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TRACTION INSTALLATION DIRECTORATE



GOVERNMENT OF INDIA,
MINISTRY OF RAILWAYS

Instruction No. TI/IN/0025 (08/2010)

**TECHNICAL INSTRUCTIONS FOR IMPROVING RELIABILITY
OF TRACTION SCADA SYSTEMS ON IR**

Aug 2010

ISSUED BY

**Traction Installation Directorate
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(Ministry of Railways)
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TI/IN/00-- Rev 0

Technical Instructions for improving reliability of traction SCADA systems on IR

1.0 Scope & objective: This technical Instruction is applicable to different types of SCADA systems provided on Indian Railways. Objective of this technical instruction is to improve the overall reliability of SCADA systems existing on Indian Railways by increasing awareness of the operating personals against any form of mal-operation of the system. These instructions should not be treated as the substitute of Annual Maintenance Contract (AMC), however, these shall help Railways in developing good operation & maintenance practices for SCADA system.

2.0 Development of SCADA system on IR: Prior to development of PC's, microprocessor based SCADA systems were commissioned in Indian Railways. Now most of them have been replaced with PC based SCADA systems running with proprietary SCADA software and protocols. The microprocessor based SCADA systems had its own limitations, like large size mimic diagram boards in RCC & their inability to implement difficult logics. Now a days PC based SCADA systems working on Railways proprietary SPORT (Standard Protocol for Railway Traction SCADA) Protocol have been made so intelligent & efficient that any logic can be easily implemented through user friendly SCADA software for control, monitoring and data acquisition.

Over the years there have been number of improvements in RTU designs as well, in terms of reduction in their size, reliability of electronic components, use of IED's in place of transducers etc.

The current specification for SCADA systems for traction is TI/SPC/RCC/SCADA/0990 (5/07) with amendment no. 1. Approximate break up of different types / legacies of SCADA systems working on IR is given below.

SN	Description & specification	Features	Approx. no. of systems	Approx. year of comm.
1	SCADA system for 25kV ac traction SCADA on IR. ETI/PSI/76(12/93)	<ul style="list-style-type: none"> • Proprietary protocols • Proprietary software and hardware 	40 (Mostly under up gradation)	1994-2001
2	TI/SPC/RCC/SCADA/0986 for Standard SCADA for single 25 kV,	<ul style="list-style-type: none"> • CMC software • Hardware /RTU 	6	2001-2005

	50 Hz ac Traction Power Supply	of any approved vendor • Standard Protocol 'SPORT'		
3	TI/SPC/RCC/SCADA/0990 (05/2007) with Amendment No.1 for Standard SCADA for single 25 kV, 50 Hz ac Traction Power Supply	• SCADA vendors/ OEM Hardware/RTU & own software with SPORT protocol	>12	2006 onwards
4	TI/SPC/RCC/SCADA/1080(9/08) with amendment no.1. Technical specification for SCADA for 25 kV 1 phase 50 Hz traction Power supply for Mumbai area.	• For Mumbai only • SPORT • IEC 60870-5-103 based communication between RTU's & numerical relays.	1	2009

3.0 Maintenance to SCADA systems: As explained above, IR is having a wide range of SCADA systems installed and also technical features of these systems varies widely, therefore, Railway Board & RDSO has time & again reiterated importance of proper un-interrupted maintenance support from OEM for all SCADA systems and in this regard instructions issued from Rly. Board & RDSO are tabulated as under.

SN	Railway Board /RDSO references	Subject
1	Letter No. 93/RE/220/3/Pt.I dated 21.11.2007	SCADA related TRD works: up gradation and AMC of existing SCADA system on IR.
2	Letter No. TI/RCC/SCADA/SPC/07 dated 15.06.2007	Issue of technical guide lines for awarding AMC of SCADA system.

3.1 SCADA System mainly consists of Remote Control Centre (RCC), Remote Terminal Units (RTU) & Communication Media and its reliability can be improved by following certain procedures, guidelines and taking some precautions against mal-operations of these sub- systems.

3.2 Railways should follow these instructions during operation & maintenance of SCADA system by themselves or through AMC.

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4.0 Remote Control Centre:

4.1 General Instructions:

- 4.1.1 All the latest documents such as Technical Manuals, Operating Instruction, Troubleshooting manuals & specifications should be available at RCC.
- 4.1.2 Only licensed copies of Microsoft Windows operating systems along with service packs compatible to SCADA software should be used.
- 4.1.3 Only genuine Anti-virus software should be available and loaded on all computers. Operating system should be upgraded with latest available service pack by the SCADA vendor who has taken the AMC.
- 4.1.4 As the system is having redundancy in respect of server, FEP and MMIs, these can be connected with internet one by one for any available upgrades for operating system & Anti-virus software.
- 4.1.5 SCADA application software latest version should be available on CD-ROM and it should be loaded on all the computers.
- 4.1.6 Preferably on weekly basis hot & standby computers (Host and FEP) must be interchanged. By doing so, healthiness of system can be ensured.
- 4.1.7 Old PCs should be upgraded especially in respect of their RAM size. Latest available maximum RAM size compatible to PC may be opted. Refer RDSO's Instruction No.- TI/IN/0020 (12/2009) for timely replacement & up-gradation of Computers at Remote Control Centre of traction SCADA systems on IR.
- 4.1.8 Improper shut down of computers (i.e. Windows not shut down properly) should never be done as it results into lost data/ Windows files.
- 4.1.9 Scandisk & defragment utilities should be run at least once in a month on all computers.
- 4.1.10 Peripherals should not be unplugged from the computer when powered on.
- 4.1.11 'C' drive of computers should have minimum 600 Mb free memory space for its optimum performance, otherwise computers slow down considerably and may also hang.
- 4.1.12 All the program drives and software supplied originally on CD-ROM should be properly stored and readily available on demand.
- 4.1.13 Computer & accessories should be cleaned at least once in a month by using soft cloth & vacuum cleaner.

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- 4.1.14 When SCADA application is running properly no other application like games, movies, spread sheet & word processor etc. should be run on same computer. It is also not recommended to load such applications on any work station/ FEP/ HOST.
- 4.1.15 Opening multiple instances/ Windows of the same application at a time should be avoided.
- 4.1.16 All the floppy, CD drives & USB drives should be disabled through software or it is preferable to protect the access of these drives through software lock.
- 4.1.17 The computers and its peripherals along with LAN Hub & master modem should be placed in such a way that a minimum space of nearly 20 cm is available for ventilation on back of the computer & devices.
- 4.1.18 All SCADA computers should be properly designated as per specification.
- 4.1.19 LAN switch/ hub should be kept at a place where it does not infringe the movement of personals.
- 4.1.20 Electrical and LAN connections including master modem should be checked periodically.
- 4.1.21 The LAN cables should be firmly cleated & its settings and connections should not be disturbed.
- 4.1.22 Power source circuits supplying to computers should be properly grounded as per IS: 3043 on earthing practices.
- 4.1.23 It is recommended that backup of data/entire folder of SCADA software configured for the project should be taken every month. For procedure of the same, the instructions of OEM or agency undertaking AMC should be followed. In exigencies this backup file may be used to restore the system.
- 4.1.24 Any error message such as debug error/ run time error on computer screen, should be saved by giving print screen command and pasting it in MS Paint by opening through start>programs>accessories>paint>edit>paste, File>save as. For any other type of on screen error messages etc., instruction of OEM or agency undertaking AMC should be followed.
- 4.1.25 Dead RTUs should be made Off SCAN to enhance the performance of the system.
- 4.1.26 The system should never be powered off suddenly when the application is running therefore healthiness of UPS & its battery set should be ensured. Working of both the UPS should be checked in presence of AMC personals at least once in a month at any convenient time by switching 'off' the power supply.
- 4.1.27 Unauthorized usage of system should not be permitted & different passwords for individual time users' login should be created.

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4.1.28 There should not be more than one project and its backup on host. More project/ application may create the confusion at the time of restoration etc. and may also affect the real time application running on the system due to memory space occupied on computer.

4.1.29 Error and temporary files generated on each computer should be got deleted periodically.

4.2 Step by step procedure to start and shut down:

There is a step by step procedure prescribed by the OEM to start and shut down the SCADA software. This should always be followed. As an example, the steps given below are for running & stopping of the SCADA application developed by M/s CMC.

The sequence for running the applications is as follows:

- 4.2.1 Start the Host application and wait till the message "This machine is Active Host" appears on the screen.
- 4.2.2 Start the MMI application and wait till the MMI displays its Active status on the Status bar of MMI.
- 4.2.3 Start the FEP application and wait till all the stations are polled.
- 4.2.4 Run the standby machines (Host and FEP).

The sequence for closing the application is as follows:

- 4.2.5 First close standby FEP then Active FEP,
- 4.2.6 Close all MMIs one by one
- 4.2.7 Close standby Host and then active host.

5.0 Remote Terminal Units:

5.1 General Instructions:

All manufacturers furnish installation, commissioning, upkeep & maintenance instructions. These should be readily available with maintenance staff and it should be referred to whenever required, however the following general instructions should be followed:

- 5.1.1 The RTU door should be properly locked and gaskets provided on the door should be available for proper sealing of the door.
- 5.1.2 RTU modules layout diagram should be available on the backside of the door within the RTU.
- 5.1.3 Various modules such as CPU, DI/ DO, AI, PSU & Modem etc. in RTU should be named.

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- 5.1.4 Detailed maintenance instructions as issued by manufacturer should be got followed by agency undertaken AMC of complete SCADA system.
- 5.1.5 While inserting/ withdrawing components like modules or PCBs etc. power supply of RTU should be switched off.
- 5.1.6 RCC Host computer synchronizes RTU Clock periodically. If time drift displayed at RCC is more than 2 sec within half an hour period. Lithium battery of the CPU cards may require replacement.
- 5.1.7 Some times RTU response is same for any command due to malfunctioning. In this case RTU should be reset from RCC through reset command or if not successful then locally.
- 5.1.8 Under voltage and PT indication voltages at site should not be set by using any un-calibrated variable source and generally setting of any transducer should not be disturbed.
- 5.1.9 The CPU cards of different RTU's should not be swapped because every card is having station address link settings. If unknowingly different station address card is put, then in spite of communication OK, the telesignals, telecommand, analog data of wrong station may be displayed and in case of command execution, a wrong device may get operated.
- 5.1.10 Generally plunger of contactors should not be pressed manually to operate contactors directly when RTU is interfaced with field devices as it may damage contacts apart from causing unwanted operation of the field devices.
- 5.1.11 The RTUs where "energy meters" are used as IEDs, it should be ensured that CT by pass links are properly inserted before removing these devices. Similarly to make IEDs in circuit, be sure that CT bypass links are removed.
- 5.1.12 Lightning protection module (LPU) should never be bypassed. It may damage modem or entire RTU during lightning or voltage surges.
- 5.1.13 The fuses of BMs in control circuit should not be bypassed. These are protective devices. For close command fuse is provided but for trip command fuse is not required because even in case of emergency trip command should get executed.
- 5.1.14 No foreign material should be kept inside the RTU panel.
- 5.1.15 RTUs may be operated on 110 V dc in place of 240 V ac as per RDSO's instruction no. TI/IN/0023(02/2010 for existing traction SCADA system on IR.

5.2 EMI precautions at RTU

Possible sources of Electro-Magnetic interference at a TSS may be switching surges, fault currents, lightning apart from inductive equipment, e.g. coils of contactors, relays or solenoid valves or due to

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two circuits sharing one cable, two adjacent cables susceptible to mutual interference via electromagnetic field, transformers and transmitters.

In view of the above following precautions should be taken:

- 5.2.1 Arrangement of the wiring at TSS/switching post should be such that all types of cable run separately i.e. power supply cables, data lines, analog signal lines and shielded signal lines should be separated from cables that are used to switch high currents or high inductive loads.
- 5.2.2 In TSS compound signal lines should not be laid parallel to power cables and ensure that distance to sources of interference (contactors, transformers) is 1metre minimum.
- 5.2.3 In case of conduit wiring, both ends of the metal ducts should be grounded.
- 5.2.4 All inactive metal parts should be grounded and make sure all connections to earth have good contact. All metal parts should be connected together such that they give good contact (broad earthing strips) with screw connections connected to ensure good contact, i.e. using lock washers or fan type lock washers.
- 5.2.5 The earthing connections of RTU body with earthing strip of control room & effective earthing resistance should be got checked periodically. Its value should not be $> 2 \Omega$.

6.0 Communication Media:

- 6.1 For communication between the RCC and the RTU, 6 wires are generally used, 2 wires are for receive (Rx + & Rx-) and 2 are for send (Tx + & Tx-) and 2 as spare.
- 6.2 Instruction No. TI/IN/0021 (1/2010) for increasing data transfer speed of traction SCADA system on IR from 600/1200 to a minimum of 9600 bps may be referred for the implementation of new communication scheme for operation of SCADA on High Speed Data Transfer Communication System.
- 6.3 Present modems support 600 & 1200 bps speed. If OFC has been laid (between stations) it is recommended that master and slave modems should be tried to work on 1200 bps speed. However, if communication noise problem increases speed may be again set at 600 bps.
- 6.4 Tx and Rx wires should have crimped lugs and their connections should be checked at master & slave modem periodically.
- 6.5 Port monitor or any other similar utility software is generally installed in FEP which shows the data bits sent to & received from field. The analysis of this data can give exact cause of failure and useful for troubleshooting. This can be saved through file>save as> File name as per requirement.

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- 6.6 It may be noted that Portmon application or similar utility should not be run continuously for more than three hours; otherwise it may cause the system to slow down. (It also depends on the storage capacity i.e. Hard Disk capacity. If this capacity is 500 GB or more then such utility software can be run for longer time.)
- 6.7 The exercise of tuning communication parameters should be carried out jointly with supplier's technical representative and S & T engineers normally at the time of commissioning of system. If retries to scan any particular RTU are more, communication parameters of that particular RTU should be checked thoroughly once again.
- 6.8 Regular checks on communication copper cable between RTU and Hut at station should be carried out with the help of S & T supervisors and the no. of joints in cable should be recorded jointly.
- 6.9 The acceptable and recommended range of standard parameters decided in consultation with Telecom Directorate of RDSO are enclosed as Annexure-I. The signal dB level should be checked at RCC & individual RTU modem terminals as per the requirements. Signal dB level should be measured by dB level meter keeping one RTU on line at a time and other RTUs in Off SCAN condition.

Annexure-I

Check list for checking health of communication channel for SCADA purpose (for each RTU)

SN	Description	Instruments	Value as RDSO		Remarks
			Acceptable range	Recommended range	
1.	Insulation resistance of cable at 500 V	Megger	>10,000 MΩ/km	>10,000 MΩ/km	As per SCADA spec. clause 4.2.1
2.	Trans signal from RCC Modem	dB level meter	0 to -30 dBm	-3 to -20 dBm	As per SCADA spec. clause 4.5.6 (vii)
3.	Receive signal at Modem		0 to -43 dBm	-3 to -20 dBm	As per SCADA spec. clause 4.5.6 (viii)
4.	Trans signal at OFC terminal near RCC		0 to -30 dBm	-3 to -20 dBm	As per Telecom Dte. Note no. STT/ DC/ MUX/ Prototest/ 245 dated 1.12.2005
5.	Receive signal at OFC terminal near to RCC		0 to -30 dBm	-3 to -20 dBm	
6.	Trans signal at OFC terminal near to switching post (stn)		0 to -30 dBm	-3 to -20 dBm	
7.	Receive signal at FC terminal near to switching post (stn)		0 to -30 dBm	-3 to -20 dBm	
8.	Trans signal at SWS (before connection to RTU is made)		0 to -30 dBm	-3 to -20 dBm	
9.	Receive signal at RTU		0 to -30 dBm	-3 to -20 dBm	
10.	Signal to noise ratio	SNR meter	>20 dB	>20 dB	