

## Changes in FA (Final Assembly) in U.S. Projects

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In December 1985, Kinki Sharyo transported assemblies for the first MBTA-bound LRV into its final assembly site, which represented its first vehicle exported to the U.S. Since then, all our U.S.-bound vehicles have been delivered to customers after final assembly on local sites. In this article, I will present changes in final assembly on these sites, focusing on early projects for want of space. Also, I will point out some current problems regarding the work scope, and the work sharing and cooperation between the Japanese and American teams, and make some relevant proposals for future projects.

### FA Sites for Respective Projects

- Boston MBTA (50 units [base] + 50 units [option]), 1985

This was the first project we won in the U.S. market, and we sought for an appropriate site in the local area. Important points comprised the method for vehicle movement, and the feasibility of function tests etc. after coupling. We found a site in Reedville, Boston to be appropriate for FA, as it could be equipped additionally with a ceiling crane, a pit for testing and a rail for vehicle movement after coupling. As a result, a total of 100 units, including an option, underwent final assembly on the site by Enprotech, an affiliate of Itochu Corp.

As Enprotech lacked experience of vehicle assembly, Kinki Sharyo dispatched many people to the site to guide final assembly. Also, work instructions were prepared mainly by the dispatched employees and other people who had studied technical illustration. The instructions were used for guidance after some modifications on the site, and served as a basic reference material for subsequent projects.

We managed to meet the hard demand to deliver all base vehicles by the end of 1986. Until the delivery of optional vehicles, Enprotech continued to use the site for the final assembly of MBTA-bound carriages manufactured by MBB. Subsequently, the assembly of 50 optional vehicles began, while part of the site was still used for the assembly of MBB vehicles. Later, the assembly of optional vehicles was suspended for a couple of months because of a need to give priority to the delivery of MBB vehicles. Despite this incident, our work was completed successfully with only a few people dispatched from Osaka, as Enprotech employees, including many American workers who took part in the manufacture of base vehicles, took the lead in performing the work.

- Dallas (40 units [base]), 1995

Our second project was the manufacture of LRVs for

Dallas (DART). This product was carried out partly by Raytheon, a major U.S. firm in the munitions industry. As Raytheon did not have any experience of vehicle assembly, a representative from the company visited our site in Osaka during vehicle manufacture, to obtain deeper knowledge of the vehicle assembly method and equipment required for FA.

Raytheon secured an FA site in Denton Drive, Dallas. No pit was made in the site for testing. Instead, a main bogie was placed on a tall temporary bogie to check functions prior to coupling and running. After the check, the main bogie was brought down with a lifting jack for the remainder of testing and inspection. Then, the body was lifted again with the jack and put on a flat freight car (called flat bed) for railway transportation. The vehicle left the site in this condition.

FA began in the year of the Great Hanshin-Awaji Earthquake. Shipment delayed by about two months partly due to damages the earthquake caused to the Port of Kobe. While many interior works fell into the work scope of FA, a considerable part of work that should have been completed in Osaka had been left unfinished. Accordingly, we dispatched many people at an early stage of the project. Also, we minimized the scope of FA to ensure the observance of delivery schedule, by greatly expanding the scope of work in Osaka for the last eight vehicles.

- Boston MBTA (20 units [option]), 1996

In this project, FA was carried out by Adtranz, a vehicle manufacturer located in Elmira, the State of New York. A short time left before delivery, as well as a small number of units, influenced the selection of the assembler. Though we dispatched a work leader in an early phase, only representatives for manufacture and quality assurance were left on the site in subsequent phases. At the start of FA, the site was being used for the assembly of SEPTA-bound LRVs for which Adtranz had received an order. Eventually, however, our FA of MBTA-bound vehicles was finished earlier than the completion of the assembly of SEPTA-bound vehicles.

- Dallas (34 units [option] + 21 units), 1998

As in the MBTA project, Adtranz carried out FA in this project. The work scope was narrowed from that for base vehicles. In my opinion, this FA work scope should provide a basis for determining FA scope in general.

Flat beds were used to transport vehicles to Dallas by rail. This was the last FA carried out based on a contract with a

third party.

- New Jersey (45 units [base]), 1998

In this project, we delivered our first low-floor vehicles to NJT. FA was conducted by Kinki Sharyo's U.S. affiliate, which improved required equipment in the site for the purpose of the project.

We dispatched many staff members to the site in an early phase, partly because a considerable part of work that should have been completed in Osaka had been left unfinished. Locally hired workers learned work procedures quickly, contributing to the completion of work on schedule. Many workers who were involved in this FA continue to work in the maintenance of vehicles for the Hudson-Bergen Line, which has been conducted by our affiliate following the FA.

- Santa Clara VTA (30 units [base] + 70 units [option]), 2001

FA was conducted in Vallejo, California, after improving equipment in the site. As the FA work scope was narrow, only a small number of staff members were dispatched to guide work in an initial phase. Later, however, a considerable number of people were dispatched additionally to remedy problems with vehicle finish and painting.

- New Jersey (28 units [option]), 2004

FA was conducted on a borrowed maintenance site in Jersey City, with no people dispatched from Japan. Partly because a maintenance site was used, priority was given to coupling work. A shuttle lift was used to move vehicles stored outdoors, and contributed to enhancing the efficiency of, and latitude in movement.

- Dallas (20 units [option]), 2005

FA was conducted on a site in Denton Drive, which was used by Raytheon to assemble base vehicles. VTA veterans constituted the core of workers.

- Phoenix (36 units [base] + 14 units [option]), 2007

FA was conducted on a borrowed maintenance site of VMR (Phoenix). In this project, we also contracted maintenance. Many of those workers who took part in FA later engage in maintenance.

- Seattle (31 units: [base] + 4 units [option]), 2007

FA was conducted on a site borrowed from Boeing in Everett, Washington. Steps were taken to minimize site reconstruction.

- Dallas (115 units, a 3-body articulated car with a middle C

body added), 2008

FA of C bodies was conducted in Denton Drive, and the remodeling of A/B bodies on a DART site. Body coupling, as well as testing and inspection before shipping, was conducted on a site linked by a track to DART's S&I (Service and Inspection Facility).

#### FA Work Scope

Basically, the final assembly of U.S.-bound vehicles is conducted on a site in the U.S., partly to meet requirements of the Buy American Act. To date, Kinki Sharyo has not secured any fixed site in the country; rather, it has made a new FA site ready for each project. This practice is advantageous in view of the number of ordered articulated LRVs and the transportation method. Foreseeably, we will stick to the same practice in future.

The FA work scope has changed for various reasons. Nevertheless, the work scope should be determined in such a manner that it can secure a certain pace of production with a limited, temporarily borrowed space, while meeting requirements of the Buy American Act. Taking advantage of our experience of on-site assembly in more than 10 projects, we should also make studies on a work scope that does not cause problems with parts supply to the Japanese side as far as possible.

#### Cooperation and Work Sharing Between Osaka and an FA Site

In the past, FA had to be carried out by many workers who had little experience of vehicle assembly. Thanks to a growing number of FA experienced workers, however, FA can be conducted by local staff alone in recent projects, and there is no need to dispatch a work leader from Osaka.

However, as vehicles are sent from Osaka to an FA site in a semi-finished condition, it is very important that staff members in Osaka and the FA site share a common understanding of detailed work partitioning regarding portions to be completed on the site, as well as procedures for parts transportation. Regrettably, some problems have arisen in recent projects, which concern on-site work procedures and the transportation of required parts from Osaka. Such problems should be solved through a closer cooperation between Osaka and an FA site.

Especially, as final coupling assemblies and many electric and related parts for connection etc. are sent from Osaka, it is realistic to have Osaka staff lead the process to determine relevant detailed work partitioning; and this step has actually been taken in the past. Also, there have been some cases in which vehicles were brought into an FA site even though work that should have been done in Osaka had not been completed for reasons related to parts etc. In such a situation, it is naturally essential to ensure the smooth progress of work on an FA site by securing required information and parts from Osaka.

To that end, cooperation between different sites can be promoted by sending an FA representative to Osaka during

the manufacture of a prototype vehicle for a check of finished vehicle design and detailed work partitioning; and sending a person from Osaka at the start of FA, who should check the finished vehicle design and cope with unexpected problems. We intend to make further efforts regarding this point.



Since our first on-site FA in 1985, many people were dispatched from Osaka to oversee FA. Having gained some experience in FA, they have been active in subsequent overseas projects. Therefore, it is probably correct to say that dispatching people to FA sites has helped develop our human resources regarding our vehicle export business.

Though the need to send people for work guidance on FA has diminished, the presence of our people for a check of final vehicle design and cooperation with FA staff results in mutual benefits, as I have explained. Also, I think that we can solve some remaining problems (e.g. the supply of parts to Osaka and an FA site) more easily by increasing staff members who are familiar with circumstances of different sites.

Kinki Sharyo has already delivered nearly 500 vehicle units to its U.S. customers. I believe that we will be able to enhance our brand recognition in the American market by delivering high-quality vehicles on schedule, through a closer cooperation between our group companies in Japan and the U.S.