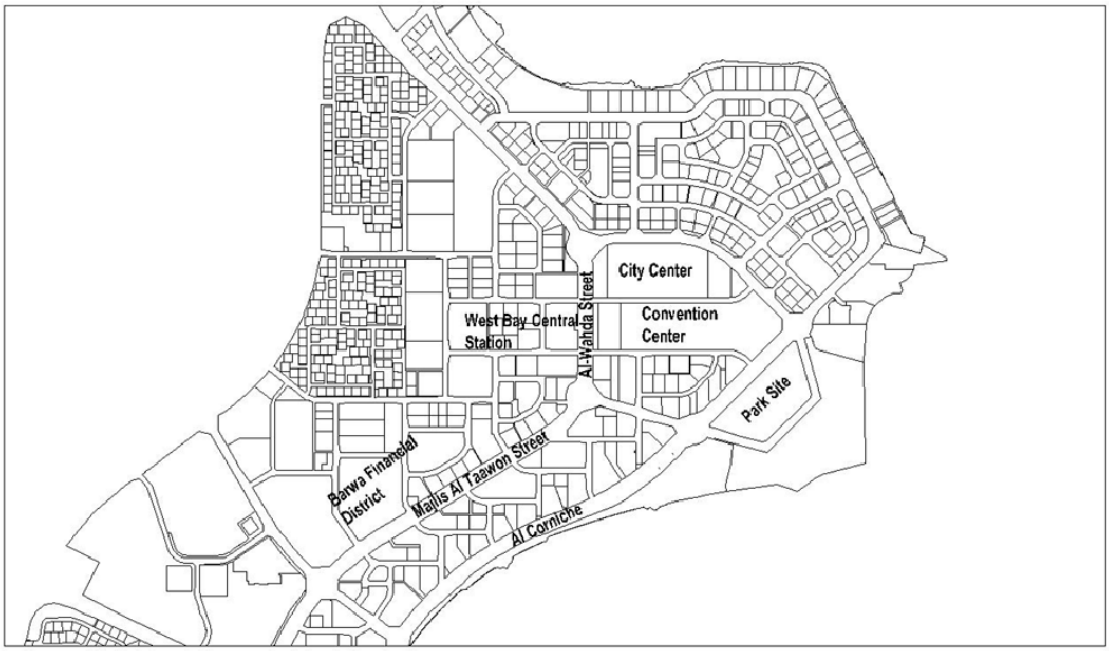

Figure 1: West Bay

Figure 2: Park Site Location

Figure 3: Park Site (right)- View of the Corniche and Towers

The Need for an APM System

Previous studies (Kamel Mokhtech et al., 2009) commissioned by the Employer highlighted the need for an Automated People Mover.

System Planning

The initial phase of the APM study was limited geographically and resulted in a preferred alternative or base System (see Figure 4). Later, the Employer decided to study the feasibility of a larger System (see Figure 5).

A phased approach has been established to provide the option to either develop the system in phases or go full out for the larger (complete) system. As a result, the design team developed two configurations, one being a subset of the other. The two systems are shown below as option 1 and option 2. Option 1 includes the civil work and all crossovers required for ease of expansion into the larger system.

Figure 4: Option 1 (Base System)

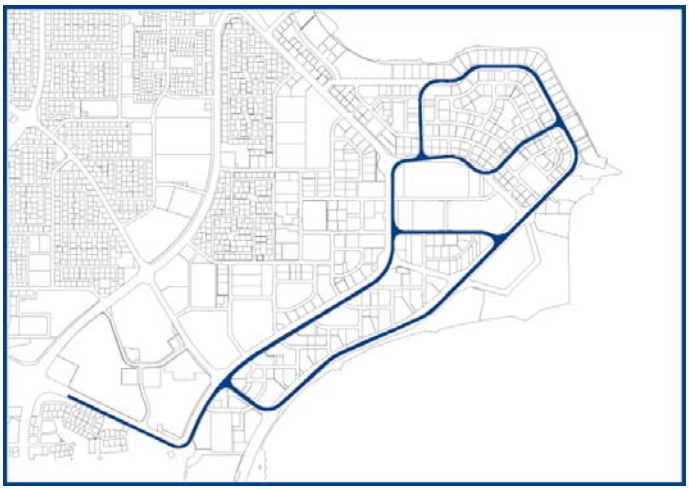

Figure 5: Option 2 (Larger System)

The larger System includes 19 stations while the base System includes 11 stations. The stations are located, on average, about 450 m apart. Station 1, or West Bay Central station, located underneath Al-Wahda Street will be an intermodal station

serviced by a future high speed rail line to Bahrain as well as two Metro lines (Red and Blue). The Red line will connect Lusail, a future big development north of Doha, and Doha International airport. The larger System includes also an additional interface station (West Bay South located in the Barwa Financial district) with the Metro line serving Doha International airport.

Stations

Stations are generally configured with side platforms to accommodate a single bore tunnel. Stations have typically three or four access points depending upon their location. The concourse is located at the upper level, while tracks and platforms are located at the lower level. The concourse includes retail areas as well as fare gates to allow access to paid passengers. Figure 6 includes a picture of the future West Bay Central station location, while Figure 7 shows the location of the future Convention Center station.

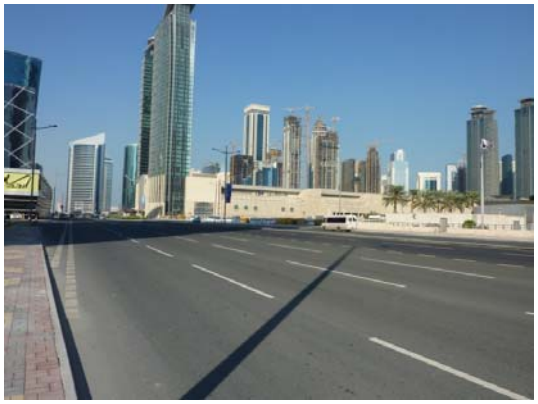

Figure 6: West Bay Central Station location

Figure 7: Convention Center Station Location

Technology Assessment

Prior to the selection of an APM system for Doha West Bay, several transportation alternatives to facilitate passenger movement between traffic generators were evaluated. An initial screening considered Personal rapid Transit, Monorail, Guided Buses, Maglev, Cable propelled as well as self-propelled Automated People Mover. Automated People Movers were identified as the applicable technology. The screening process as well as the considerations used to select an underground APM is described elsewhere (Kamel Mokhtech et al., 2009).

Alignment

Alignment was analyzed, in conjunction with tunnel configuration for various alternatives. The initial configuration consisted in twin-bore tunnels and center platform stations. However, right-of-way constraints south of the convention center precluded the use of twin-bore tunnels. This led to the selection of a single bore tunnel and a side platform arrangement. Given the nature of the soil (Simsima rock) at the elevations being considered, a Tunnel Boring Machine (TBM) was deemed adequate for construction. Discussion with tunnel builders led to the target of 200 m radius of curvature in areas that would be constructed using a TBM. Stations will be constructed using the cut-and-cover technique.

Maintenance and Storage facility

The scarcity of available land in West Bay led to the original selection of the Park Site, where a two storey underground parking structure sized for about 2000 parking spaces will be located. The Maintenance and Storage facility will be located underneath the parking structure. The Park site construction is consistent with the construction of the Convention Center which is scheduled for completion prior to the start of construction of the Automated People Mover. In order to support the design of the Park Site, a detailed construction interface has been initiated. Some of the issues that were considered are described below:

Insertion of cars in the maintenance facility will be performed using an insertion shaft sized to accommodate the largest car of the applicable technologies being considered. Given that the surface level of the Park Site includes landscaping and architectural features, the location of the insertion shaft required a detailed coordination effort including a structural review of the crane requirements, loading zone dimension and road access. A review of the originally planned Park site column grid spacing (9m x 9m) was performed by laying out the Maintenance and Storage facility track work using the switching characteristics of the applicable technologies (crossover layout, linear distance between crossovers, track centerline distance, heavy and light maintenance lanes locations, forklift movement and access, overhead crane location, offices and shops footprint etc.). It was concluded that an 18 m x 18 m column grid was required in the area of special trackwork (crossovers), a 9 x 18 m column grid in the linear portions of the maintenance and flow through lanes, and a 9 x 9 m column grid in the shops and offices areas. The column grid layout was coordinated with APM manufacturers. Figure 8 shows a layout of the maintenance and storage facility under the Park Site.

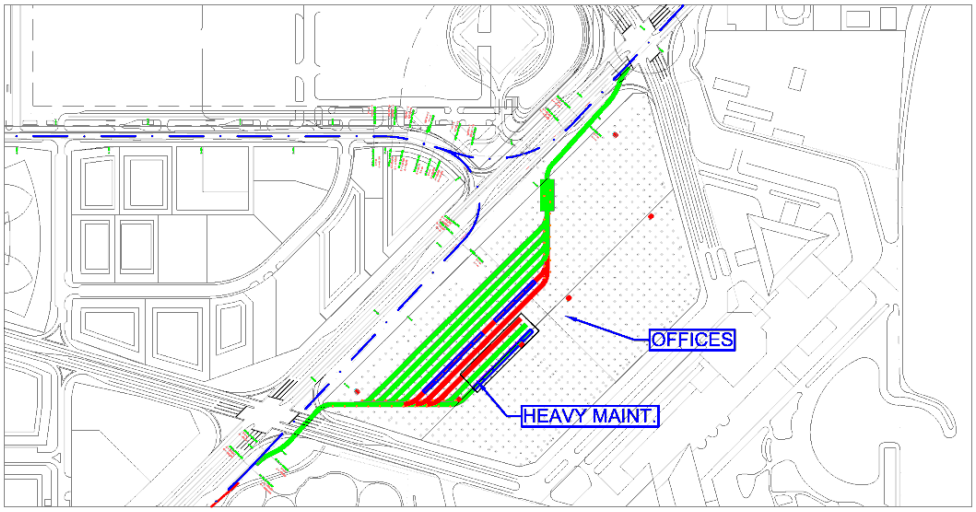

Figure 8: Maintenance and Storage Facility Layout

The larger System may require an additional, or satellite, Maintenance and Storage facility to efficiently perform light maintenance activities. If required, the satellite maintenance and storage facility will be located under a Park and Ride facility. The Park and Ride location will be investigated in support of the Ministry of Municipalities and Urban Planning (MMUP) and will be an integral element of the West Bay traffic mitigation and parking strategy.

System Operation

Figure 9: Base System Operation

The base System operation is configured in three loops (see Figure 9), an outer loop where trains run counterclockwise and two inner loops where trains run clockwise. This configuration provides a comprehensive coverage of the area and allows a

reduction of the overall trip time. Another advantage is that the offered capacity and train consist size can be tailored to the demand for each loop and not based on the highest link load, as would be the case for a pinched loop alignment. Given the expected ridership in the three loops, it became apparent that the size of the train consist required flexibility to tailor the offered capacity to passenger demand. A review of the projected ridership led to need to specify trains consists with two and three car length. One car will be dedicated to VIPs and families where the other cars will be dedicated to other riders. This requirement dictates that the smallest operational train consists of two cars.

The larger System operation is configured in four loops (see Figure 10), an outer loop where trains run counterclockwise and three inner loops where trains run clockwise. The outer loop runs, on the western side, along a tower-dense area as well as the Corniche Street that runs along the waterfront.

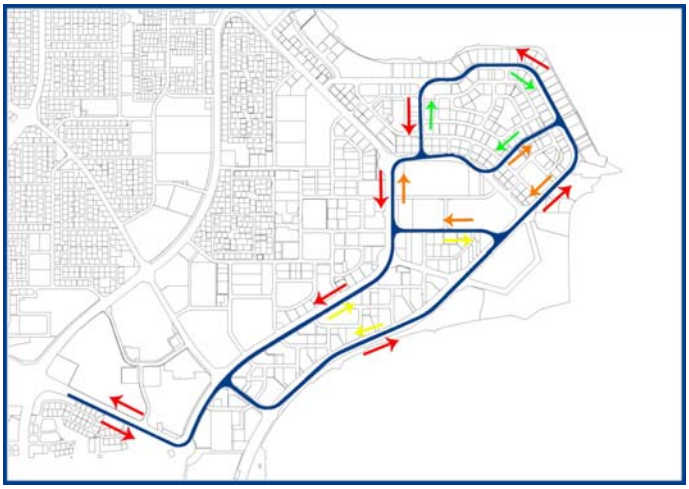

Figure 10: Larger System Operation

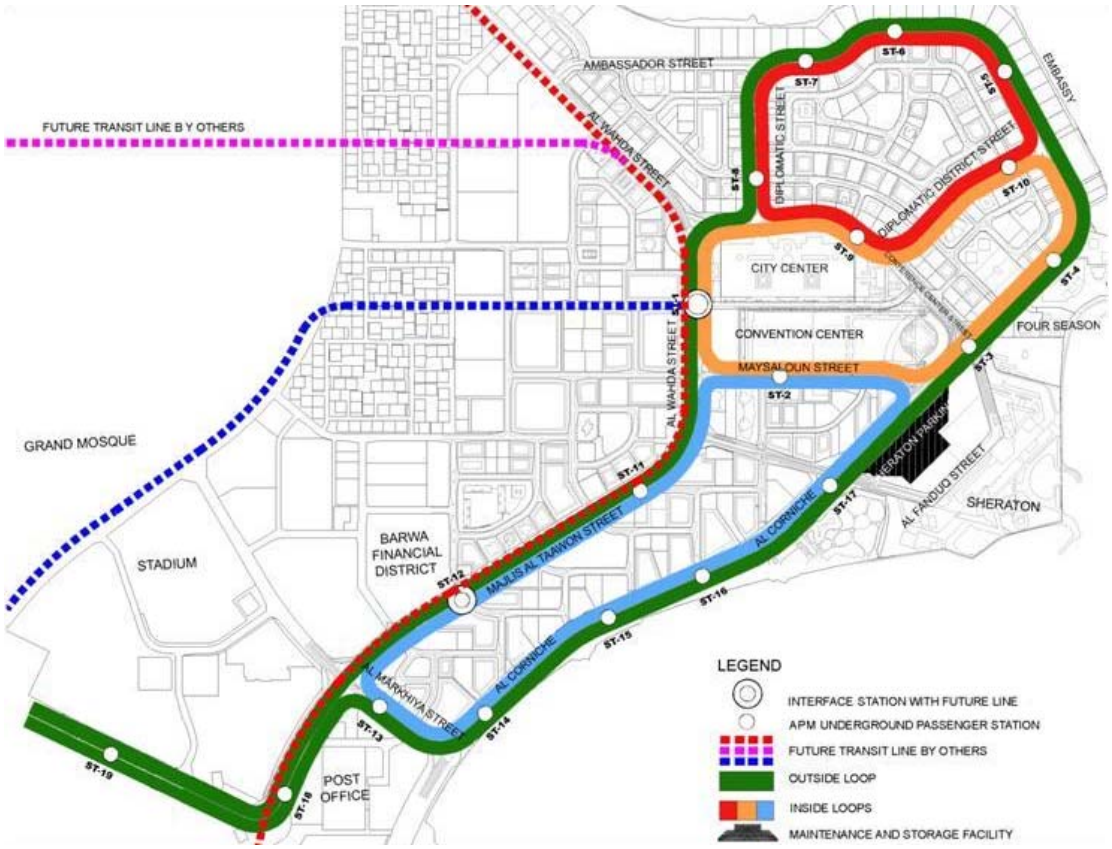

Figure 11: Larger System Details

Procurement

The procurement approach will follow a conventional design-build. The Infrastructure will either be tendered or awarded to a nominated Contractor, while the Operating System Contract will be competitively awarded. The Operating System procurement documents include the Conditions of the Contract based on the FIDIC Yellow Book (Fédération Internationale Des Ingénieurs Conseils), Instruction to Tenderers, Special Provisions, Technical Provisions, Reference Drawings and Operations and Maintenance Provisions. The initial Operations and Maintenance Contract will have five year duration, with two optional five year options for a total of fifteen years.

To allow a greater control of the capital expenditure, the Operating System procurement has been split into phases: the first phase consists in Notice to Proceed (NTP1A) and includes the final design of both alignment options D and C. The duration of this phase is expected to last about 12 months. At the end of this phase, the Employer will make a decision on whether to proceed with Option D, or Option C (NTP 1B). Further flexibility is provided by designing the Option D alignment as a subset of Option C alignment. Several procurement options have been also retained, such as: a) option to procure the Fare Collection subsystem that can be exercised within 2 years after NTP1A, and b) option to procure additional vehicles.

Request for Qualifications

A request for qualifications (RFQ) has been launched in the first semester of 2009. Known manufacturers of People Movers have been approached by the Employer who sent an RFQ questionnaire to the interested manufacturers. As part of the RFQ, manufacturer's visits were organized to allow the Employer to gain a better understanding of the manufacturers' capability, and to allow the manufacturers to acquire a better understanding of the project requirements.

Questionnaires were prepared for each RFQ respondent and were discussed during the site visits. Some of the issues discussed related to tunnel environmental control, single car operation and M&SF layout. The Park Site column grid has been reviewed by most RFQ respondents who provided positive feedback.

Request for Proposals

A request for proposals of the Operating System has been launched in the fall of 2010. It was distributed to Operating System manufacturers that have participated in the request for qualification process. Clarification questions have been transmitted by the potential bidders. Responses to these questions have allowed the respondents to further their understanding of the contractual requirements. A site visit has also been organized and has given the Employer the opportunity to present the physical System (base and larger Systems) to the potential bidders. Proposals have been received during the first week of March and are under evaluation.

Conclusion

The Doha West Bay APM, along with the other transportation systems planned in Doha, will bring a much needed relief to the ever growing traffic congestion. Studies have shown that the major arteries level of service has reached a critical point that highlights the need for the implementation of strategic transportation planning and investment measures. A transit system success is greatly enhanced if it is implemented as part of an overall transportation plan. This is the case for the Doha West Bay People Mover that will connect all major traffic generators such as hotels, convention center, City Center and residential as well as office towers in the West Bay district. It is being planned, and will be built, as an integral part of the other regional and local transportation systems in the city of Doha and in the state of Qatar.

References

Kamel E. Mokhtech et al. (2009). "Planning and Procurement of the Doha West Bay APM." ASCE APM Conference Atlanta USA.