MANUAL

PLANT TELECOMMUNICATION

DEP 32.71.00.10-Gen.

July 1998

DESIGN AND ENGINEERING PRACTICE

PREFACE

DEP (Design and Engineering Practice) publications reflect the views, at the time of publication, of:

Shell International Oil Products B.V. (SIOP)
and
Shell International Exploration and Production B.V. (SIEP)
and
Shell International Chemicals B.V. (SIC)

The Hague, The Netherlands,

and other Service Companies.

They are based on the experience acquired during their involvement with the design, construction, operation and maintenance of processing units and facilities, and they are supplemented with the experience of Group Operating companies. Where appropriate they are based on, or reference is made to, national and international standards and codes of practice.

The objective is to set the recommended standard for good design and engineering practice applied by Group companies operating an oil refinery, gas handling installation, chemical plant, oil and gas production facility, or any other such facility, and thereby to achieve maximum technical and economic benefit from standardization.

The information set forth in these publications is provided to users for their consideration and decision to implement. This is of particular importance where DEPs may not cover every requirement or diversity of condition at each locality. The system of DEPs is expected to be sufficiently flexible to allow individual operating companies to adapt the information set forth in DEPs to their own environment and requirements.

When Contractors or Manufacturers/Suppliers use DEPs they shall be solely responsible for the quality of work and the attainment of the required design and engineering standards. In particular, for those requirements not specifically covered, the Principal will expect them to follow those design and engineering practices which will achieve the same level of integrity as reflected in the DEPs. If in doubt, the Contractor or Manufacturer/Supplier shall, without detracting from his own responsibility, consult the Principal or its technical advisor.

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2) Other parties who are authorized to use DEPs subject to appropriate contractual arrangements.

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All administrative queries should be directed to the DEP Administrator in SIOP.

NOTE: In addition to DEP publications there are Standard Specifications and Draft DEPs for Development (DDDs). DDDs generally introduce new procedures or techniques that will probably need updating as further experience develops during their use. The above requirements for distribution and use of DEPs are also applicable to Standard Specifications and DDDs. Standard Specifications and DDDs will gradually be replaced by DEPs.

TABLE OF CONTENTS

APPENDICES

1. INTRODUCTION

1.1 SCOPE

This DEP specifies requirements and gives recommendations for equipment and systems used for plant telecommunication and for the selection and specification of such equipment and systems.

This DEP is a revision of the DEP with the same number dated July 1991.

This DEP is complementary to DEP 32.71.00.12-Gen. which deals with telecommunications for offshore platforms. Reference is made to DEP 32.71.00.11-Gen., 32.71.00.14-Gen., 32.71.00.16-Gen., 32.71.00.30-Gen. and 32.71.00.31-Gen. for details of specific telecommunication subsystems.

1.2 DISTRIBUTION, INTENDED USE AND REGULATORY CONSIDERATIONS

Unless otherwise authorised by SIEP/SIOP, the distribution of this document is confined to companies forming part of the Royal Dutch/Shell Group or managed by a Group Company, and to Contractors nominated by them (i.e. the distribution code is "C" as described in DEP 00.00.05.05-Gen.).

This DEP is intended for use in oil refineries, chemical plants, gas plants, oil/gas export terminals and, where applicable, in supply/marketing installations.

If national and/or local regulations exist in which some of the requirements may be more stringent than in this DEP, the Contractor shall determine by careful scrutiny which of the requirements are the more stringent and which combination of requirements will be acceptable as regards safety, environmental, economic and legal aspects. In all cases the Contractor shall inform the Principal of any deviation from the requirements of this DEP which is considered to be necessary in order to comply with national and/or local regulations. The Principal may then negotiate with the Authorities concerned with the object of obtaining agreement to follow this DEP as closely as possible.

1.3 DEFINITIONS

1.3.1 General definitions

The **Contractor** is the party which carries out all or part of the design, engineering, procurement, construction, commissioning or management of a project, or operation or maintenance of a facility. The Principal may undertake all or part of the duties of the Contractor.

The **Manufacturer/Supplier** is the party which manufactures or supplies equipment and services to perform the duties specified by the Contractor.

The **Principal** is the party which initiates the project and ultimately pays for its design and construction. The Principal will generally specify the technical requirements. The Principal may also include an agent or consultant, authorised to act for, and on behalf of, the Principal.

The word **shall** indicates a requirement.

The word **should** indicates a recommendation.

1.3.2 Specific definitions and abbreviations

T1 American system of classifying ISDN bandwidth of 1.5 Mbit/sec

TDMA Time Division Multiple Access Microwave

Tie line A circuit between two private exchanges

CCD Charged Coupled Device

CCTV Closed Circuit Television

City line Sometimes referred to as an **Exchange line**.
or, as used in this DEP,
- circuit between a private exchange and a public exchange,

DOD Direct Outward Dialling

DTMF Dual Tone Multi-Frequency

E1 European system of classifying ISDN bandwidth of 2 Mbit/sec

FAR Field Auxiliary Room

FPFF Fixed Position Fixed Focal length camera

Frequency bands

HF High frequency, 3 MHz-30 MHz

VHF Very high frequency, 30 MHz-300 MHz

UHF Ultra high frequency, 300 MHz-3000 MHz

NOTE: VHF frequencies for industrial use are normally in the ranges of 70 MHz and 160 MHz. UHF frequencies for industrial use are normally in the range of 460 MHz or 900 MHz. The above frequency bands are heavily used and congestion is often experienced.

Hazardous area As referenced in IEC 79-14, an area may be classified as Hazardous (Zone 0, 1, or 2) or Non-hazardous.

Intranet A private information sharing service using public Internet technology

ISDN Integrated Service Digital Networks

ITU-R The International Telecommunications Union - Radio (located in Geneva, Switzerland)

ITU-T The International Telecommunications Union - Telegraph and Telephone (located in Geneva, Switzerland)

2B+D European system of providing ISDN channels.
B = 64 kbit/sec and D = 16 kBit/sec. 2B+D consists of two channels of 64 kbit/sec (can be used for voice or data) and one of 16 kBit/sec (usually used for telephone signalling)

MDF Main Distribution Frame

PABX Private Automatic Branch eXchange

RCZ	Remote Controlled pan/tilt/Zoom/focus camera
SPC Exchange	Stored Program Controlled Exchange, that is a telephone exchange controlled by a computer
Toll Ticketing	Recording the cost of a call

1.4 CROSS-REFERENCES

Where cross-references to other parts of this DEP are made, the referenced section number is shown in brackets. Other documents referenced in this DEP are listed in (13).

2. GENERAL

2.1 USER REQUIREMENTS

The safe and efficient operation of a plant generally requires:

- voice communication between the control room and operators at various locations in the plant;
- video monitoring of critical equipment and critical areas;
- voice, data and e-mail communication between control room, attached offices, workshops and laboratories;
- voice communication with on-site contractors, customs and government inspectors;
- entrance control, intruder detection and communication with security staff (usually data, video and voice);
- voice, data, fax and e-mail communication with the import and export terminals or facilities;
- voice and pager communication with staff in residential areas;
- voice, data, fax and e-mail communication with the national 'main office' if this is not located within the plant boundary;
- voice, data, fax and e-mail communication with the third parties, both nationally and internationally.

Plants which are heavily integrated with other facilities, e.g. gas gathering or distribution networks have additional user requirements and will require detailed advice from the Principal.

The telecommunication requirements for the construction of a plant, particularly on a 'green field' site, require special consideration since they are not the same as for normal operation.

2.2 TELECOMMUNICATION AUTHORITY

Contact with the Telecommunication Authority (usually a department or agency of government) shall be made by the Principal for each project in which telecommunication is included.

The involvement of the Telecommunication Authority in plant communication systems varies from country to country. In some countries the authority has only to be assured that the interface of the plant telephone exchange to the public system meets their requirements (Type Approval), while in other countries the Telecommunication Authority is responsible for the complete supply and maintenance of the plant telephone system.

In all cases it shall be assured that those systems which are connected to the public communication network and all systems based on radio transmission (plant radio, paging) have the approval of the Telecommunication Authority.

If extensive private communications systems are required for construction and later operation of the plant, more extensive discussion with the regulatory authorities is needed (see DEP 32.71.00.31-Gen.).

It may often be difficult to obtain the necessary approvals from the Telecommunication Authority and application shall be made at the earliest opportunity. The approved radio frequencies need to be known before equipment can be ordered since the equipment is usually specially made.

2.3 SYSTEMS REQUIRED

The following systems or facilities are normally required:

- telephone system with connection to the public network;

- plant radio system;
- data system with connection to the Shell Group network;
- CCTV system;
- security system;
- emergency call-out.

The following special telecommunication systems may be required:

- communication for marine loading terminal and facilities;
- communication for gas gathering and/or gas distribution network;
- temporary local, national and international communications for construction on 'green-field' sites.

3. TELEPHONE SYSTEM

The following sub-systems are required:

- wiring;
- telephone switch;
- telephone sets;
- connection to the public network.

3.1 WIRING

The following DEPs give guidance:

- within the battery limits of oil, gas or chemical plants see DEP 32.37.20.10-Gen.;
- for office buildings see DEP 32.71.00.30-Gen.;
- for residential areas and other off-plant locations see DEP 32.71.00.16-Gen.

3.2 TELEPHONE SWITCH

Guidelines affecting the choice of a telephone switch (PABX) are given in (Appendix 1).

Only telephone switches with local Type Approval shall be considered. See (2.2).

3.3 TELEPHONE SETS

A mixture of the following types of telephone sets may be required:

- wire-connected DTMF sets with ITU-T Q.23 DTMF signalling;
- wire-connected digital sets for ISDN use (2B+D) or a proprietary standard;
- radio-connected digital set.

It shall be clearly indicated where:

- each type of set has to be provided;
- additional features are required such as executive-secretary communications.

If telephone sets have to be installed in a hazardous area, the sets shall have the appropriate type of protection in accordance with IEC 79-14. The hazardous area classification of analyser houses shall be as specified in DEP 32.31.50.13-Gen.

For telephones installed outside the control room or offices, environmental protection shall be to a specified level of IEC 529.

Wire-connected digital telephone sets have a cable length limitation depending on the make and type which will prevent the use of such instruments in some locations. This shall be documented at the design stage and alternative solutions provided.

Radio telephones offer the advantage of portability but all such sets shall have a type of protection "EX-i" (intrinsically safe, preferably type "EX-ia") as specified by IEC 79-14, unless it can be guaranteed that they will not be carried into the plant, even accidentally e.g. in an emergency.

3.4 CONNECTION TO THE PUBLIC NETWORK

The telephone exchange shall be designed for direct connection to the public network without operator intervention so that direct inward and outward dialling is technically possible from any extension.

NOTE: The service class will allow specific telephones to access the public network.

The local telephone company should be consulted about the interface required. This may

limit the makes and types of telephone exchange which can be considered. The preferred connection is E1 (2 Mbit/sec or 30 traffic channels) or multiples of E1 depending on the number of extensions which will be accessing city lines. T1 service may be offered in North America and some other countries.

3.5 BACK-UP FACILITIES

Continued operation of the telephone exchange and the ability to reach the public network is crucial, particularly during plant upsets and emergencies.

Modern telephone exchanges provide internal redundancy by having separate but linked independent units each serving 50 to 100 subscribers. When telephone lines are first assigned, critical subscribers shall be spread over more than one unit. The connection to the public network shall also be made from more than one unit.

The telephone exchange shall be supplied from a battery with sufficient capacity to run the telephone exchange with full traffic for at least 8 hours in the event of mains power failure.

The following alternative means of communication shall be provided in the event of a PABX fault:

- direct outgoing telephone lines by-passing the plant telephone exchange;
- direct lines (hot lines) to the local community Emergency Services and to utility companies.

4. PLANT RADIO SYSTEM

For very small plants, a radio system consisting of a main station in the control room and a number of handheld radios all operating on a single radio frequency should be adequate. For all other plants, a trunked radio system should be chosen since this will provide the necessary flexibility and a framework for growth. The number of handheld radios needed will depend on the operating philosophy of the plant. Discussions should be held with the operations department at an early stage.

Most private radio systems use the 450 or 900 MHz bands but higher frequencies may be allocated if there are many other users in the area.

4.1 TRUNKED RADIO

For a trunked system, the minimum number of radio channels is three; a control channel and two traffic channels. This will support 20 to 50 users depending on the number of calls they make. More channels can be added to support more traffic from more users. While a system with one traffic channel is technically feasible it has operational limitations and should be avoided.

Software in the control station allows users to be allocated to virtual groups. These groups communicate with each other over the two or more traffic channels e.g. operations, maintenance, security. Priorities can be set to resolve conflicts when there are more callers than traffic channels to support them. A user can also belong to more than one group, e.g. operations group and an emergency team group. Allocations can be changed from the main system console.

The air interface should use a standard signalling protocol, e.g. the British MPT 1327. This has the advantage that radios made by different Manufacturers can be mixed.

For small systems having no more than 3 channels each base station shall have a stand-by transmitter/receiver set. Switch-over from one set to the other shall be done manually.

For a trunking system, the loss of a channel would not be serious, since all channels are dynamically shared but users may have to wait longer to obtain a free channel. Depending on the size and criticality of the system, at least one spare transmitter/receiver should be kept on site.

The control unit assigning the channels shall have redundancy built in.

Each user group shall have one or more radio operator consoles which should be capable of being placed at any point in the plant.

A radio operator console consisting of a handset or microphone, loudspeaker and push-to-talk button should be provided at every operator position in the (central) control room. The loudspeaker is used to monitor the conversation of the operational group and of the security group. Alternatively, separate loudspeakers may be considered, in which case the volume of both speakers shall be individually adjustable, and the system shall be designed such that there is no acoustic feedback.

NOTE: If the radio operator console is to be built into the desk or panel, timely co-ordination with the engineer responsible for the design of the instrument desk or panel is required.

4.2 LOCATION AND ANTENNA

The radio equipment and associated antennas should be located in a position to give optimum coverage of the plant. A telecommunications tower may be required. See DEP 32.71.00.14-Gen. If it is not possible to provide reliable coverage from a single location, one or more repeaters should be considered. For coverage inside buildings, tunnels or areas shaded by steelwork, leaky coaxial cable may be used.

4.3 EXTRA CONNECTION POINTS

When communication is required into a space or area where radio transmissions are prohibited, e.g. in the vicinity of certain electronic equipment, then a wired audio channel

shall be provided. For this purpose, a number of sockets into which a headset can be plugged shall be distributed in the room or basement. The sockets shall be connected to a transmitter/receiver, which shall be treated as a portable/mobile. The number and distribution of the sockets shall be such that easy accessibility to all cabinets is obtained.

Two headsets per room shall be provided.

4.4 INTERFACE WITH THE TELEPHONE EXCHANGE

Depending on operational requirements, the radio system may be connected to the telephone exchange allowing automatic access to a radio channel by telephone. This is only applicable to trunked systems.

Access to a radio channel shall be limited to selected extensions only. This restriction is a feature which is possible with modern telephone exchanges. It shall be assured in the design of the interface that access from the radio operator console to the radio channel is not blocked by communication between the radio channel and a telephone set.

4.5 HANDHELD RADIOS

Handheld (portable) radios for use in plants shall have a type of protection "EX-i" (intrinsically safe, preferably type "EX-ia") as specified by IEC 79-14. The handheld radios shall be small and light weight (maximum 1 kg, including battery pack) and shall be physically robust to withstand the harsh environment and rough handling on site.

Each handheld radio shall be provided with:
- a short flexible antenna (helicoil or short whip);
- a leather case and carrying strap;
- a separate microphone/speaker/push-to-talk button, which can be attached to the collar of a jacket; in some cases it may be desirable to install this in a safety hat;
- two battery packs: one in use and one being recharged.

Handheld radios used in extreme conditions (e.g. operations and fire-fighting) shall be "splash waterproof", having an ingress protection (IP) of minimum IP 54 as defined by IEC 529.

A sufficient number of charging units shall be provided at all locations where handheld radios are kept. The battery chargers should be capable of "rapid" charging. Radio batteries are expensive and if there are a significant number of radios (say 20 or more), a computer based battery charging and management system should be considered.

Additional spare handheld radios should be purchased to replace units withdrawn for maintenance.

4.6 VEHICLE RADIOS

The plant radio system should be used only for communications within the plant boundary. All the radios will therefore be handheld. If there are operational requirements for radios to be used in vehicles, special adapters should be available as an option from the Manufacturer. When a handheld radio is inserted into this adapter, then use shall be made of:

- the car battery instead of the battery of the handheld radio;
- a car-mounted antenna;
- a separate audio amplifier and loudspeaker mounted in the car.

It is unlikely that permanently installed mobile radios will be required but if they are, they shall be of durable design to withstand the intended use (such as in a rough-terrain vehicle on unpaved roads). The radio shall be powered by the car battery and an antenna shall be installed on the car. If necessary the car shall be equipped with a suppressor to overcome the electromagnetic noise generated by the car engine.

4.7 POWER SUPPLY

The plant radio system is crucial to the safe operation of the plant, especially during plant upsets. It shall be assured that the system will continue to operate in the event of a mains failure. To obtain a high degree of availability, the system shall be powered from a battery backed power system. The battery back-up time depends on the operational requirements but shall be at least 8 hours (see DEP 33.64.10.10-Gen.).

5. PUBLIC ADDRESS SYSTEMS

Public address systems inside buildings and in the plant areas allow spoken messages to be given to all persons in the vicinity and consist of one or more control panels and a number of distributed loudspeakers. Public address systems supplement rather than replace the plant radio system.

The Principal should decide whether to not to install a public address system.

5.1 CONTROL PANEL

Each control panel shall consist of a loudspeaker with volume control knob, a microphone, press-to-talk button and, for larger applications, a zone selector switch or a push-button unit. The control panel should include the ability to broadcast pre-recorded tones and emergency messages. This is particularly applicable in multilingual environments.

5.2 LOUDSPEAKERS

In order to reduce the maximum volume, several small loudspeakers should be installed (distributed over the area) rather than a few large ones . The speakers shall comply with the respective Area Classification and IP rating. The system shall be designed so that the audibility is not reduced by the sound arriving from different loudspeakers located at different distances. The produced sound level shall be at least 5 dB higher than the local (plant) noise. All loudspeakers shall be correctly phased at the time of manufacture with clear indication at the connectors.

NOTE: A combination of the public alarm system (normally sirens) and the public address system may be considered.

6. COMPUTER DATA SYSTEM

The computer data system provides staff with personal productivity tools and administrative programmes. It shall be entirely separate from any process control computers or system. The computer data system consists of several parts:

- wiring;
- hubs/bridges/routers;
- servers;
- applications.

6.1 WIRING

The control room and offices shall be wired for data in line with DEP 32.71.00.30-Gen. The Principal shall be consulted about which other locations should be wired, e.g. analyser houses.

6.2 HUBS/BRIDGES/ROUTERS

Hubs are required to allow the network card inside each personal computer to communicate with the network over the wiring described above. Bridges and routers direct the information packets between personal computers and servers (see below). The Principal shall be consulted for advice on the Manufacturer and type of equipment to be used.

6.3 SERVERS

For ease of administration, control and back-up, most general applications like word processors, spreadsheets, and user-generated data are held centrally on a server which is a powerful personal computer specially configured for the purpose. Because technology is developing rapidly and equipment becomes obsolete very quickly, the Principal shall be consulted for specific advice on which hardware and software will be used.

6.4 APPLICATIONS

The Principal shall be consulted about the applications which will be run on the network such as:

- personal productivity tools e.g. spreadsheet, word processor;
- information sharing tools e.g. Intranet;
- specific business applications e.g. cost accounting, time-sheet, technical calculations.

6.5 NATIONAL AND INTERNATIONAL CONNECTIONS

It is likely that there will be a requirement for an Internet connection as well as data transfer with other Group Companies and with local Suppliers. Connection to any network shall comply with Group security guidelines. Direct connection to the public Internet is specifically not allowed. The Principal shall be consulted about the choice of a secure gateway if required.

6.6 E-MAIL

Electronic mail (e-mail) is an application running on top of the infrastructure described above. E-mail has replaced telex. Since the e-mail system needs to communicate with the Group e-mail system, the Principal shall be consulted on the following:

- choice of e-mail product(s);
- computer hardware on which the e-mail product(s) will run and the configuration settings;

- connection to the Group e-mail system;
- security which should be applied.

6.7 NETWORK SIZING

It is particularly important to make an estimate of the likely data traffic in cases where long distance data communications is needed since the data traffic will affect the choice and sizing of the carrier, e.g. fibre optic, microwave, or satellite, and the total cost. Each application requiring regular data transfer shall be identified to determine the minimum necessary data rate and likely quantity of data. The data network shall be sized using this information but if this results in a disproportionately complicated or expensive network the potential users should be requested to modify their requirements or to justify them.

7. CLOSED CIRCUIT TELEVISION FOR PLANT SUPERVISION

CCTV systems are used in plants to observe critical equipment. A CCTV system for plant supervision is an additional aid to the control panel operator of the plant. It does not reduce the amount of instrumentation that would otherwise be required.

A distinction is made between non-controllable cameras which have a fixed position and a fixed focal length (FPFF cameras), and cameras which can be controlled from the monitor position (RCZ cameras). The RCZ cameras can be panned, tilted, zoomed and focused onto an object.

For detailed design of the CCTV system see (Appendix 2).

7.1 CAMERAS

Apart from the overall views of the process area itself, CCTV cameras should be considered to monitor:

- smoke emission and light intensity of flares (FPFF cameras);
- the emission from the stacks in the case of non-gas firing furnaces (FPFF cameras);
- personnel in plants handling toxic products (RCZ cameras);
- remote-controlled fire-fighting monitors (water and/or foam cannons; one RCZ camera for each fire-fighting monitor);
- the loading areas of road tankers or rail cars (RCZ cameras);
- jetties where tankers are loaded (RCZ cameras);
- critical plant areas, where the cameras can be the same as those used in the process area (RCZ cameras);
- jetties/wharfs (RCZ cameras);
- hot oil pumps, liquefied gas pumps and generally the pumps and areas below pipe bridges which transport gases and liquids above their auto-ignition temperature (FPFF cameras).

7.2 MONITORS

Video monitors shall be located in the control room(s), on which the image transmitted by any of the plant supervision cameras shall be selectable.

In addition, monitors shall be installed at those locations where personnel (operators, supervisors) need to see the picture transmitted by particular cameras such as:

- in the jetty or harbourmaster's office, for the jetty loading cameras;
- at the place from where the remote controlled fire-fighting monitors are controlled (fire-fighting cubicle);
- at the place from where the rail car or road car loading operations are supervised. This can be for example a loading office or a gate-house;
- in FARs, if they are regularly manned with operators.

Monitors shall be positioned such that reflection from room lights and windows is minimized.

7.3 RECORDING

Digital video recorders should be provided to record continuous 'snapshots' from critical cameras. High capacity discs should be installed and the time between each snapshot should be chosen so that overwriting will not occur in less than 24 hours or as specified by the Principal. The emergency / contingency plan for the plant should provide for the removal of discs after an event to prevent further overwriting and to allow for later analysis.

7.4 POWER SUPPLY

The system (cameras, monitors and recorder(s)) shall be connected to a power supply

which will continue to operate in the case of a mains power failure. This supply can be the plant emergency generating set, instrument-vital, battery-based power supply or a dedicated-vital power supply. The vital power supply should allow operation of the whole CCTV system for at least 4 hours.

7.5 HAZARDOUS AREAS

Cameras should be installed in non-hazardous areas. Where this is not possible, they may be installed in Zone 2 hazardous areas, but only in exceptional cases in Zone 1 hazardous areas. All equipment shall comply with IEC 79-14, having the type of protection required by the hazardous area classification. This will normally be achieved by specifying degree of protection 'd' (= flameproof) or ‘p’ (= pressurization) for cameras in Zone 2 or Zone 1.

NOTE: Generally the investment cost for flameproof enclosures will be higher than for air purging but the annual maintenance cost will be lower.

7.6 LIGHTING

The area to be viewed by CCTV cameras shall be illuminated as specified in DEP 33.64.10.10-Gen.

8. SECURITY SYSTEM

Telecommunications provide support to an overall security plan and procedures appropriate to the local threats and consequences. The telecommunications aspects may include:

- entrance control;
- intruder detection;
- communication with security staff;
- communication with city or national security forces.

Simple systems are best and the local maintenance capability will often limit the complexity which can be used.

8.1 ENTRANCE CONTROL

The security plan will have divided the plant to be protected into separate zones, some or all of which may need an entrance control system to:

- permit and register incoming and outgoing personnel;
- give entrance/exit to vehicles.

The system and procedure shall control the specified area and establish the inventory of people within that area.

Authorised persons and/or vehicles are provided with electronic badges or tags. Each badge is unique and is interrogated by fixed equipment (badge readers) at the normal entrances and exits. The interrogation should be by inductive coupling or radio and should not rely on physical contact with the card.

There shall be separate badge readers to record in-coming and out-going persons. The system shall contain a data base of valid cards with the name of the bearer. Facilities for restricted areas and time-zones shall be provided. The system shall check the validity of the card and shall record each reading.

The contents of the memory of the badge reader shall not be lost in case of power failure. The system shall start automatically at power return.

Each reader position shall be provided with indication "valid" and "invalid" and intercom facilities to the gate-house. The "valid/invalid" indication shall be repeated in the gate-house.

The pedestrian entrance mechanism shall allow entrance of one person after the reading of a valid card.

The car and truck entrance may be equipped with traffic lights and barriers. The barriers shall be controllable from the gate house; depending on a switch setting, the barrier shall open and, if applicable, the traffic light shall turn green on the presentation of a valid card. There shall be readers at two heights, i.e. one for cars and one for trucks.

The gate-house shall have intercom facilities to all badge reader locations.

The Manufacturer and make of the system and the type, location, and configuration of barriers, sliding gates, or revolving doors etc., needs the approval of the Principal.

All entrances and exits shall have an emergency release, controllable from the gate-house.

All emergency exits shall be interfaced with the system; open position shall raise an alarm at the gate-house.

8.2 INTRUDER DETECTION

The intruder detection system provides an alarm when persons or vehicles attempt entry or exit other than through the recognised entrances. Most plants are protected by fences and/or guards, but these "conventional" protection methods are often insufficient and additional measures are then required.

The system should detect attempted entry reliably and without false alarms due to weather,

birds, animals etc. There are many methods and systems. The choice is usually not easy, as more than one system may be needed, and specialist advice is required. CCTV as described in (7) should be considered to provide a visual check and back-up to other alarm system(s).

The selection of the system(s) needs the approval of the Principal.

8.3 COMMUNICATION WITH SECURITY STAFF

Communication with security staff throughout the plant and offices will be an integral part of the security plan since these staff will provide the human response to alarms raised by the automatic equipment. They will normally be assigned a separate group on the plant trunked radio system. If there is no trunked radio system they may need their own radio channel. In extreme cases, encryption of the radio traffic may be required to prevent intruders overhearing or interfering with instructions to the security staff.

8.4 COMMUNICATION WITH CITY OR NATIONAL SECURITY FORCES

Plant security staff may not be able to deal with all situations and back-up from city or national security forces may be required. The plant PABX will provide the normal means of communication but a separate secure line may be justified. In extreme cases this may need to be protected from interception or from being cut off, e.g. a direct radio link.

9. EMERGENCY FACILITIES

Telecommunications provide support for the plant emergency and contingency plans. The important phases for telecommunications are:

- reporting of emergency;
- call-out of staff;
- communications for the emergency / contingency room during the emergency;
- recording of important voice traffic and CCTV pictures for later analysis.

9.1 REPORTING OF EMERGENCY

One telephone number shall be assigned which is publicised as the number on which to report an emergency. This telephone will be configured:

- to accept only incoming calls (outgoing calls barred);
- either as a non-busy extension (new callers will not get busy tone even if the telephone is in use) or to queue calls with a recorded message that the operator is aware of the emergency situation and will handle their call as soon as possible;
- the telephone itself will be clearly coloured or marked as the emergency phone and will have a distinctive loud ring which can be heard at all locations in the control room.

9.2 EMERGENCY CALL-OUT (ECO)

It will usually be necessary to summon key staff to attend a plant emergency. Depending on the time of day and day of the week, staff may be in the attached offices, at home or in town. Staff out of town will generally be too far away to be of help so they are not included in the call-out. There are two main methods of contacting staff: telephone and paging. It is likely that both will be required.

With telephone call-out a selected number of telephone sets both inside and outside the plant can be called simultaneously and a pre-recorded message can be given.

The ECO should have a recorder on which the operator can record a message which is then played on the telephone system and the paging system (the latter only when it can handle voice).

Pagers are complementary to telephones and are well suited to emergency call-out. If the majority of staff are either in the plant or in an adjacent and compact residential area, then a private system is likely to be suitable. If the majority of staff live off-site, spread over a wide area, a public system should be chosen. The selected system is subject to the approval of the Principal.

NOTE: The **advantage** of the public paging system over a private paging system is that it provides wide area coverage. A paging call is placed via the telephone.

Disadvantages are:

- More digits have to be dialled to call a paging unit than with a private system connected to the plant telephone exchange;
- The use of the system relies on the correct operation of the plant telephone exchange, the public telephone network and the trunk lines in between. The overall reliability could therefore be reduced. For example, the number of trunk lines may be insufficient causing them to become overloaded during peak periods, thus hampering the use of the paging system;
- The majority of public systems cannot offer intrinsically safe paging units.

Whichever system is chosen it shall allow both individual as well as group paging.

Users are normally notified by one or more of the following means:

- tone;
- vibration;
- flashing light.

The various paging systems offer several options, including:

- numeric display with different number of display positions;
- alphanumeric display with different number of display positions;
- tone coding;
- voice transmission;
- "meet me" facility on the plant PABX.

As a minimum, the paging units shall have a numerical display of at least 4 digits, with distinct tones for individual and group call and a memory to hold the last message.

The units should have rechargeable batteries. If non-rechargeable batteries are used they shall last at least 2 months at 8 hours per day of service. For rechargeable batteries a suitable number of charging units shall be available.

The paging units shall be robust enough to withstand rough handling. They shall be small, lightweight and designed to operate under the environmental conditions as specified.

The paging units shall be certified intrinsically safe.

The paging base station should be connected as a telephone set to the plant telephone exchange. The telephone user may be able to call a paging unit by first dialling the telephone number of the paging transmitter, and then the number of the paging unit, possibly followed by the message to be displayed. In order not to block the telephone access to the paging base station, the base station shall automatically go 'on-hook' after a certain idle time in case the telephone user has forgotten to replace his handset.

The system shall accept signalling from:

- wire-connected DTMF push-button sets;
- wire-connected digital sets;
- radio-connected digital sets (if used).

Besides placing a paging call via the telephone system, it shall be possible to make a call via a dedicated keyboard connected to the paging base station. The keyboard will normally be located near the reception telephone operator or in the guard house.

The paging system shall be connected to a supply to allow for continued operation in the event of a failure of mains power.

Where available, public cellular radio could be considered instead of or in addition to paging. However there are limitations such as:

- group call is not available and units need to be called individually;
- handheld cellular radios are not intrinsically safe and procedures must be in place to prevent them being taken into hazardous areas;
- as with the public telephone the system may become overloaded or withdrawn from service at times of national or local emergencies and disasters.

9.3 EMERGENCY ROOM COMMUNICATIONS

The main control room is normally the centre of activities for emergency response. However, there is a need for a quiet area where management can confer, making the more strategic decisions and providing a location for centralised contact with the city or national emergency services, the press and third parties. The facilities should be self-contained for handling all non-process emergencies.

The normal plant telephone and plant radio systems shall be designed to cope with the extra traffic expected during emergencies.

The emergency room should be equipped with one or more telephones on the plant PABX and city exchanges. Consideration should be given to loudspeaking telephone instruments. A fax machine should be considered.

The emergency telephone will normally be answered first by the panel operator or supervisor but there should be a parallel extension in the emergency room so that someone

else can answer subsequent calls to reduce the workload in the control room area.

The lighting and equipment in the emergency room should be powered from a vital supply to allow continued operation during a mains power failure.

9.4 RECORDING FOR ANALYSIS AFTER THE EVENT

The plant emergency telephone described in (9.1) should have a tape and time recorder attached to the line which is activated whenever a call is received. Taping other telephones in the emergency room may be considered. Every telephone instrument which has traffic recorded from it should be visibly marked.

If necessary, it is relatively easy to tape-record conventional radio systems using one or more channels since each call appears on the same channel throughout the whole conversation. In a trunked radio system the channels are assigned dynamically and there is no guarantee that a conversation consisting of several exchanges between the parties will take place on the same radio channel. If tape recording is required the Manufacturer of the equipment should be consulted.

Critical CCTV cameras should be recorded as described in (7.3).

Procedures shall be established to remove recording media after an event to prevent them from being over-written.

The recording equipment shall be powered from a vital supply.

10. TELECOMMUNICATIONS FOR MARINE LOADING

In many cases crude or product is imported or exported through a marine terminal. While the complexity of each terminal varies with the product, the quantities handled and the location, there are a few features which are standard.

10.1 COMMUNICATION WITH SHIPS

There is a need to first communicate with a nominated carrier when it is about two days' sailing time away. Nowadays this is normally carried out using the Inmarsat satellite system. All ships are equipped with Inmarsat facilities. The messages can be passed by either fax, voice, e-mail or telex. Inmarsat facilities are usually accessible through the plant and public telephone system but in some countries this may not be possible or sufficiently reliable and a dedicated Inmarsat land station may be required, located at or near the terminal. This allows direct communication between the terminal and the ship.

Within about 40 km, the International Maritime Mobile Band (156-162 MHz) can be used to communicate with approaching carriers. All vessels carry ship-to-ship and ship-to-shore VHF channels. The shore terminal should be equipped with a marine band radio which can select ship-to-ship channels and also keeps a continuous watch on the international calling channel 16.

It may also be possible to establish a maritime shore station with one or more shore station frequencies. This would allow more reliable communication with ships from portable radios by using the shore station as a repeater. In most countries, special permission is needed to establish a private maritime shore station.

In many areas of the world the International Maritime Band is congested and critical ship-to-shore communication may be interrupted by others. For mooring operations, where integrity of communications is important, a private VHF or UHF frequency may be needed.

All portable radio equipment used in the mooring should be of intrinsically safe design. The fixed equipment on shore, on mooring / hose handling vessels and on the tanker may be of normal design.

10.2 LOADING OPERATIONS

There is a requirement for verbal communications between the loading master on board the ship and the control room on shore during cargo handling. If the ship is berthed alongside a jetty, either a temporary wired telephone or a portable VHF/UHF radio can be used. Any wired telephone shall meet the hazardous area classification of the location where it is installed. If the ship is moored at an SBM (Single Buoy Mooring) only radio can be used. In either case, if radio is required, a private frequency shall be used since the International Maritime Band does not provide sufficient integrity and regulations do not normally allow the use of maritime mobile channels in port.

There is also a requirement to remotely stop the flow of oil in an emergency and to shut down the shore-based loading pumps. This can be done by means of a command sent from the loading master's radio. A separate clearly marked and protected button should be provided for this purpose. The integrity of the link and coding / decoding of the transmitted radio signal shall be sufficiently robust that it operates reliably and does not operate spuriously. Since the shut-down signal may be sent from inside the vessel (ship's loading control room) it may not be possible to span the distance to shore directly. If this is the case, a repeater should be provided on an existing structure such as an offshore loading platform where one exists. Otherwise it may be necessary to modify procedures so that the shut-down signal is only given from an exposed part of the ship e.g. deck or bridge.

NOTE: The (US) Factory Mutual hazardous area certification permits the use of higher power handheld transmitters than Cenelec and, where allowed, can improve the reliability of the shut-down communication signal.

If an SBM is used, a radio telemetry system should be installed to transmit the tension of the tanker mooring line to the control room or marine office on shore.

10.3 OTHER SERVICES

Depending on the country and location, port services may be provided by the government or the Principal or both.

Typical port services are:

- approach radar if the berthing is difficult or congested or there is frequent poor visibility;
- pilot services;
- tug services;
- harbour master services;
- mooring / hose handling if an SBM (single buoy mooring) is used;
- weather and/or sea state monitoring and forecasting;
- customs and other government controls.

Reliable communication is needed between all parties. The exact requirements should be determined early in the project as equipment may need to be purchased by the Principal for installation in premises belonging to others.

11. TELECOMMUNICATIONS FOR GAS GATHERING AND DISTRIBUTION

LNG and gas processing plants often have an associated gas gathering system. There may also be some distribution to major gas consumers in the local area. The plant responsibility will generally be limited to the trunklines. It is assumed that both gas producers and gas consumers will provide a control room(s) as a centre for their own activities and as a point of contact for end-to-end control of the pipeline linking them with the plant.

11.1 USER REQUIREMENTS

The specific user requirements should be established on a project-by-project basis since they can vary considerably. The following are the most common requirements:

- voice and record communication between the plant control room and the gas Supplier/consumer control room(s);
- voice and record communication with scheduling department(s) if in a different location from the control room(s);
- voice communication with pigging teams, pipeline right-of-way inspectors and others working on the line e.g. cathodic protection staff;
- telemetry for pipeline leak detection (if required);
- telemetry for remote closing of sectionalising block valves (if required);
- telemetry of custody transfer metering (if required);
- emergency communications to deal with a pipeline rupture.

Record communication provides a hard copy output on a medium and in a format agreed by both parties. Nowadays, for these purposes, fax is the record communication of choice. Previously it was telex. Unless specially configured, e-mail does not provide the necessary immediacy.

11.2 TELECOMMUNICATION SOLUTIONS

Use should be made of the public telecommunications infrastructure in those areas of the world where it is available and reliable. Otherwise, infrastructure shall be constructed specifically for the project.

The main requirement is a reliable end-to-end communication bearer which can carry several services (voice and data) simultaneously. The possibilities are microwave, fibre-optic cable, satellite or a combination of these. A long undersea pipeline will limit the possibilities. The choice of technology will be influenced by cost, expected reliability, maintainability, susceptibility to damage either accidental or deliberate, and need for communications services at intermediate sites (see DEP 32.71.00.31-Gen. for guidance on using microwave and satellite systems).

The end-to-end communications bearer will provide the infrastructure for voice and record communications between the distant control rooms. Hot line phones and fax machines should be provided at each end, either connected directly or through one or both PABXs if they are sufficiently reliable. Extension to the system may be needed to provide contact between scheduling departments but their needs are less immediate than those of the control rooms. Telemetry for leak detection and custody transfer metering can be carried on the same end-to-end bearer.

Voice communication with staff working on the right-of-way should be provided by means of VHF or UHF vehicle-mounted radios. A separate radio system, not an extension of the plant system, should be used since it is important not to compromise the integrity of the plant radio system. Depending on the length of the pipeline, it may be necessary to provide radio repeaters at intervals (approx 50 km) to cover all the right-of-way. These repeaters should be co-located with microwave or fibre-optic repeaters to provide the necessary remote control channel and to share prime power.

If possible, the microwave or fibre-optic repeaters should be located at sectionalising block

valve sites so that telemetry for remotely closing the valves can be connected back to the plant. If this is not possible, spurlinks to the block valves sites should be planned. A TDMA microwave system (see DEP 32.71.00.31-Gen. (Appendix 1)) should be used instead of multiple spurlinks

If the pipeline network is extensive, an emergency communications package should be provided which shall be deployed at the site of a pipeline break to help the repair work. This package shall be designed so that it can be transported to site quickly by locally available transport e.g. by land, water, or air. The unit shall be self-contained with its own means of power. As well as a link back to the main communications network the package should provide for local area communications with hand held radios. Electronic still or video cameras and a means of transmitting the picture back to the main emergency contingency centre should be considered.

12. TELECOMMUNICATIONS FOR CONSTRUCTION SITES

This section covers telecommunications during construction on 'green field' sites, particularly for sites located in areas of the world where the public telecommunications infrastructure is unreliable or lacking. In more developed countries, use should be made of the existing public infrastructure wherever possible.

In all cases, every effort should be made to assemble user requirements at the start of a project. In undeveloped areas of the world the time required to correct omissions is usually so long that services may not be available during the entire construction phase if their provision was neglected at an early stage. In developed areas mistakes and omissions can be corrected more easily and rapidly since the basic infrastructure is already in place.

Lack of reliable communication to and from the construction site is likely to delay project completion and increase costs.

12.1 USER REQUIREMENTS

In the first stage of a project (phase 1), most of the work will be carried out within and between established offices of the Principal and the Contractor. The communication requirements will be telephone, fax, e-mail and file transfer.

Both Principal and Contractor are likely to establish or expand existing representative offices in the country where the plant will be built, usually in the capital. Telephone, fax and e-mail will be required.

Some civil work will be started at the plant site e.g. land clearance and pre-loading of tank bases. The minimum requirements will be telephone and fax between the construction site and the in-country office for passing instructions and for emergency contact. At this stage, international telephone and fax connections direct from the construction site are an advantage but may not be essential depending on the project organisation.

In the next stage of a project (phase 2), contracts are let for major equipment and long-lead items. Telephone, fax and e-mail communication are required between the design office and the fabrication yards. The Principal may or may not be involved.

Site work then intensifies: building the construction camp, opening a landing area or jetty for importing heavy equipment, making or improving roads etc. The telecommunication requirements are voice communication covering the construction site as well as telephone, fax and e-mail to the in-country offices and design office.

In the main construction stage (phase 3), the plant itself is built. The site office will probably become the construction base. The requirements are:

- voice communications within the site office, around the plant and marine areas with additional coverage of the construction camp and the residential area (if one is to be built);
- telephone, fax, e-mail and file transfer communication from the site office to the in-country offices of Contractor and Principal and to the design office;
- telephone, fax, and e-mail communication with major Suppliers and Manufacturers;
- telephone, fax, e-mail and data communications to allow Manufacturers' visiting commissioning engineers to call their home base.

12.2 TELECOMMUNICATION PLAN

A master plan for telecommunications should be drawn up to meet the specific user needs of the project. The plan should highlight the timing of both requirements and solutions with particular emphasis on any regulatory approvals which may be required.

The plan should consider early installation of the main communications equipment to provide service during the construction phase. Re-use of some equipment for the later operations phase may be possible but portable equipment is not likely to be in good condition at the end of the construction phase.

The telecommunication requirements outlined above are a combination of those required by the Principal and those required by the Contractor. The split will vary depending on the involvement of the Principal and should be resolved at the start of the project. Although the Contractor will build all the telecommunication facilities, project management staff reporting to the Principal are likely to need an independent means of communication with Group offices.

Overall, telecommunication for construction and operations can be expected to cost between 1 and 2% of the entire project budget depending on how much of the telecommunication infrastructure has to be built specifically for the project. This estimate includes all the capital charges as well as the operating cost during the construction period. Since the Principal will eventually pay for all project communications, either directly or through the charges of the Contractor, it may be economic to provide an integrated solution incorporating mechanisms to meet the separate security requirements of each party and to avoid abuse, particularly where services are provided by Inmarsat or the PTT and calls are charged by the minute.

12.3 SUGGESTED TELECOMMUNICATION SOLUTIONS

During phase 1, PABXs and local area data networks should be established in the offices of Principal and Contractor and connected to the public system. In the absence of reliable public telecommunications infrastructure, fixed or portable Inmarsat terminals should be considered for main or back-up communications between the construction site, the in-country offices, and the head offices of Principal and Contractor.

Phase 2 is the time to install and commission communications for the main construction phase. The construction site office should be equipped with a PABX through which all voice services are connected. It may be preferable to use some radio-connected phone sets if the laying of cable is difficult or if it may be damaged by earthmoving activities. TDMA radio systems (see DEP 32.71.00.31-Gen.) may be used if the range of PABX radio-connected phones is insufficient. The site PABX should be linked to the public system either by wire, fibre-optic cable or microwave. In the absence of a reliable public system a private satellite connection should be considered.

A simple local area network should be established within the construction office complex, linked to the in-country offices of the Contractor and Principal and connected directly or through them with the outside world. E-mail should be provided at an early stage since it can significantly improve communication with the design and project offices.

Phase 3 is the time to install communications for the operational phase of the plant. All communications should be installed and working before the commissioning of the plant since this is the time when user requirements reach their peak.

13. REFERENCES

In this DEP, reference is made to the following publications:

NOTE: Unless specifically designated by date, the latest edition of each publication shall be used, together with any amendments/supplements/revisions thereto.

SHELL STANDARDS

Index to DEP publications and standard specifications	DEP 00.00.05.05-Gen.
Instrument signal lines	DEP 32.37.20.10-Gen.
Telecommunication standards	DEP 32.71.00.11-Gen.
Telecommunications for offshore platforms	DEP 32.71.00.12-Gen.
Telecommunications towers and guyed masts	DEP 32.71.00.14-Gen.
Design and installation of telephone cabling	DEP 32.71.00.16-Gen.
Structured cabling systems for telecommunications	DEP 32.71.00.30-Gen.
Microwave systems	DEP 32.71.00.31-Gen.
On-line process stream analysis - Analyser houses	DEP 32.31.50.13-Gen.
Electrical engineering guidelines	DEP 33.64.10.10-Gen.

BRITISH STANDARDS

A signalling standard for trunked private land mobile radio services	MPT 1327

Issued by
UK Department of Trade and Industry
Radiocommunications Agency
New King's Beam House, 22 Upper Ground
London SE1 9SA, England

INTERNATIONAL STANDARDS

Electrical apparatus for explosive atmospheres: Part 14: Electrical installation in explosive gas atmosphere (other than mines)	IEC 79-14
Classification of degrees of protection provided by enclosures	IEC 529

Issued by:
Central Office of IEC (Sales Dept.)
3, rue de Varembé,
CH 1211 Geneva 20,
Switzerland

Intrinsically safe apparatus and associated apparatus for use in Class I, II and III, Division 1 hazardous (classified) locations	UL 913

Issued by:
Underwriters Laboratories Inc
333 Pfingsten Rd
Northbrook
Illinois 60062-2096, USA

Technical features of push-button telephone sets: From “General recommendations on telephone switching and signalling”	ITU-T Recommendation Q.23

Issued by:
International Telecommunication Union
General Secretariat - (Sales Dept.)
Place des Nations

CH-1211 Geneva 20, Switzerland

APPENDIX 1 PLANT TELEPHONE SWITCH SPECIFICATION

1. Scope of work

When purchasing or renting a telephone switch it is important to define exactly the Supplier's scope of work, e.g.:

- supply of equipment;
- installation;
- cables and jointing of cables;
- inclusion of the MDF;
- telephone sets (these need not necessarily be obtained from the same Supplier as the exchange);
- interface with the public telephone system, public data networks, etc. (including interface and cable connection);
- interface with private systems such as other PABXs, radio systems, paging systems;
- integration into existing private network;
- facilities as described in this DEP.

NOTE: From the outset of a project, the Telecommunication Authority should be involved. Items to be discussed should include:

- type approval of PABX, permission to connect;
- incoming and outgoing signalling;
- group hunting on incoming (city) lines;
- purchase or rent of the PABX.

The telephone switch includes:

- switching unit (PABX);
- MDF with lightning arresters for all cables;
- rectifier and batteries;
- loading device for programmes and data;
- error logging device;
- printer for management reports;
- alarm display;
- operator console(s);
- maintenance console;
- radio base station(s) and antenna(s) for radio connected telephone sets;
- toll ticketing subsystem;
- telephone directory subsystem;
- all cabling between switching unit, MDF, radio base stations and peripherals such as operator console, error logging device, etc.;
- interface facilities with the public networks and private networks such as a private telephone network, radio systems and paging systems;
- all special tools and test equipment required for preventive maintenance and first line maintenance.

2. TECHNOLOGY

The telephone switch shall be a digital, Stored Program Controlled (SPC) distributed processor, business communication system. It shall be suitable for connection to both analogue and digital networks, and should be compatible with the local public version of Integrated Services Digital Network (ISDN).

The system shall be provided with all modern PABX facilities and able to handle voice, text, data and image communications.

It shall be possible for voice and data communications (2B+D (144 kbits/s)) to be carried simultaneously on a single (twisted) pair. Connections to the public network should be

possible by 2 Mbit/s links (30B+D) in addition to any requirements for analogue city lines.

NOTE: The use of a different type of exchange requires the approval of the Principal.

The exchange shall be suitable for use with DTMF wire-connected push-button telephone sets, 2B+D wire-connected digital sets and, if required, radio-connected digital sets.

If the exchange becomes non-operational because of a failure (e.g. total power failure) there shall be a facility to switch selected telephone sets to the city lines. For this facility, the following extensions should be considered:

- security department;
- medical department;
- central control room;
- general manager;
- telephone operator;
- PABX location.

3. SIZE OF THE SWITCH AND PERIPHERALS

For the correct sizing of the switch, the following items shall be considered:

- initial capacity required (number of extensions);
- ultimate capacity (maximum number of extensions ever likely to be required);
- initial and ultimate numbers of city lines to the public system;
- initial and ultimate number of tie lines to other private switches (if any);
- number of operator consoles;

NOTE: In most cases one console should be sufficient. Every effort should be made to persuade the local telephone company to provide DID (direct inward dialling), to avoid the need for an operator. An operator may be provided during office hours if desired but this is not essential. Where DID and DOD (direct outward dialling) are not available or restricted, it may be necessary to increase the number of consoles.

- capacity of the batteries, specified in hours under full traffic (at least 8 hours), and whether a stand-by rectifier is required;
- special interfaces, for example with plant radio system, plant paging system, etc..

The MDF shall be sized for the maximum capacity of the exchange as specified, plus 10% spare to cater for direct subscriber lines, other line-based systems etc. All conductors of the cables shall be terminated at the MDF (no loose hanging conductors). All cable pairs leaving the building shall be protected by lightning arresters. Attention shall be paid to the matching of the conductor diameter and the terminal size.

Larger systems, e.g. with more than 500 extensions, shall include a battery charging system with two 100% rectifiers (fed if possible from independent AC supplies). The rectifiers shall run in parallel to charge the battery (with blocking diodes to prevent back feeding).

Separate malfunction alarms from each rectifier, plus a battery under-voltage alarm, shall be provided for remote indication. Means shall be provided to individually isolate the rectifiers for maintenance purposes.

4. STANDARD FACILITIES

The following facilities shall be provided as a minimum:

- Direct dialling to another extension of the exchange;
- Restriction of direct outward dialling from certain extensions, i.e. selective prohibition of the following user facilities:
  - dialling of certain internal extensions;
  - dialling to the local public exchange network;
  - dialling to the national public exchange network;
  - dialling to the international public exchange network;

- Enquiry. During an external connection, enquiry with another internal extension shall be possible while the external connection remains in the hold position;
- Transfer. It shall be possible to transfer an incoming external connection to another PABX extension;
- Changing the class of service outside business hours. It shall be possible to centrally change the facilities of the extensions, for example a set which can normally directly dial international calls will only be allowed to dial local calls outside business hours. These changes in user facilities shall automatically become operational at a specific time of day or when the night console is switched on;
- Intrusion/data protection. The operator shall be able to intrude into an established connection. A tone shall warn the parties of the intrusion. Extensions used for data communication shall be excluded;
- Night console. When the operator console is not manned (for example outside working hours), it shall be possible to transfer all calls to a preselected extension which is designated as the night console, e.g. in the gate house.

5. OPTIONAL FACILITIES

The following optional facilities shall be considered (if not already provided as a standard feature of the exchange):

- DID for all extensions, subject to the availability of this facility in the public network. This option requires a more complicated interface;
- Automatic call-forwarding on 'no answer'. If there is no answer after ringing a prescribed number of times, the call will be transferred to a pre-determined number or the operator;
- Automatic call-forwarding on 'engaged' (busy). Calls to an engaged extension are rerouted to a pre-determined number or to the operator;
- Executive-secretary arrangement. This shall allow single-digit or two-digit dialling between two defined users and a simplified transfer of calls between them;
- Three-party conference (add-on conference);
- Abbreviated dialling. The exchange contains a list of abbreviated numbers which can be used by all, or preselected, extensions;
- Hot-line facility. When the handset is lifted the extension will be automatically connected to a predetermined extension, where the telephone will start ringing;
- Follow me. It shall be possible to reroute all calls from an extension to another extension;
- Automatic ring-back. The system rings back the caller and the engaged extension at the moment the engaged extension is free;
- Group hunting. A number of sets are assigned a general number. When this number is called a free set in the group will be selected, either at random or in a certain sequence. The individual sets can be called directly by their individual numbers;
- Exception of night time "class of service" for individual extensions;
- Additional "class of service" for access to international abbreviated numbers;
- Additional class of service as "space" for later configurations;
- Telephone directory. A separate module should be provided which can be used to maintain the telephone directory. Updates and changes should be easy to carry out and it should be possible to provide both online and printed versions;
- Toll ticketing. The switch should provide a port with a standard interface to which a separate toll ticketing module can be connected. As a minimum, the toll ticketing module shall be able to determine the cost of international calls made from the PABX. More extensive call cost recording should be considered. For ease of administration, the toll ticketing module should share the same database as the telephone directory module described above.

  NOTE 1: If DID is not available, consideration should be given to providing an auto operator facility which answers the incoming city line and prompts the user to dial the extension required. This facility is usually linked with voice mail.

NOTE 2: For exact cost calculation it is necessary that the city telephone exchange provides the metering pulses to the PABX. This will not always be possible. If no pulses are available, the approximate cost of a call can be calculated on basis of the destination, time, duration and known rates. In either case, the operator of the city telephone exchange should be asked to provide itemised billing for all city lines which can be compared with the PABX toll ticketing system on either a random or continuous basis. From time to time, the PABX clock should be synchronised with the city exchange to make the comparison easier.

6. RADIO-CONNECTED DIGITAL TELEPHONE SETS

Radio-connected digital telephone sets offer the advantage of portability. Telephone sets can be easily carried by individuals. However, this portability can be a disadvantage in certain situations e.g. at large meetings. The telephone set batteries need to be charged and a regime established so that the majority are operational at any one time. Some fixed telephone sets are still required.

The design needs to provide adequate radio coverage throughout the service area. This is likely to require a separate radio base station on each floor and more than one if the area to be covered is large. These need to be powered either from the main exchange or from internal batteries to meet stand-by requirements in the event of a mains power failure. The traffic handling capacity of each base station should allow a reasonable number of users away from their normal location to be able to use their telephones in a specified area e.g. outside meeting rooms.

7. VOICE-MAIL BOXES

Voice-mail provides the user community with a means of receiving messages when they are not available and playing them back later. This service can be provided either centrally or on an individual basis. The centralised service is less maintenance-intensive and can be provided with battery back-up to cover mains power failure. Centralised voice-mail will work with digital telephone sets whereas individual recording machines cannot. They usually require an analogue line. Not everyone needs or wants voice-mail. It should be used with discretion.

APPENDIX 2 CCTV SYSTEM DESIGN

1. GENERAL

The CCTV system can either be colour or monochrome. The choice shall be made by the Principal.

NOTE: The advantage of a colour system is the additional information colour may give; the disadvantages are a generally lower resolution and higher required light intensity.

The system shall be either 625 lines/50 Hz or 525 lines/60 Hz, 2:1 interlaced, depending on the local broadcasting standard.

It shall be designed for continuous duty.

The system and its transmission facilities shall be such that a clear and sharp picture is obtained on each monitor (even if the same picture is selected simultaneously on all possible monitors). Fibre optic cable transmission is preferred. The use of intermediate amplifiers shall be avoided where possible.

It shall be assured that the whole system will automatically restart at power return.

The system shall operate normally under the maximum voltage and frequency deviations of the power supply as specified for the site. It shall tolerate at least a 10% deviation in the voltage and 2% deviation in the frequency.

2. CAMERAS

The cameras shall have CCD (charged coupled device) image pick-up devices. The resolution in the centre of the picture shall be 550 lines minimum for monochrome and 320 minimum for colour. The signal-to-noise ratio shall be at least 43 dB.

The sensitivity on the CCD target for a maximum signal shall be at least 0.5 lux for monochrome and 10 lux for colour.
The cameras shall be provided with facilities for the later insertion of filters.

The cameras shall be equipped with remote-controllable 'window' cleaning facilities when specified by the Principal.

FPFF cameras shall have a manual focus adjustment.

RCZ cameras shall have remote control pan, tilt, zoom and focus facilities.

The maximum permissible ambient temperature for the cameras shall be at least 50 °C.

It shall be assured that internal condensation or condensation on the 'window' will not occur. If necessary, thermostatically controlled internal and/or 'window' heaters shall be provided.

A power key switch shall be installed in the direct vicinity of the camera to switch off all power to the camera, pan and tilt head, heater, spotlight, etc.

It is expected that the plant will be covered by a radio system which can be used by technicians for camera maintenance. If not, a weather-protected jack shall be provided near each camera for a sound-powered telephone, providing a voice link to the central CCTV cabinet.

The pan and tilt heads of the RCZ cameras shall allow rotation over a minimum of 300 degrees in the horizontal plane, 60 degrees upwards and 60 degrees downwards. They shall have limit stops/switches which can be set by the user. The orientation of the camera shall not be affected by strong winds.

The camera enclosures shall be made of stainless steel with a rain/sun shield and a protective cover for the 'window'. The ingress protection (IP) of the cameras shall be minimum IP 65 as defined by IEC 529.

For cameras equipped with a spotlight, power for the spotlight shall be supplied from the plant lighting system so that it can only be switched on when the plant lighting is on. The spotlight for an RCZ camera shall move with the camera.

The ratio between maximum and minimum focal length for the zoom lens shall be at least 6.

The aperture ratio (f-number) of the lenses shall be selected such that a good picture is

obtained at night with the existing plant and equipment lighting. It shall be 1.4 or less for fixed focal length lenses and 1.8 or less for zoom lenses.

3. LOCATION OF THE CAMERAS

The plant and security cameras should be integrated as far as possible. If a plant model or a complete model is available, it should be used to determine the location of all the cameras. The viewing angle of the cameras shall be shown on the plant lay-out drawings.

When selecting the camera positions, care shall be taken to prevent the direct light of the sun or of lamps from shining into the camera lens.

Cameras shall always be located inside the fence.

4. MOUNTING OF THE CAMERAS

Wherever possible, existing non-vibrating structures shall be used for mounting the camera, otherwise special structures shall be provided. The location of the camera shall be selected so that the camera and its supporting structure will present the least obstruction and the risk of accidental damage will be minimized. Where necessary, protective rails or fences shall be provided. The cameras shall be easily accessible for maintenance with fixed or mobile access platforms. Swing-type poles are not recommended.

The apparent vibration of any object on the screen due to the vibration of the structure on which the camera is mounted shall be less than 2 mm with a frequency of less than 2 Hz. Swing and torsion of the structure and backlash of the pan and tilt heads shall be taken into account.

The camera housing and camera shall be mounted on the pan and tilt head, so that with the mounting facility disconnected, the camera will be balanced in the horizontal position.

5. MONITORS

Unless otherwise specified the screen size shall be 44 cm (17 inch).

The monitors shall have a band-width of at least 7 MHz (-1 dB) and a horizontal resolution in the centre of the picture of 600 lines at moderate brightness.

The ingress protection (IP) of the monitors shall be minimum IP 20 as defined by IEC 529.

The maximum permissible operating temperature shall be at least 40 °C.

The monitors shall have facilities to loop the video signal through to other monitors.

The monitor shall remain dark if no camera is selected or if there is no signal at the video input.

The screen shall have a non-reflective surface.

Each monitor shall have the following control facilities:

- Control of the wiper/washer or air jet window cleaning, if fitted;
- Pan, tilt, zoom and focus controls in the case of RCZ cameras. Control of a camera shall only be possible when it is selected on the monitor. In the stand-by position no camera shall be selected and the monitor shall be dark.

Also required may be (subject to the requirements of the Principal):

- Camera selection; if more than one camera can be selected at one position there shall be an indication of which camera is selected. Automatic sequencing with a hold facility shall be provided; the operator shall be able to select which camera is included in the automatic sequencing and be able to adjust the scan speed. The camera switching shall be effected within the frame blanking interval.

For cameras with a spotlight, an 'on' push-button and an 'off' push-button shall be provided at the most appropriate monitor position.

6. TRANSMISSION

For the cable selection, earthing and lightning protection, DEP 32.37.20.10-Gen. shall apply.

The cabling shall provide for each camera:

- video link;
- control of wiper/washer or air jet (if fitted), and control of pan, tilt, zoom and focus (for RCZ cameras). The control signals may make use of their own signal path or may be multiplexed;
- link for the sound-powered telephone if the plant radio system cannot be used.

Fibre optic transmission is preferred. Intermediate amplifiers shall be avoided.

7. CCTV CABINETS

Buildings having more than 2 monitors shall have a CCTV cabinet (or box). The cables from the cameras shall be terminated in this cabinet, and from there the signals shall be distributed to the monitors. Video amplifiers, video matrices, etc. forming part of the system shall be installed in the cabinet.

The cabinet shall have facilities to connect a test monitor to any of the inputs (from the cameras) and a sound-powered telephone set to provide a voice link to the camera. The cabinet shall have full facilities to enable control of the pan, tilt, zoom and focus of RCZ cameras when they are connected to the cabinet, and a power point for test equipment.

8. TEST EQUIPMENT

The system shall be supplied with all special tools and test equipment required for preventive and first-line maintenance, and shall include the following:

- three sound-powered plug-in telephone sets;
- a 12-inch portable test monitor.

APPENDIX 3 LIGHTNING PROTECTION AND EARTHING

LIGHTNING PROTECTION

It is assumed that the plant will be protected against lightning in accordance with DEP 33.64.10.10-Gen. In all cases the telecommunication tower shall be protected since it is likely to be one of the taller structures in the plant and its foundations are liable to be damaged by any lightning discharge. Earth electrodes shall be installed near the base of the tower and connected to the structure by the most direct route and without twists or bends using copper braid of at least 70 mm^2.

To minimise damaging potential differences occurring across the telecommunications equipment in the event of a lightning strike on the telecommunications tower, all cables to the tower, including feeders, the earth connection, and power for any hazard warning lights shall be made through the same feeder opening in the telecommunications equipment room.

Since it is accepted that some telephone cables will run in areas of the plant which are not protected by the overall lightning protection system of the plant, all cables terminating on the telecommunications MDF will be provided with lightning arresters of the gas discharge tube type.

EARTHING

Telecommunications shall have a separate earth from the electrical system - a telecommunications clean earth. This clean earth shall not be connected to other clean earth systems such as the instrument clean earth. If a telecommunications tower is located nearby, the earth electrodes provided for lightning protection should be used for the telecommunications earth otherwise separate earth electrodes should be buried near the equipment room. In all cases the earth resistance should be as low as practicable and the aim should be to achieve 1 ohm between the telecommunications equipment and the general mass of the earth.

A clearly marked and separate earth busbar shall be provided in the telecommunications equipment room. The positive side of the telecommunications battery or batteries and all telecommunication equipment shall be connected to this earth busbar.

Since it is not possible to completely isolate the telecommunications earth from the electrical safety earth and to avoid potential differences appearing between the two earths, the telecommunications earth busbar should be connected to the electrical safety earth at one point only and by the most direct route using copper cable of at least 70 mm^2.