

Preparation and Training for First-Time Light Rail Operations and Maintenance

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Successful revenue operation of a new light rail system depends to a great extent upon adequate preparation and training of operational, maintenance, and service staffs. The importance of early involvement by key senior operating and maintenance personnel is emphasized so that operating and maintenance requirements appropriate to the particular transit agency will be defined and addressed in the new system's design criteria. Based on experiences of several new system start-ups, an outline has been drafted that may be followed to develop the necessary skills for effective operations and maintenance. If part or all of the operations or maintenance will be carried out under contract by outside forces, it is still important that a trained, core group of the transit agency staff be developed so that they may thoroughly understand the system and be capable of monitoring the contractors' activities in the interests of the transit agency. Practices with respect to preparation of rule books, training, qualification of operators, and periodic recertification are discussed, together with the opportunities to develop operators' skills and judgment during the prerevenue stage of "running in" and commissioning the system. Basic courses in electrical propulsion and subsystems may be arranged through technical colleges for maintenance personnel training before obtaining specific training from the suppliers for the equipment installed.

Implementation of a new light rail transit (LRT) system is the culmination of a lengthy and complex process involving planning, securing approvals and funding commitments, engineering, community relations and interaction, project management, contracting, procurement, construction, testing, and eventual acceptance of the works done. However, successful operation of the line will depend upon adequate preparation, staffing, and training of the people who will manage, operate, maintain, and service the new system.

Originally, public transit systems were primarily rail transit operations—streetcar, suburban and interurban systems—but through the 1930s and into the 1950s most of these operations were discontinued or converted to rubber-tired bus systems except for a few heavy rail systems, commuter lines, and surviving street railways. Unfortunately this meant that trained, experienced rail transit personnel were lost to the industry and now, with the renewed interest in light rail and to provide staff for the inauguration of new-start LRT lines, it is necessary to develop a new generation of rail transit staffs.

Several options are available to a transit agency embarking on a new-start LRT system—hiring key personnel from one of the established light rail operations or from the suppliers, contractors, or consultants engaged in building their project (or perhaps outside specialists in train operating rules, sig-

naling, trackwork, or electrification from a railway or electric utility company); or training their own staff in preparation for the opening of revenue service. Whether it is better or more satisfactory to train the technically competent "outsider" in the practices, procedures, and nuances of the local transit operation or to train experienced "inside" transit staff to the necessary levels of technical expertise can be argued at length and may ultimately be governed by local factors (such as a union agreement, the complexity of the equipment, a design, build, operate turnkey-type contract for the system, etc.). It is to the option of training and developing suitable expertise within the transit agency's own staff and thereby increasing the pool of skilled rail transit personnel that this paper is addressed.

It is difficult to determine the proper timing for establishing the initial light rail operating organization. Until the actual decisions to proceed with the light rail project are in place the planning process will likely be lengthy and often frustrating, particularly to operations-oriented staff who are geared to handle day-to-day activities and used to experiencing immediate results. Nevertheless it is extremely important that someone familiar with the local transit operations of the system and the community should become involved in the planning process from the outset (normally on a part-time basis) so that the line is planned as an integral part of the whole. As the plans are developed the operational needs and maintenance requirements should be carefully addressed. The early preparation of a draft operating plan is most important in this context. This draft should outline local considerations of hours of operation and policy headways desired, feeder bus connection points, timings and access routes to proposed stations, potential park-and-ride sites (and their servicing for security, lighting, snow removal, clean up, etc.), desired storage and turnback track locations, train crew relief and amenity points, resources and strategies to cope with emergencies, opportunities to integrate the light rail central control functions with those for the bus operations, as well as for certain maintenance and repair work that might be shared between the light rail and the bus shops (such as seats and upholstery, radios, and other common or similar "unit repair" components).

Such a plan can then be used to prepare initial design criteria for the proposed new LRT system and, of equal importance, the interaction with the various departments and groups involved provides excellent opportunities to introduce them to the concepts of the proposed system. Some particular security risks or locales may be identified and avoided or at least mitigated (such as by moving a station to avoid a potentially troublesome location or placing a station in conjunction with a neighborhood police precinct station as in

Philadelphia's Penn Center). Local experience drawn from the maintenance of the bus fleet can also be useful in preparing some of the preliminary design criteria and specifications with respect to the auxiliary systems for the light rail vehicles. Although the primary systems in modern light rail equipment (e.g., propulsion, braking, lighting, ventilation, etc.) tend to be highly reliable, it is often the door systems, for example, that are more likely to cause service interruptions and extraordinary maintenance (particularly if they are sensitive and vulnerable to severe weather conditions—problems which may have already been experienced and solved in the bus fleet). In this way relatively minor changes in the designs and specifications can be incorporated that will enhance the operational features of the system in the local environment.

APPROACHING THE INITIAL ORGANIZATION

The primary qualifications for the lead LRT project person are experience and knowledge of the transit agency and its operations, adaptability to changes, enthusiasm for the project and the ability to generate enthusiasm in others, a sense of vision, and, lastly but by no means least, a great supply of patience. Familiarity with light rail equipment and operations can be acquired, usually through visits to several established light rail operating systems and discussions with their operating and maintenance staffs. In addition supplementary expertise is available through peer reviews, that is, bringing in groups of experienced practitioners from other operating LRT agencies at key milestones during the design and implementation schedule to provide invaluable assistance in avoiding problems and pitfalls encountered elsewhere.

Once the decisions and funding are established then the preparation and initiation of an appropriate operating organization should commence, even though there will likely be a relatively tight budget and time constraints. The organization for the project may take several forms—the transit agency may or may not be the agency designated as responsible for the planning function, the direction of the engineering, or the construction or procurement of the system. And it may have been decided that the future light rail system would be operated or maintained either in whole or in part by contracted forces. In any case it is important, indeed essential, to the success of the project that the transit agency develop as a minimum a knowledgeable core group of senior personnel familiar with the local operations and maintenance practices of the agency at the earliest stages of the design when the criteria are being drawn up and reviewed. The members of this group will be able to contribute their knowledge and experience to the design and engineering process while at the same time becoming knowledgeable about the proposed new system and the reasoning leading to the choice of various details.

Their colleagues in other operating light rail systems will be found to share their own experiences willingly and, through technically oriented trips to those properties, these core personnel will gain useful information about not only features that should be included in the designs but also about some that should be avoided. The information so gained can be applied throughout the development of the designs to simplify and make certain operations less critical, safer, or to facilitate

future maintenance or servicing of the system (for example, in the operating rules and procedures, maintainers' safety while working on the line, shop and yard layouts, and the like).

As a further benefit, exposure to the engineering of the systems from the beginning will make the subsequent details much more easily understood during their development.

In some cases "internships" have been arranged to place selected operating and maintenance managers or supervisors in on-the-job training at one of the established light rail operating agencies.

About the time when equipment procurement contracts are awarded the formal training of the LRT operating and maintenance staffs should be under way.

MAINTENANCE PERSONNEL TRAINING

Maintenance personnel for the light rail vehicles, whether recruited from within the transit agency or from outside, will require uniform, basic, formal training in electrical circuits, devices, and controls; instruments and their proper use; safety and applicable code requirements. This training must relate to both high-power, traction voltage and to lower voltage auxiliary power equipment. Appropriate courses can be arranged through community or technical colleges or institutes, which should be contacted early enough to give them sufficient lead time to organize and set up such courses. These can take the form of night classes, part-time day classes, or more intensive semester-type sessions, depending upon the availability of instructors and facilities and arrangements made with respect to the students' time and remuneration (if any).

Satisfactory completion of such courses (or, possibly, approved equivalents) would be required as a prerequisite for the detailed, specific instruction provided by the manufacturers and suppliers on their equipment (which should be covered under their various procurement contracts as awarded). This level of instruction would include specific details on the various systems and interfaces, connections, and so forth, and their functions; testing and inspection; troubleshooting and diagnostic procedures; repair and overhaul methods. The manufacturing and testing of the system's equipment presents a valuable opportunity for key members of the maintenance staff to visit the manufacturers' shops to observe the construction, the shop facilities and testing equipment, and perhaps to participate in the activities there. Such opportunities give key staff the chance to gain hands-on familiarity with their future equipment. Finally, even though the manufacturers' representatives will be responsible for the adjustment, troubleshooting, and repair of their equipment as it is delivered, "run in," and commissioned, and for making good early failures and repairs under warranties, full and complete explanations should be forthcoming from the supplier about causes and their remedies or the modifications made to complement the staff's knowledge of their equipment. It is vital that all repairs and modifications be properly documented and in a form that enables all circuit diagrams, manuals (including parts catalogs) and service bulletins to be kept up to date and readily available to the maintenance staff for reference.

It should be noted that where the maintenance is planned to be carried out under contract it is still necessary to train

key maintenance personnel to ensure that they will be able to monitor the contractor's work for adherence to the transit agency's standards and to see that the agency's best interests are being protected.

Shop Staff

Normally the need for a shop support staff during the early years of a new system's operation will be only slight and can quite possibly be supplied for the most part on an "as needed" basis from the transit agency's bus shops (for example, the services of welders, body workers, painters, upholsterers, etc.). The exception is a machinist qualified to operate a wheel lathe, which will probably see a lot of use at the outset when braking systems are being properly adjusted and operators are likely to be applying emergency braking applications more frequently than after the new line and its operations settle in.

Track, Signals, Traction Power, Stations, Buildings, and Grounds

For an initial light rail line a minimum or skeleton track maintenance force can be used to adjust minor misalignments, adjust and service track switches, and generally inspect the trackage and the trackway. When major work, such as rail grinding and resurfacing, realignment and retamping of the track is necessary, this staff can be used to supervise the work of contractors who have the equipment available to handle these kinds of jobs more effectively than the agency would likely be able to, because the investment for such equipment is very high and its use would be infrequent. Such a staff would probably be best recruited from railroads or from the track-laying contractor who built the line.

Similarly the staff required to support the traction electrification power substations are specialized and best recruited from power utility personnel (or perhaps a contract could be established with the local power utility to look after the transit substations) who would receive specific instruction on the equipment and relays, settings, and so forth supplied. They would then be capable of performing the necessary periodic inspections, checking, cleaning, and making any subsequent adjustments for the system as required (possibly on a part-time basis, allowing them to be available for other work assignments).

Arrangements must also be made for a crew to inspect the trolley overhead system regularly and to repair damaged overhead (caused by overheight loads crossing the line, a defective pantograph snagging the trolley line, etc.) in as short a time as possible. Such a crew would also most likely be recruited from either electric power utility line crews, from the contractor building the overhead system, or possibly the local power utility might contract to do this work for the transit agency.

The signal system requires a signal maintainer skilled in handling either relay or solid-state circuits and performing the necessary periodic inspections, cleaning, and adjustments as specified by the supplier. This is also likely to take up only a

portion of this worker's time, and it may be possible to include maintenance of the communication system (or at least the land-line [telephone] part of it) to the duties and responsibilities of this position.

Finally the maintenance and service crews for the stations, buildings and grounds, and ancillary equipment such as fare machines, fire systems, and so forth, would primarily be an extension of those performing substantially the same work for the transit agency at present, either as the transit agency's own force or through a contracted arrangement.

OPERATIONS PERSONNEL TRAINING

Training for operators starts with the production of a comprehensive rule book. This is normally composed of elements contained in the rule books of other successful light rail operations, suitably modified for the local system and situations. (The rule book will likely have to be reviewed and approved by the appropriate regulatory authority, where one exists, or by the agency's insurance firm for risk coverage). Classes for operators, supervisors, and control center staff candidates would then follow. This instruction would include the rule book, description of the light rail and vehicle systems and equipment, and their functions so that the operating staff would understand basic diagnoses of troubles, problem description reporting, procedures for working around failures, and the operators' part in protective measures for equipment. A thorough coverage of track switching is essential, because it has been the experience in other systems that most of the accidents in the early stages of a new rail operation occur through a lack of understanding of the basic function of track switching, switch fouling points, and clearance precautions necessary in yard curves.

Certification examinations would follow the instructional sessions. Subsequently hands on experience in operating and handling single and multiple car trains, towing "dead" cars, coping with simulated failures, judging speeds and stopping distances, and driving and braking on dry, wet, or greasy tracks would be practiced. These sessions should be conducted as the cars are delivered for "running in" the equipment, commissioning it, and for prerevenue service so that operating staffs can learn their skills without the pressures of maintaining schedules and dealing with passengers and peak hour traffic situations.

Similar training should also be a requirement for the maintenance and service staffs so that they will also be able to operate the trains safely and properly in the yards and shops.

CONTINGENCY AND EMERGENCY PLANS

Finally a series of plans to cope with contingencies and emergencies that may occur on the system (collisions, derailments, fires, traffic accidents and injuries, severe storms or natural disasters, and the like) must be prepared. These plans should be drawn up and tested through simulated events to demonstrate their effectiveness and to exercise the staff and the equipment procured for such situations. (Such exercises may even be required by the regulatory authorities, local fire,

TABLE 1 Project Activities and Functions

| Project Activities | Staffing and Training Functions |
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| Initial concept for a light rail system | Obtain and inform a leader who will sponsor and support light rail for the community |
| Planning—identifying corridors and potential routes; determining the most suitable “starter” line | Draw on the agency’s senior department heads and their staffs for positive and negative effects on the existing transit system and community relations Identify an operating and maintenance coordinator-liaison person to work with the planners |
| (A peer review to comment on the proposed system layout, starter line, and next steps can be very useful at this point.) | |
| Preparation of preliminary engineering (PE) plans and draft environmental impact statement (DEIS) | Establish the core group from transit staff to provide comment and review as the plans develop |
| (A peer review at approximately the midpoint of PE can be very useful in noting significant points that may have been overlooked, reviewing estimates of patronage, costs, and so on.) | |
| Approval of PE plans and DEIS; commencement of final engineering | Appoint a full-time project manager from the transit agency and an assistant (with complementary operations and maintenance backgrounds) |
| [(Frequent reviews within the transit agency are extremely important during this stage, supplemented by several peer reviews (depending on the complexity of the project).] | |
| Project approval; proceed with procurement and construction | Prepare LRT-bus service integration plans Familiarize staff with the new system in detail by observation and inspection of the work being done Select and train maintenance staff, followed by operating staff, in time for deliveries, preparation, and testing of equipment |
| Testing, commissioning, acceptance and prerevenue service | Suppliers provide specific, detailed training Staff gains hands-on experience with the new system during this stage (under the contractor’s direction and responsibility) Operating staff (in particular) become proficient in operating the system during prerevenue service |
| Revenue service | Operating supervision must be particularly vigilant during the early years of revenue operation to ensure that passengers become familiar with the system, that operators progress along a steep learning curve and do not become complacent and develop poor driving habits as they become used to the system Periodic exercises of emergency plans should be carried out; as well as periodic refresher classes and recertifications |

police, and disaster agencies.) These exercises also build confidence in the new system and its staff. For the public at large, some of whom may be fearful of the new rail system because of reports of misadventures and accidents on some other rail systems, the exercises provide reassurance.

REQUALIFICATION AND RECERTIFICATIONS

A requirement to requalify and reexamine operators annually is usual and, in any case, it is good practice to do so. Periodic refresher courses should be conducted to keep operators up to date on any rule changes or changes to equipment or operating procedures. (It is a common practice to require operators to sign a master sheet declaring that they have read and understood rule and procedure changes as these are promulgated.)

The various contingency and emergency plans should also be exercised and reviewed periodically in the light of experience

so that those concerned remain competent to deal with situations should they arise again.

It is also necessary to establish procedures to ensure that the light rail cars are properly tested and certified for return to service whenever major work or replacement of components vital to the safe operation of the trains has been done (such as insulation levels on the traction power circuits, operation of the train controls, any work on the braking system, and so forth).

CHRONOLOGICAL OUTLINE FOR STAFFING AND TRAINING

The uncertainties in the approvals process to launch a new LRT project preclude defining a reliable schedule for the transit agency’s recruitment, selection, training, and staffing. Project functions associated with certain key project activities are outlined in Table 1.