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User-Friendliness as Business

– Operation and Maintenance Support Services Growing in Overseas Markets –

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Every overseas project involves operation and maintenance support as part of customer demands; they represent mandatory services to be provided in connection with the delivery of vehicles. Regarding a system lifecycle as defined in EN50126 (*1), phases for which a vehicle manufacturer is responsible, comprise: design and execution; manufacture; system installation; system validation check; and operation and maintenance. According to this standard, operation and maintenance support are complementary services that apply to all these phases except manufacture.

Concretely, the services comprise the prediction of the extent to which RAMS (*2) demands will be satisfied, and a feedback of this prediction on design; the selection and delivery of maintenance equipment and inspection systems; the demonstration of the satisfaction of RAMS demands; the preparation of an operation manual, and a maintenance manual including a maintenance plan; and the training of workers in operation and maintenance procedures.

Among these topics, this chapter will outline maintenance plans, manuals and training programs provided by Kinki Sharyo; and discuss some concrete examples.

Maintenance Plan

A rolling stock is manufactured by assembling a large number of components, which are procured from different suppliers. The supplier of each component stipulates the frequency and method of maintenance. The first step to be taken when preparing a maintenance plan is to draft a table of overall vehicle maintenance which comprises the maintenance procedures for all individual components.

In the case of an export project, our company recommends, by way of the standard inspection frequency for its vehicles, a maintenance plan consisting of three different inspections: inspection without disassembly, to be conducted every three months; the inspection of important parts, to be conducted every three years or each time a mileage of 600,000 km has been attained (whichever is earlier); and an overall inspection to be conducted every six years or each time a mileage of 1.2 million km has been attained (whichever is earlier). This standard maintenance plan has been determined based on the experience which we have gained regarding vehicles used in Japan or exported to other countries. The standard plan is generally modified to a higher or lower maintenance frequency, to suit the conventional maintenance practices of a customer or the particular conditions of a railway (e.g. a severe natural environment). The inspections of individual components

are allocated to a cycle of maintenance rounds, so that each inspection will be conducted within a recommended period.

Needless to say, a maintenance plan is prepared to satisfy each RAMS demand. On the other hand, a plan is prepared based on the consideration of a vehicle's LCC (life cycle costs); this consideration leads to the streamlining of maintenance activities and the optimum coordination of part replacement cycles. In the KCRC project in which the upper limit of LCC had been specified by the customer, we presented an overall plan that met the demanded lifecycle cost target by determining the total labor and parts costs for the rounds of preventive maintenance which a vehicle would go through in its lifecycle; and incorporating streamlined maintenance methods into equipment design.

Operation and Maintenance Manuals

An operation manual is prepared for a train crew; and mainly consists of the technical exposition of vehicle devices as to do handled by crew members, and the description of operation procedures and steps to cope with an abnormal event. Sometimes, an operation manual is designed as a small handbook that can be easily carried by crew members, to meet the customer's request.

A maintenance manual is prepared as a document for engineers and maintenance personnel. This kind of manuals are broadly classified as shown below, though the actual composition of a manual depends on customer needs.

A technical exposition of all vehicle components, with complete design information

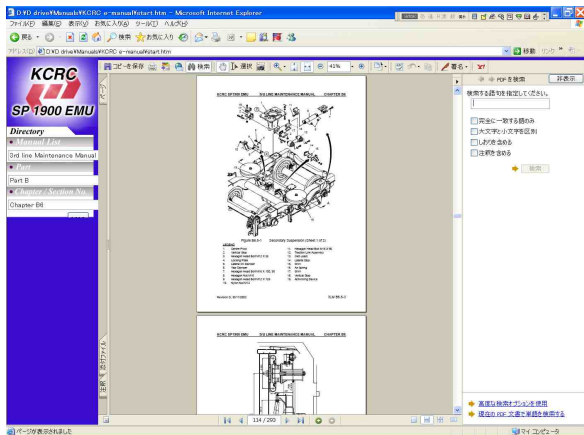
A running maintenance manual including cleaning

An overhaul manual for an overhaul involving vehicle disassembly

A parts catalogue

A maintenance manual must be prepared by compiling all maintenance information, referring to a previously drafted maintenance plan. Such information includes recommended maintenance methods; methods to use special tools; and recommended detergents, oils and fats. Special care is taken when describing reference values for vehicle component inspection, because this description should ensure the safe use of a vehicle.

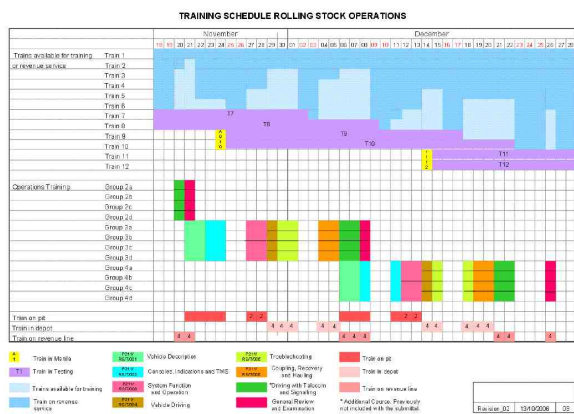
In many recent projects, manuals have been prepared by incorporating results of RAMS analysis at design, and related agreements. For example, the satisfaction of safety demands entails the provision of safety information for each work. Therefore, prepared documents, in total, comprise



thousands of pages (or even 20,000 pages in one case). Computer-based manuals have also been prepared to improve portability and the ease of consultation in the face of the vast volume of information to be provided.

Operation and Maintenance Training

When delivering vehicles, training in vehicle operation and maintenance methods must also be provided. Generally, a training program consists of teaching in a classroom, as well as practical training involving equipment operation using an actual vehicle or depot. The program is implemented over several months, during the period from vehicle delivery to the start of operation.



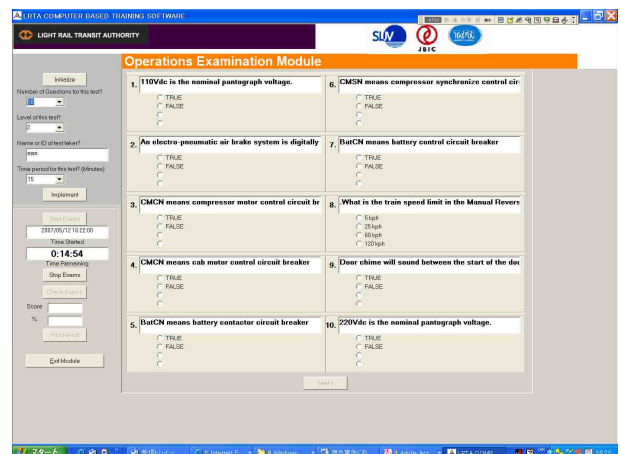
Operation training is aimed at developing the ability of engineers to operate new vehicles, and provided by experienced instructors. A training program comprises the method for starting up a vehicle; a practice in running a vehicle at high speeds on a main line, and troubleshooting including emergency aid.

A maintenance training program comprises the teaching of a maintenance plan and details of vehicle components, as well as a practice including the disassembly and reassembly of actual vehicle components by way of demonstration. Training is given by instructors specialized in such areas as vehicle body, brakes and electrical/electronic



devices. Also, equipment suppliers cooperate in the program by sending engineers in charge of such special areas as the methods for using special tools and testing/diagnostic apparatuses, which are delivered together with the vehicles.

Training manuals are prepared separately for operation and maintenance. If requested by a customer, we also prepare a textbook for trainees, as well as a guidance sheet for the customer's instructors who will give in-house training. As the use of PCs has become widespread in recent years, an increasing number of customers have requested the provision of self-teaching materials for CBT (computer based training).



As Kinki Sharyo has been entrusted with a succession of major overseas projects, it has accumulated a know-how on product support business attendant on the delivery of vehicles proper. We are standardizing relevant documents and curriculums, to be able to provide product support services in a packaged form.

*1 EN: European Norm (a European standard)

*2 RAMS: Reliability, Availability, Maintainability and Safety