Australian Government

Department of Education, Employment and Workplace Relations

ICTRFN4178A Maintain hybrid fibre coaxial broadband cable network

Release: 1

ICTRFN4178A Maintain hybrid fibre coaxial broadband cable network

Modification History

Not Applicable

Unit Descriptor

Unit descriptor	This unit describes the performance outcomes, skills and knowledge required to maintain a hybrid fibre coaxial (HFC) broadband cable network. It involves routine maintenance tasks, analysing results and initiating corrective action. Licensing, legislative, regulatory and certification requirements apply to working at heights, confined spaces, crane operation, rigging, driving and other operations involved in this unit. Users should confirm requirements with the relevant federal, state or territory authority.

Application of the Unit

Application of the unit	Field officers from telecommunications carriers, service providers and contractors apply the skills and knowledge in this unit. They combine a broad range of optical and radio frequency (RF) technical skills with organisational skills to maintain the HFC broadband cable network, generally with limited supervision and guidance. Relevant job roles involve adjustment of optical and RF power levels, investigating sources of RF and broadcast interference to the network and conducting specialised tests to determine the status of the HFC network.

Licensing/Regulatory Information

Refer to Unit Descriptor

Pre-Requisites

Prerequisite units		

Employability Skills Information

Employability skills	This unit contains employability skills.

Elements and Performance Criteria Pre-Content

Elements describe the essential outcomes of a unit of competency.	Performance criteria describe the performance needed to demonstrate achievement of the element. Where bold italicised text is used, further information is detailed in the required skills and knowledge section and the range statement. Assessment of performance is to be consistent with the evidence guide.

Elements and Performance Criteria

ELEMENT	PERFORMANCE CRITERIA
1. Prepare for routine maintenance of broadband cable network	1.1. Obtain ***relevant legislation***, ***codes***, ***regulations and standards*** for the given work 1.2. Determine the ***HFC network elements*** requiring ***maintenance*** and obtain maintenance details from the various HFC manufacturer's equipment manuals 1.3. Plan a detailed ***routine maintenance schedule*** and discuss with all relevant personnel 1.4. Notify the ***network operations centre*** (***NOC***) ***of the proposed maintenance details and maintenance schedule*** 1.5. Assess the ***potential impact*** of the proposed maintenance on customers and network, and plan for minimal possible ***outage*** or deferral of maintenance 1.6. Obtain necessary ***tools*** and ***resources*** and ***test equipment*** to undertake the maintenance 1.7. Ascertain and record recent ***network stability*** and network ***performance***
2. Undertake routine HFC network maintenance tasks	2.1. Conduct ***routine maintenance tasks*** according to documented enterprise instructions and following occupational health and safety (***OHS***) ***and environmental requirements*** and record results 2.2. Protect the network from excessive interference or degradation of service during maintenance routines 2.3. Monitor relevant alarms during the running of the maintenance tasks and report incidences to NOC 2.4. Escalate unresolved faults according to established enterprise procedure 2.5. Conduct ***performance measurements*** following routine maintenance schedule
3. Analyse results and initiate corrective action	3.1. Assess outcomes of performance measurements and maintenance routines to ensure they are according to specification 3.2. Analyse identified problems for likely impact and repair within capability and initiate or escalate repair action where repair is beyond capability 3.3. Undertake outage if required in conjunction with NOC and according to prescribed enterprise outage plan 3.4. Record problems and incidences in the maintenance log for future action as required by the maintenance

ELEMENT	PERFORMANCE CRITERIA
	agreement 3.5. Verify alarms to ensure maintenance routines did not generate further problems

Required Skills and Knowledge

REQUIRED SKILLS AND KNOWLEDGE

This section describes the skills and knowledge required for this unit.

Required skills

- analytical skills to evaluate impact of maintenance on customers and network
- communication skills to provide advice and guidance to others and to liaise with other technical staff on operational matters
- initiative and enterprise skills to identify improvements to maintenance procedures
- literacy skills to read technical data and interpret technical and non-technical information from a range of sources and write reports
- PC skills to upgrade installed software
- planning and organisational skills to plan for outage
- technical skills to:
  - identify noise and ingress
  - set up, operate and interpret results on complex test instruments:
    - optical instruments: optical time domain reflectometer (OTDR), optical power meter
    - RF instruments: digital signal level meter, RF sweep equipment, spectrum analyser
  - use hand and power tools to assemble and disassemble equipment in pits and in elevated situated situations

Required knowledge

- 16 QAM
- 256 QAM
- 64 QAM
- overview of AC and DC theory
- amplifier types and placement
- awareness of forward error correction (FEC) and Reed-Solomon Code
- bi-directional RF amplifier and unidirectional RF amplifier
- bit error ratio (BER) and acceptable values
- calculation of overall gain or loss when given signal levels in dBmv

REQUIRED SKILLS AND KNOWLEDGE

- coaxial transmission line characteristics including cable tilt or slope
- constellation diagram interpretation
- digital modulation techniques
- DOCSIS cable modem characteristics
- eye diagram interpretation
- forward path from head end to subscriber showing expected signal levels at key points
- frequency spectrum and RF frequency plan HFC broadband cable network
- future BCN and migration to all-optical cable networks
- HFC broadband cable network principles, architecture and associated equipment
- measurement of optical power
- minimum standards allowable in the return path for ingress
- modulation error ratio (MER) and acceptable values
- optical fibre characteristics
- passive devices including filter, attenuator, power inserter, coaxial splitter, coupler, multitap, equaliser
- power supply requirements in a HFC broadband cable network
- quadrature phase shift keying (QPSK)
- return path from subscriber to head end showing expected signal levels at key points
- RF amplifier characteristics including gain and tilt adjustment, equalisation, overload
- services carried on HFC broadband cable network
- spectrum utilisation of the return path showing location of telephony and data channels and signalling and test frequencies
- forms of ingress and where they may fall in the return path
- video stream transport formats:
  - DVB-ASI
  - HD-SDI
  - MPEG-2
  - SD-SDI

Evidence Guide

EVIDENCE GUIDE	
The evidence guide provides advice on assessment and must be read in conjunction with the performance criteria, required skills and knowledge, range statement and the Assessment Guidelines for the Training Package.	
Overview of assessment	
Critical aspects for assessment and evidence required to demonstrate competency in this unit	Evidence of the ability to: • plan, conduct and record HFC maintenance activities procedures and techniques • comply with site risk control, OHS, environmental, quality and communication requirements • perform RF and optical measurements
Context of and specific resources for assessment	Assessment must ensure: • sites on which HFC maintenance may be conducted • use of maintenance tools and test instruments currently used in industry • relevant regulatory, enterprise and equipment documentation that impact on maintenance activities.
Method of assessment	A range of assessment methods should be used to assess practical skills and knowledge. The following examples are appropriate for this unit: • direct observation of the candidate carrying out HFC maintenance activities • review of maintenance reports completed by the candidate for different sites and equipment within the HFC network • oral or written questioning to assess knowledge of maintenance procedures.
Guidance information for assessment	Holistic assessment with other units relevant to the industry sector, workplace and job role is recommended. • ICTTEN4085A Monitor, analyse and action telecommunications network alarms • ICTTEN4086A Undertake routine maintenance of the telecommunications network. Aboriginal people and other people from a non-English speaking background may have second language issues.

EVIDENCE GUIDE	
	Access must be provided to appropriate learning and assessment support when required. Assessment processes and techniques must be culturally appropriate, and appropriate to the oral communication skill level, and language and literacy capacity of the candidate and the work being performed. In all cases where practical assessment is used it will be combined with targeted questioning to assess required knowledge. Questioning techniques should not require language, literacy and numeracy skills beyond those required in this unit of competency. Where applicable, physical resources should include equipment modified for people with special needs.

Range Statement

RANGE STATEMENT	
The range statement relates to the unit of competency as a whole. It allows for different work environments and situations that may affect performance. Bold italicised wording, if used in the performance criteria, is detailed below. Essential operating conditions that may be present with training and assessment (depending on the work situation, needs of the candidate, accessibility of the item, and local industry and regional contexts) may also be included.	

Relevant legislation, ***codes***, ***regulations and standards*** may include:	• appropriate licences:
	  • cable
	  • electrical
	  • elevated work platform (EWP)
	  • rigger
	• Australian Communications Industry Forum (ACIF) standards and codes
	• Australian Communications and Media Authority (ACMA) technical standards
	• Australian building codes and regulations

RANGE STATEMENT	
	• Australian standards • enterprise standards • environmental protection • equipment standards • fire regulations • heritage legislation • international standards • intrinsically safe lightning protection • local government • OHS • site engineering standard • Telecommunications Act.

HFC network elements may include:	• headend
	• optical network:
	  • optical node
	  • optical or RF hub
	• RF network:
	  • customer tap
	  • global network amplifier (GNA) with reverse path amplifier
	  • isolator
	  • line extender (LE) with reverse path amplifier
	  • line power inserter
	  • splitter.

Maintenance may include:	• corrective maintenance • remote maintenance • routine maintenance.

Network Operations Centre may include:	• coordination of repairs or changes to the network
	• escalation of faults
	• monitoring:
	  • network alarms
	  • optical fibre cuts
	  • power failures
	• performing diagnostic tests
	• troubleshooting.

Maintenance schedule may be:	• details from service level agreement (SLA) • frequency:

RANGE STATEMENT	
	• monthly • quarterly • procedures • responsibilities and commitment • timings.
Potential impact may include:	• degradation of service to residential customers • disruption of service to residential customers • intermittent degradation of service to residential customers • intermittent performance • loss of service and revenue to enterprise customers • outage • total loss of service to residential customers.
Outage may include:	• loss of service to customers due to a network fault or upgrade • planned in the case of network upgrades • unplanned in relation to faults.
Tools may include:	• anti-static wrist strap • PC board or sub-rack removal tool • pliers • power drill • screwdrivers • sockets • soldering iron • spanners.
Resources may include:	• elevated work platform hire • licensed cabler • licensed electrician • licensed rigger • optical fibre specialist • optical fibre splicer.
Test equipment may include:	• network profiler - spectrum analyser and digital modulation analyser fitted with: • cable TV (CATV) module • dual path sweep module • sweep ingress analyser • integrated sweep transmitter • laptop computer

RANGE STATEMENT	
	• multimeter • optical fibre power meter • OTDR • oscilloscope.

Network stability may include:	• reliability of the network:
	  • over time
	  • under varying load conditions
	  • under varying traffic conditions.

Routine maintenance tasks may include:	• adjusting pads and equalisers to obtain correct output signal levels in RF amplifiers
	• conducting:
	  • basic AC DC voltage and resistance measurements using a multimeter
	  • constellation measurement
	  • MER measurement and BER measurement (pre and post FEC) using a digital analyser
	  • multi channel tests across the whole band
	  • system ingress measurement
	• digital channel power
	• measuring:
	  • hum modulation
	  • optical power levels at:
	  • head end
	  • hub
	  • node
	  • RF carrier levels at:
	  • GNA
	  • Hub
	  • LE
	  • tap
	• performing RF level and frequency measurements:
	  • level
	  • tilt
	• remotely monitoring and recording customer broadband cable modem levels to assist in pinpointing network problems
	• sweep testing the RF coaxial portion of the network:

RANGE STATEMENT	

	• forward sweep test:
	  • high frequency short circuits
	  • standing waves
	  • frequency 'suck-out'
	  • flatness - peak to valley
	  • reverse sweep test
	• using a network profiler instrument to troubleshoot faults in the HFC network
	• verifying and confirming:
	  • forward optical transmitter output power and optical loss budget
	  • reverse optical transmitter output power and optical loss budget.

OHS and environmental requirements may relate to:	• decommissioning and isolating worksite and lines prior to commencement
	• safe working practices, such as the safe use and handling of:
	  • asbestos
	  • chemicals
	  • materials
	  • tools and equipment
	  • work platforms
	• safety barriers
	• safety equipment
	• warning signs and tapes
	• environmental considerations:
	  • clean-up
	  • noise and dust
	  • stormwater protection
	  • waste management.

Performance measurements may include:	• Proof of performance tests on the:
	  • forward path
	  • return path
	• optical power levels and confirm correct operation
	• RF BER and MER measurements using network profiler.

Unit Sector(s)

Unit sector	Telecommunications

Co-requisite units

Co-requisite units		

Competency field

Competency field	Radio frequency networks