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TH-3 Medium-Haul Application:

Equipment and Building Considerations

By R. A. SWIFT and J. A. WORD

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This paper points out the salient equipment and building considerations peculiar to the TH-3 radio system with emphasis on the ability to combine TH-3 with existing radio systems.

I. INTRODUCTION

TH-3 radio in its overall systems equipment concept for 4000-mile long-haul radio is almost identical to TD-3 radio.[1] The primary difference is in the frequency band, the circuit capacity, and the number of radio channels per route. All of the supporting equipments, such as power plants, FM terminals, radio line protection switching, entrance link and FM terminal protection switching, patching and access and emergency restoration equipment as well as test equipment, are essentially identical in their application to TD-3 and TH-3. Some of of the supporting items will handle broadband channels of both TD-3 and TH-3 on a direct intermix basis whereas others require only minor changes.

The largest application of TH-3 will be in the addition of TH-3 radio at 6 GHz to already established fully loaded TD-2 and TD-3 radio routes operating at 4 GHz (overbuilding); this involves using existing buildings and common facilities, including antennas and waveguide insofar as possible.

Two TH-3 radio systems have been developed; a version for use on 4000-mile long-haul routes and a simplified version for use on medium-haul routes where only one working broadband channel is required. This capacity restriction for medium-haul usage permits the protection switching to be greatly simplified and the use of a single antenna for transmitting and receiving in each direction. This medium-haul system should have considerable application in meeting

operating company needs for microwave radio systems on other than major routes.

II. BUILDINGS AND FACILITIES

The Central Office Layouts and Design Committee of the Long Lines Department of the American Telephone and Telegraph Company has initiated the design of a Type 1260 building (see Fig. 1) which is proposed as a standard for repeater station applications and can also apply to small "through"* main switching stations. This building, having a floor area of 1260 square feet, can contain 16 TH-3 T/R bays (8 two-way broadband channels), 24 TD-3 T/R bays (12 two-way broadband channels), and the necessary supporting equipment for a through route. Provision is made for a third module addition to provide for additional side-leg routes or additions such as terminal facilities.

The use of a systems combining network in the vertical run of waveguide enables the simultaneous use of antennas and vertical circular waveguides for both 4- and 6-GHz signals for long-haul applications. Separate horizontal rectangular waveguides are required to accommodate 4 and 6 GHz from the separation networks into the station.

A new dehydrator provides dry air to both the external waveguides and antennas and to the indoor waveguides to stabilize the performance of the Transmit-Receive filters. This dehydrator combines a refrigerating element plus a desiccant (drying agent) chamber to remove the air moisture. It can provide 100 cubic feet per hour of −40°F dewpoint air at a pressure of approximately 7 inches of water which is adequate to supply a combined TD-3/TH-3 through repeater station. A relief valve is incorporated in this unit to avoid over-pressure on low loads.

When TH-3 is used to overbuild on a 4-GHz TD-2 system, the problem becomes more complicated. The dc power required in an existing TD-2 station is at voltages of −12, +130, +250, and −24. The basic voltage for TH-3 and its latest supporting equipments is −24. Since the −24 V requirements for a TD-2 station are small, TH-3 additions to a TD-2 station in most instances will require either additions to or a larger −24 V power plant. A further problem is that of building additions since the initial station planning may not have considered this extent of expansion.

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* Non-junction stations.

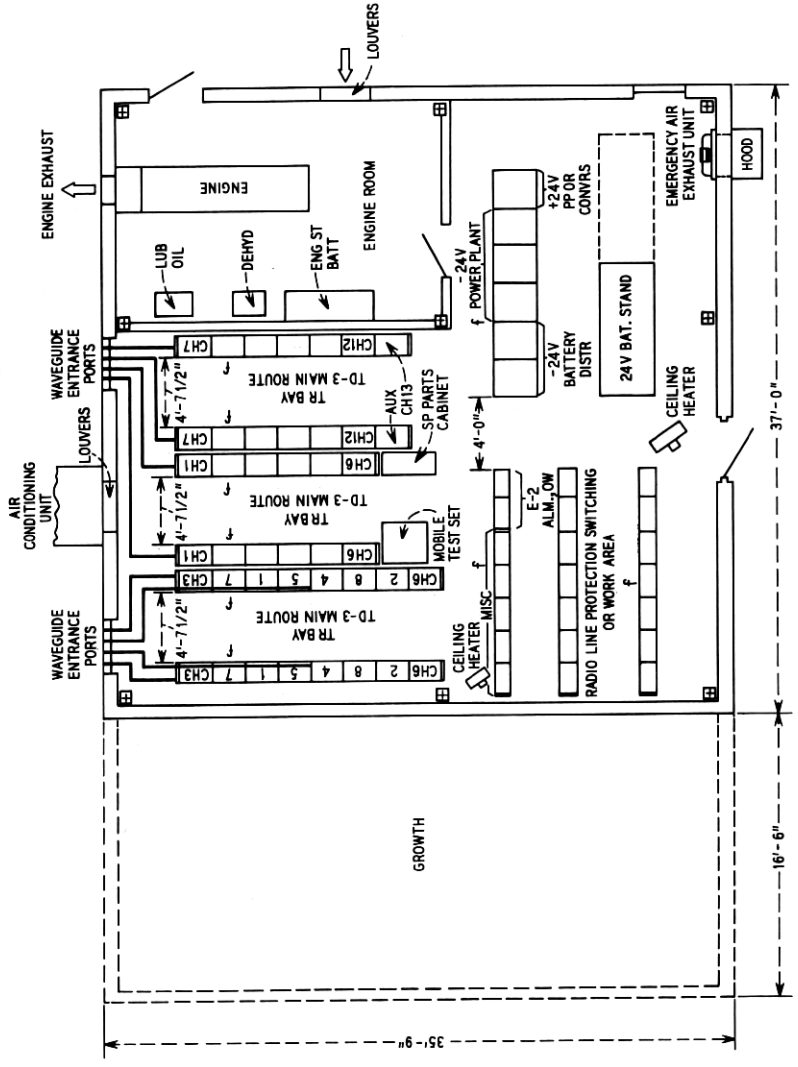

Fig. 1—Standard 1260 radio repeater building.

In the first installations of TD-3 certain power supply leads feeding into noisy loads such as dc-to-dc converters were put in metallic ducts to avoid the possibility of unwanted coupling into critical circuits. Through use of additional filtering in the input to such loads the noise has been reduced to acceptable levels and isolation of these power leads is no longer required in TD-3 and TH-3 installations.

III. TH-3 MEDIUM HAUL

In addition to its use for long-haul and major routes, a specific application of TH-3 is for medium-haul routes, where the protection system is 1 × 1 utilizing a single working radio channel protected by a second identical channel. Protection is from baseband at one terminal to baseband at the far terminal, encompassing the total radio facility from end to end. In this medium-haul system the stations will be either small buildings or factory-equipped transportable shelters. The shelter is an aluminum structure similar in appearance to a truck trailer body. It provides an economical alternative to small buildings, deriving savings through reduced first costs, standardized engineering, and factory installation and test. Two typical floor plans (Figs. 2 and 3) show the placement of equipment in a small building and in a shelter, respectively. Although the medium-haul system is presently protected by a one for one switching system, plans for growth include a one for three system. Table I lists the basic elements required in a TH-3 medium-haul radio station.

It is anticipated that applications of the TH-3 medium-haul system also will be in existing telephone company buildings. The repeater station at Dunbarton, New Hampshire, shown in Fig. 4, is an example where the TH-3 system has been installed in a small building which houses a TJ 11-GHz microwave radio system.[2]

Some relaxation in requirements is allowed in medium-haul systems. In the case of the environmental station temperature, limits of 40°F to 120°F are permissible whereas 55°F to 95°F is a requirement for TH-3 long haul. No requirements are placed on humidity in either case because of the dry air in the microwave networks and filters.

IV. ALARMS AND MAINTENANCE ORDER CIRCUITS

The office alarm system for TH-3 stations is basically the same as that provided for TD-3. The individual audible and visual alarm equipment is decentralized with individual alarm relay circuits and lamps located in the equipment where the alarms originate. The alarm

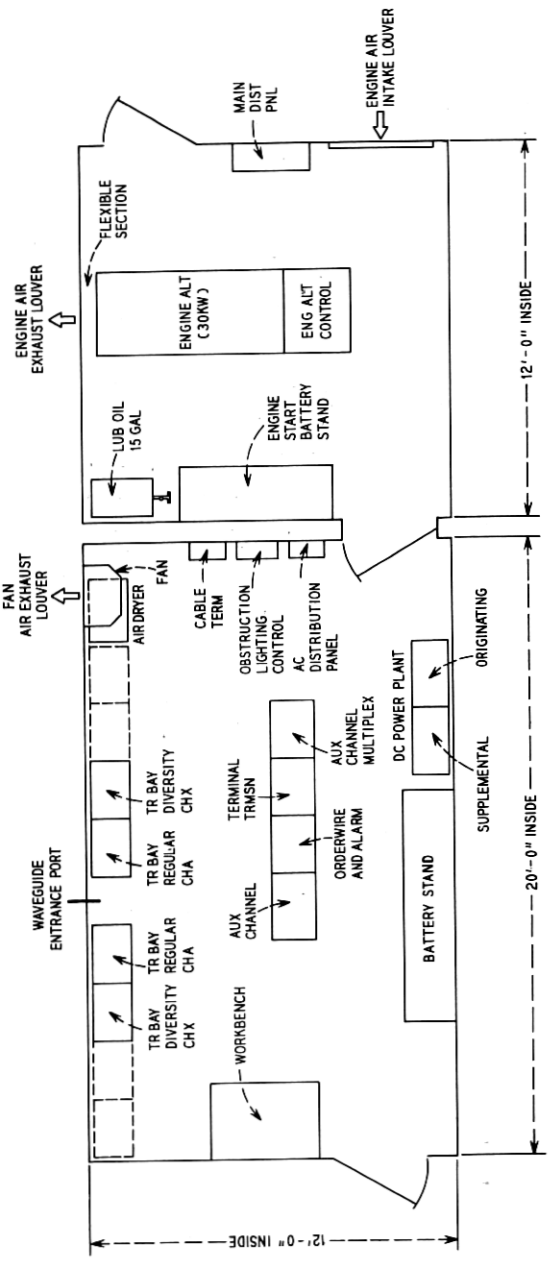

Fig. 2—Standard floor plan layout for a TH-3 repeater station in a small building.

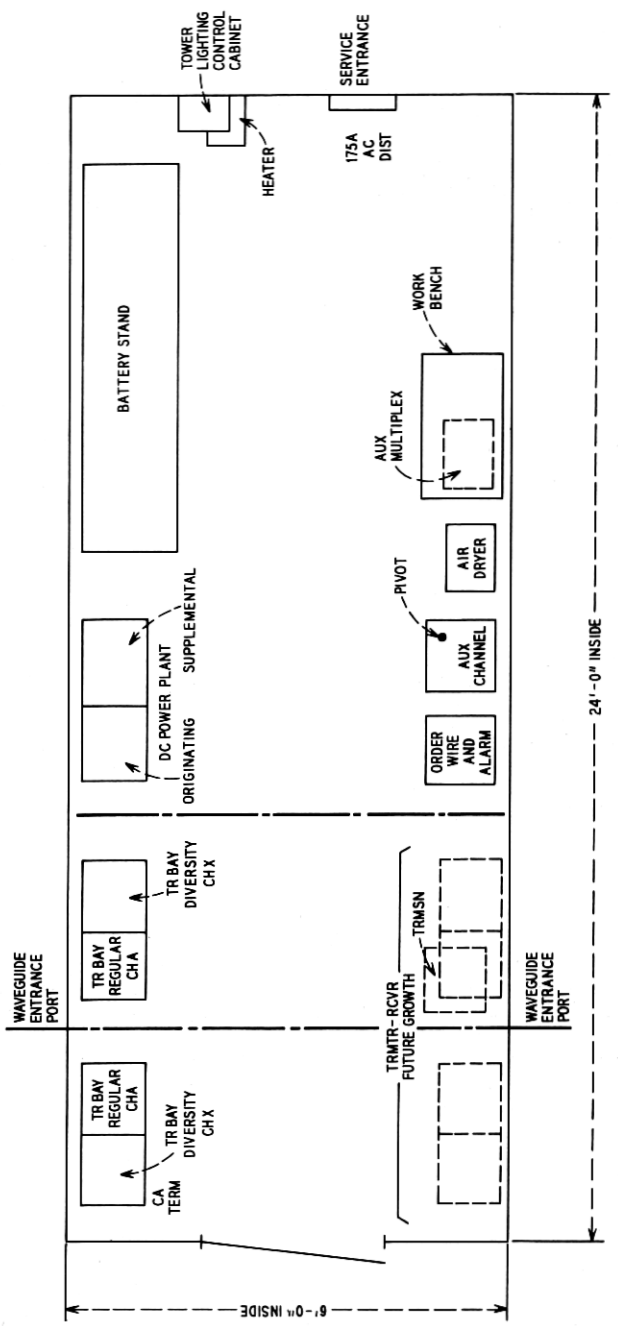

Fig. 3—Floor plan layout for a TH-3 repeater station in a standard shelter.

TABLE I—EQUIPMENT IN TH-3 MEDIUM-HAUL RADIO STATIONS (1 × 1 SYSTEM)

Equipment	Station	
	Terminal	Repeater
1. Transmitter-receivers	Two per station	Four per station
2. Frequency-diplexed auxiliary channel (optional)	One per station	One per station
3. 48-circuit backhaul multiplex applied to auxiliary channel	As required	As required
4. E-type status and control system	One central bay at an alarm center or one remote unit if the terminal is not an alarm center	One remote unit per station
5. General pupose order wire	One per station	One per station
6. 300A protection switch* (1 × 1)	One per station	None required
7. 4A FM terminals	Two transmitters and two receivers per station	Two receivers required in each auxiliary channel
8. 3A wire line entrance link	Two gain and equalization panels and a maximum of four auxiliary gain and equalization panels as required	
9. Test equipment and spare parts	One set of portable test equipment and spare parts to be stored at one terminal or as required	
10. Dehydrator for dry air supply to antenna system and to the transmitter-receiver bays	One per station	One per station
11. Tower obstruction light control panel	One per station if required	One per station if required
12. AC power distribution panel	One per station	One per station
13. Emergency engine alternator	One recommended per station	One recommended per station
14. −24-volt power plant	Two 100-ampere rectifiers (one redundant for reliability) per station	Two 100-ampere rectifiers (one redundant for reliability) per station
15. −24-volt battery	One string per station	One string per station
16. +24-volt power plant	3.5-ampere, −24 V to +24 V converters provided where required	3.5-ampere, −24 V to +24 V converters provided where required
17. Heating and air conditioning equipment	As required for personnel comfort or battery reserve capacity and life	As required for personnel comfort or battery reserve capacity and life
18. Antennas and associated waveguide	Single antenna required for transmitting and receiving	Single antenna in each direction required for transmitting and receiving

* Normally located at the multiplex end of the wire line entrance link. The 300A protection switch may or may not be located in the radio station.

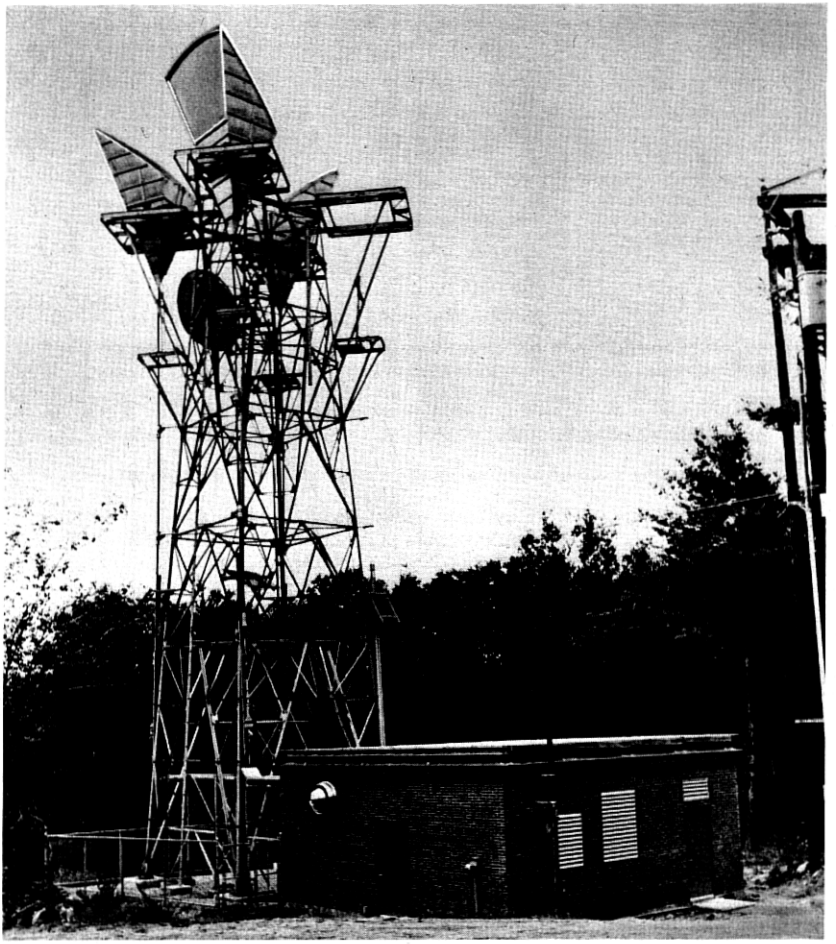

Fig. 4—Dunbarton, New Hampshire, combined TH-3 and TJ radio repeater station.

system directs maintenance personnel by means of main and cross-aisle lights to the failed equipment. Relays and indicating lamps for miscellaneous common office equipment including the waveguide pressure, dehydrator, open door, and tower navigation lighting are located together in a common unit.

The new E2 status reporting and control system is a digital alarm system used to transmit alarm and status information from unattended stations to the attended control station and to transmit orders from

the control station. The E2 system has a maximum capacity of 4096 alarms and indications and 4096 orders per unattended station. It also offers greater speed of operation, space reduction, and flexibility than previous alarm reporting and control systems.

The increased capacity and flexibility of the E2 system has made it economical to prepare a standard arrangement of the indications and alarms, reducing the effort required to engineer a particular office. In addition, the maintenance operator at the control station requires fewer records to interpret the signals he receives from the unattended stations because his display is identical for a particular piece of equipment for all offices.

The E2 system, in conjunction with certain additional equipment, also has the capability to gather analog readings from unattended stations and the potential to provide automatic surveillance under control of a computer at the control stations. With these two features, the frequency of routine visits to the unattended offices could be reduced resulting in reduced maintenance expenditures for these offices.

The new general purpose order wire is used for voice communications between the TH-3 offices. Both local and express order wires may be furnished. The equipment is solid state and provides direct station-to-station *Touch-Tone*® dialing and selective signaling. In a repeater station all of the equipment, including the handset, dial, and electronics, is housed in a 6-inch-high unit in a 23-inch bay.

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