EMERGENCY TELEPHONE SERVICE – CIVIC EXCHANGE, CANBERRA

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INTRODUCTION

At approximately 1 a.m. on Friday 22nd September, 1961, a fire which originated in the air treatment wing of the pre-fabricated aluminium telephone exchange building at Civic, resulted in the complete destruction of a 2,000 type exchange, with 5,482 working lines and a capital value exceeding £500,000. It served the main Canberra commercial centre at Civic as well as the hospital, police and fire brigade, in effect over one-third of the Canberra network. The cause of the fire was not apparent, but it was determined later that it had been started deliberately by vandals. Figs. 1 and 2 illustrate the damage.

The organisation which was set up to meet the emergency and the manner in which works were carried out, resulted in the restoration of telephone services to virtually every subscriber within 14 days, an effort unequalled in the Department previously. It is the intention of this article to present a broad picture, drawn from a considerable number of personal reports, of how the emergency was met, and to discuss the organisation which made the relief possible as a stimulus to thinking should such an emergency arise again.

* See page 348.

FACILITIES EXISTING BEFORE FIRE

The Civic exchange and line depot shared a common site, as shown in Fig. 3, with a fence separating the two sections. The line depot building is approximately 40 x 80 ft. of clear span construction and was internally partitioned to provide office and storage spaces. The aluminium exchange building was centrally located on its portion of the site and a concrete coaxial cable repeater hut was located on the southern side.

A 2,000 type equipment installation of 6,000 lines, for which an extension to 6,800 lines was almost complete, existed in the exchange room together with an M.D.F. on which 12,000 subscribers and 1,200 junction cable pairs were terminated. Paper insulated to silk insulated cable pot-head joints were accommodated in a room parallel to the M.D.F. and separated by a timber and glass partition. Silk insulated cable tails fed the M.D.F. via metal cable chases provided on the basis of one chase per vertical.

Civic was trunked as a main exchange in a city network of three main exchanges, the others being Barton (1,800 lines) and Manuka (3,500 lines). There was also one repeater branch at Yarralumla, parented on Barton, and a semi-automatic trunk exchange at Central.

There was no separate equipment uncrating area in the Civic building and a quantity of material for the new extension had been stored in the air-conditioning plant room. The fire was started with this material. The air treatment installation included an automatically controlled oil fired boiler which was located in the room and contributed to the destruction.

DESTRUCTION BY FIRE

The fire started a fire bell, outside the Exchange building, which was heard ringing at approximately 12.48 a.m. A passing taxi driver also noticed the fire

Fig. 1.—Looking down on Damaged Building, showing Destruction of Air Treatment and Equipment Areas.

burning in the air treatment room and raised an alarm via his radio to the Police. The Fire Brigade arrived a few minutes after 1 a.m. A local technician who was passing the building about that time went to the rear of the building, where the air treatment room was an inferno, and saw the windows of the room collapse. He then entered the power room when the fire, which had broken through the wall between the equipment and air-conditioning rooms, was advancing rapidly through the ceiling and cabling over the equipment area as shown in Fig. 3. The technician turned power switches off and arranged for a fireman to chop through the main exchange 50V power supply ammeter shunts which were glowing red hot at the rear of the power board. The fire was extinguished by 2 a.m.

Examination immediately after the fire was extinguished revealed that the switching installation was completely destroyed. Considerable portions of most racks were seriously damaged by fire and almost all equipment was saturated by water and covered with a sticky deposit. The upper part of the M.D.F. was badly damaged and lead-covered silk-insulated subscriber and junction cable tails were burnt through. The roof over almost the entire length of the 100 x 40 ft. equipment/M.D.F. room had disappeared. It was apparent that, as the walls were seriously damaged and structurally unsound, rehabilitation of the building would virtually require a completely new equipment room. The power and battery room installation was almost undamaged and the test desk, together with the power and test desk rooms, had suffered minor damage only. The M.D.F. and cable record cards were recovered intact, which was of considerable significance in the light of subsequent events.

RELIEF MEASURES

General Measures

The Divisional Engineer, Canberra, was advised of the fire within half an hour of the alarm and immediately alerted the local engineering organisation and advised the Assistant Director, Engineering, in Sydney, who, in turn, alerted the senior engineers of the State Engineering organisation. By 7 a.m. on the morning of the fire, these officers, together with supporting staff, had met in conference and the subsequent discussion, based on information passed from Canberra and on detail available in the State Headquarters, enabled four basic decisions to be taken:

(i) To provide all possible relief by connection of urgent services to Barton and Manuka over junction cable and to provide interception on the Civic "J" level at other network exchanges.
(ii) To abandon the damaged Civic exchange and M.D.F.
(iii) To divert to Canberra all possible portable exchange equipment for emergency telephone service provision.
(iv) To construct a new semi-permanent exchange, including M.D.F., in the line depot building at the rear of the Civic exchange building.

These decisions were discussed with the Engineer-in-Chief and other Headquarters Senior Engineers, and the agreement of Headquarters with the proposed course was obtained.

Connections to Manuka and Barton

Implementation of the first relief phase had begun in Canberra within hours, and emergency lines to the Hospital, Police and Fire Station were being arranged via the junction cable to Barton and Manuka. By 10 a.m. 37 of these lines had been connected. In view of the fact that the M.D.F. was substantially intact and particularly that the cable pot-heads were undamaged, a basic decision had to be made whether any cross connections for these emergency services should be attempted at this point. A significant factor was that the lead-covered cables from the pot-head joints to the frame were destroyed at the top of the M.D.F. Thus re-tailing would have been necessary to use the M.D.F. terminations as connecting points, although a limited amount of jumpering for the initial urgent services could have been carried out on the fanned silk tails. On the other hand, junctions and subscribers' cable pairs could be picked up in street manholes and cross connected, thus leaving the street cables immediately in front of the exchange site free for re-arrangement in conjunction with the proposed new M.D.F. The arrangement of cables is shown in Figs. 4 and 5, and the decision very early on Friday to leave the exchange entry cables free of active lines by carrying out cross connecting in street manholes, was shown subsequently to have advantages over-riding the disadvantages. The latter arose mainly from the damage which occurred to street cable joints as pairs were sought for cross connection. Problems did occur through this course of action as not all subscribers' cables paralleled the junction cable to Manuka and Barton and in one particular case, jumper wires

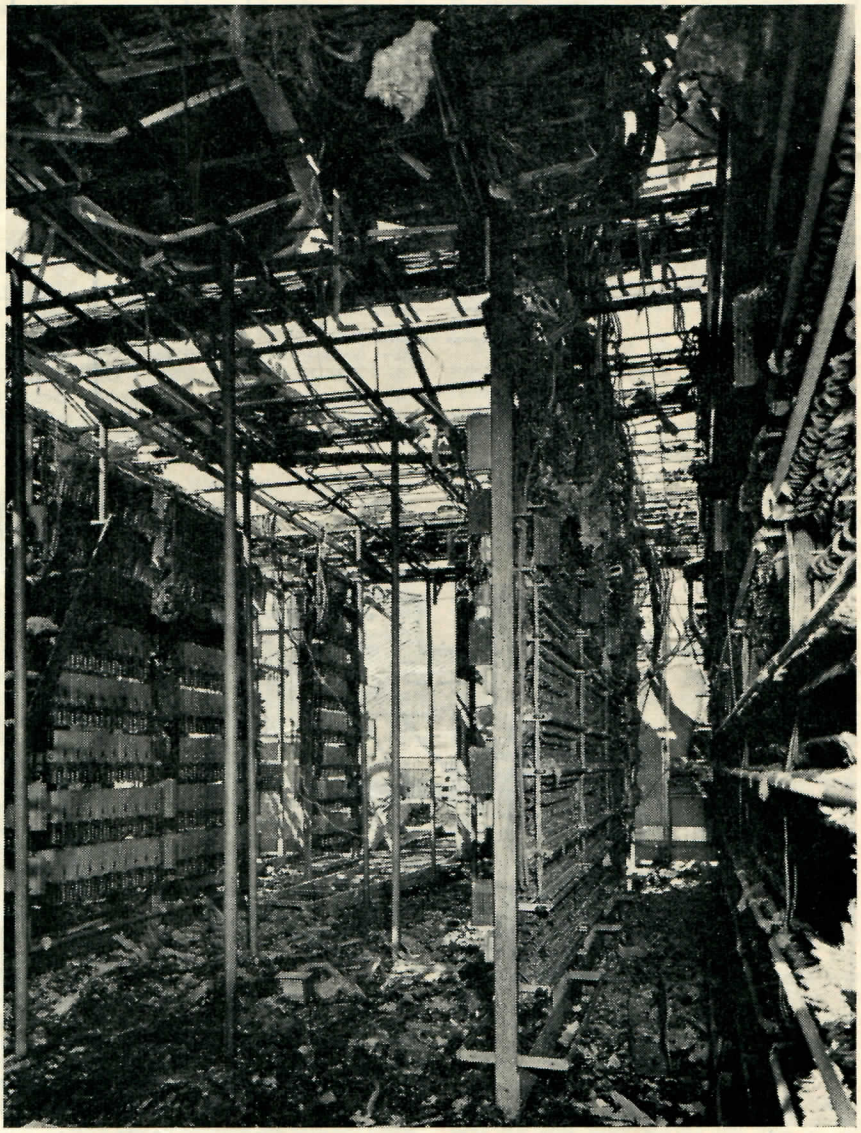


Fig. 2.—Scene inside Civic on the Morning after the Fire, looking towards Air Treatment Room.

were run from one manhole through trees to another manhole to restore two urgent services of high priority. Nevertheless for the first few days, the only way in which emergency services were provided from Manuka and Barton over junction cables was by cross connections in manholes. 352 services were provided in this way.

Interception

Concurrently with the connection of urgent services to spare exchange numbers in Manuka and Barton, interception facilities were being established for calls directed to the destroyed exchange. An early decision was to refrain from advertising a special code to call instead of a "J" number, and to rely on interception on the "J" level at main exchanges to provide the necessary information to telephone callers. This concentrated interception on one code only and avoided the need for interception on a new code as well as on "J".

Interception facilities were arranged on the "J" level at network exchanges on the Friday morning, by routing all early choices from selector junction gradings to interception positions consisting of 2 + 4 or 3 + 9 cordless switchboards established at the Barton and Manuka Local and the Semi-automatic Trunk Exchanges. These positions were staffed by Technicians and provided for the bulk of the interception traffic until it became known generally to local subscribers that "J" numbers could not be reached. A 12-track recorded announcement machine was installed at Barton, and served the three points of interception, Barton, Manuka and the Semi-automatic Trunk Exchange. This removed the necessity for staffing the temporary manual positions at each exchange and directed callers to "dial information" for further details of urgent services, etc. The machine provided all interception until 11 p.m. on Sunday, 24th, when a new installation of four lamp-signalling P.B.X. switchboards at the Trunk Exchange became available. At this time, "J" junctions after the third choice outlet from each exchange, were connected to the new switchboards and calls were cord switched to handset telephones. The first three choices were left on machine interception until 8 a.m., Monday, when the four manual positions were staffed and the machine removed from service. Subsequently machine in-

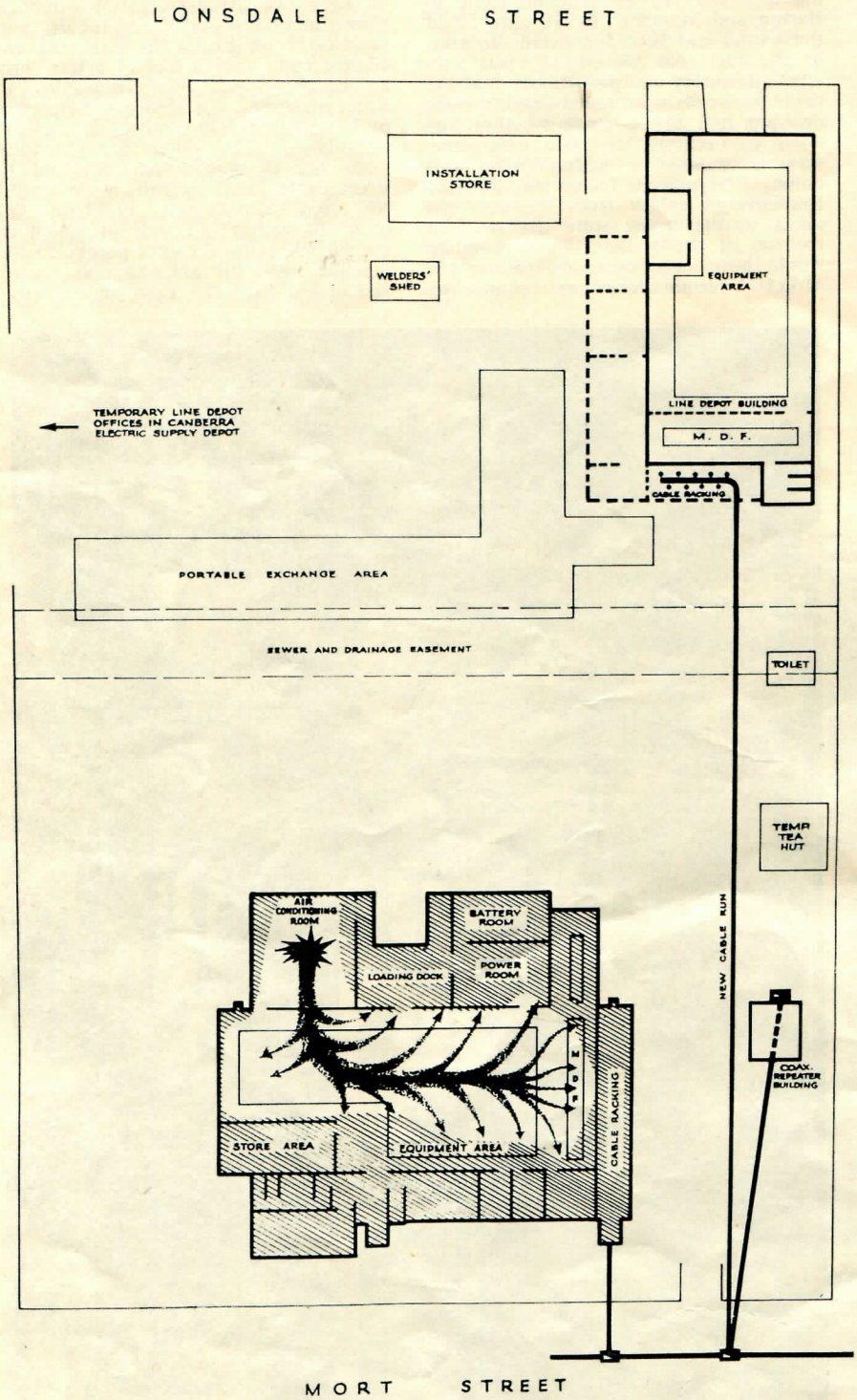


Fig. 3.—General Layout of Exchange and Line Depot at Civic. Temporary Buildings shown in Light Outline.

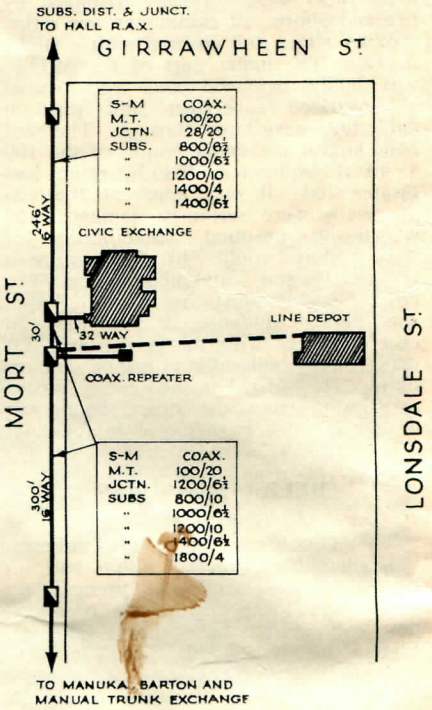


Fig. 4.—Ducts and Cables at Civic.

terception only on the first three choices from each exchange was used between 11 p.m. and 8 a.m. and manual interception during the day.

As emergency numbers were connected, suitable lists were prepared by the District Telephone Officer and published daily through the co-operation of the local press. In addition an interim Canberra directory of the emergency numbers was issued, during the week ending 21/10/61, to all Canberra subscribers and all trunk centres, and this greatly reduced interception traffic. A few days later machine interception and redirection only was found to be adequate on the "J" level.

Abandonment of Damaged Installation

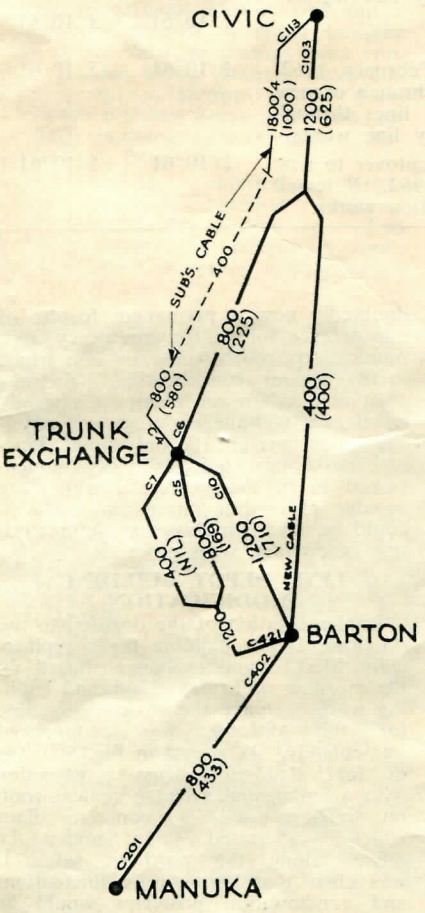
The decision to abandon the damaged building came before noon on the day of the fire, after a detailed examination of rehabilitation work necessary had been made by the Works Director, Canberra, and discussed with the Superintendent, Buildings Branch. It was the considered opinion of that group that erection of a roof over the area would take two weeks, and that the completion of walls would take additional time. Renovation of such a seriously damaged building is obviously fraught with difficulty and it appeared likely that unforeseen delays could upset this optimistic estimate. A usable temporary building structure could not be made available for three weeks, and there would be obvious difficulties in attempting any major exchange re-establishment whilst building work was in progress.

The decision to abandon the installation was therefore influenced by two major factors:

(i) Appreciation of the delays which could occur to prolong completion of the emergency buildings rehabilitation beyond two weeks.

(ii) An acceptable building in the form of the Line Depot was available and reconstruction of the Civic exchange could commence immediately.

In the light of the subsequent achievements made possible by establishing a replacement exchange and M.D.F. in a new building, the decision was proved to be a good one.



NOTE: (400) INDICATES SPARES AS AT 22.9.61

Fig. 5.—Junction Cables in Canberra at 22/9/1961.

PORTABLE EXCHANGES

From a quick assessment, it was apparent that at least 2,400 lines of portable exchange equipment (Ref. 1) could be diverted to Canberra and could be absorbed into augmented trunking of the co-main exchanges of Manuka and Barton as repeater branch units. New exchange numbers could be provided by this means as emergency lines to priority subscribers until a replacement "J" exchange was built.

The initial survey of portable exchanges on 22/9/61 showed that the units in Table I, Part A, could be made available immediately or within a short period, and transport arrangements were set in motion. The first units from Unanderra and Ingleburn were loaded and en route to Canberra by mid-day. Intensive installation effort released the Wallsend unit by 6 a.m. on Sunday, 25th, and the first Rydalmere unit by Tuesday, 26th.

A preliminary trunking scheme was prepared on the Friday for the 2,400 lines but by Monday, 25th, as a result of Headquarters asking the Victorian and South Australian administrations to investigate the availability of portable exchanges, a further 1,700 lines of equipment was in sight. On the same day the New South Wales Engineering Division decided to release a 600-line unit from Morriset East and a modified trunking diagram was completed on Tuesday, 26th, for 4,700 lines total. By Wednesday, 27th, however the Sydney Metropolitan Installation section had devised a method of releasing a second unit of 600 lines from Rydalmere and the trunking scheme was amended to include the total of 5,300 lines.

At this point it was clear that emergency service could be provided to every Civic subscriber, either from 5,300 emergency numbers in portables at Civic or via junction cable to spare numbers in Barton and Manuka. It was expected that provision of these emergency lines would be completed within three weeks. The complete relief within such a short time was a matter of great satisfaction to all concerned and a very real example of co-operative effort in meeting a major emergency. The additional portable units to take relief from 2,400 to 5,300 lines are listed in Part B of Table 1.

It was the intention to cutover the Morriset East exchange by stages, leading to the eventual amalgamation into a single exchange area of two existing manual exchanges and an R.A.X. The first stage cutover was to take place approximately one month after the fire. All external cables had been terminated with the final testing of equipment about to take place. Disconnection of these cables was completed by 9 a.m. on Tuesday, 26th, and the exchange was loaded and on its way to Canberra by mid-day.

Subscribers' lines on the 500-line portable exchange at Elizabeth, South Australia, had been cutover to the permanent exchange one month earlier, but cables were still connected to the M.D.F. As soon as it was confirmed that the units available in South Australia should be sent to Canberra, work was commenced to release the exchange. It was loaded and despatched from Adelaide on Wednesday, 27th, together with the second unit which had been free at Osborne.

In the case of Drouin, Victoria, the exchange was being prepared for cutover as a 900-line repeater branch of Warragul following the replacement of a magneto exchange at Warragul in February, 1962 by an 1,800-line automatic exchange. The Victorian administration agreed to the release despite the considerable inconvenience involved, and after a concentrated effort the unit was cleared of cables and loaded on Friday, 29th.

The release of the second 600-line unit from Rydalmere involved extensive re-arrangements to transfer the subscribers working on the portable exchange equipment to the same numbers made available on the incomplete permanent exchange installation. The effort involved was justified as utilisation of the portable exchange for emergency numbers at Civic just allowed all services to be restored. The unit was loaded and on the way to Civic by Sunday, 1/10/61.

ADDITIONAL JUNCTION PROVISION

It was fortuitous that the existing junction cable was adequate for the connection of the 352 subscribers to Manuka and Barton and the establishment of 3,800 lines of portable equipment, since cable extensions had been completed only a short time before the fire. However it was clear that to provide adequate junctions for the full 5,300 lines of portable exchange equipment, additional junction provision would be necessary. As shown in Fig. 5, spare subscriber cable capacity existed from Barton via the Trunk Exchange M.D.F. towards Civic and vice versa, and a decision was taken on Tuesday 26th to bridge the gap with S.T.A. (steel tape armoured) and P.I.Q.L. (lead-covered paper insulated) cable which was in stock.

Two cables, each of 200 pairs, were laid for one mile across the bed of the proposed Canberra Lake, and an additional one-third of a mile of cable was

TABLE I — PORTABLE EXCHANGE UNITS DIVERTED TO CIVIC

PART A — FIRST EVALUATION 22/9/61 — 2,400 LINES

No.	LOCATION	LINES	TRUNKING	STATUS	SITED	ESTAB-LISHED
1	Ingleburn	600	2,000 Type—Sels. + F.S./U.S.	Unencumbered	23/9/61	25/9/61
2	Unanderra	300	Pre 2,000 Type — F.S./U.S.	Unencumbered	23/9/61	25/9/61
3	Wallsend (including Annexe)	500 + 300	Pre 2,000 Type — Sels. + F.S./U.S.	Being prepared for cutover to new building on 7/10/61 without number change. In final testing stage. Released by intensive lines effort.	27/9/61 28/9/61	29/9/61
4	Rydalmere I	700	2,000 Type + 100 lines pre 2,000 — Sels. + F.S./U.S.	Being prepared for cutover to new building without number change in few weeks. Released by intensive installation effort.	28/9/61	29/9/61

SUB-TOTAL — 2,400 LINES

PART B — ADDITIONAL UNITS 25/9/61

5	Morriset East	600	2,000 Type — Sels. + F.S./U.S.	Being installed as a new exchange amalgamating several small exchanges and an R.A.X. Released by lines re-arrangements.	28/9/61	30/9/61
6	Elizabeth, S.A.	500	2,000 Type — Sels. + pre 2,000 F.S./U.S.	Lines recently cutover to permanent exchange but cables still on M.D.F. Released by line works.	1/10/61	3/10/61
7	Adelaide, S.A.	300	Pre 2,000 Type — F.S./U.S.	Unencumbered.	1/10/61	3/10/61
8	Drouin, Vic.	900	2,000 Type — Sels. + F.S./U.S.	Being prepared for February, 1962, cutover as repeater branch of new Warragul. Working lines through M.D.F. Released by line works.	3/10/61	5/10/61
9	Rydalmere II	600	Pre 2,000 Type — Sels. + F.S./U.S.	Being prepared for cutover to new building January, 1962. Released by line and installation works.	2/10/61	5/10/61

COMBINED TOTAL — 5,300 LINES

laid in existing ducts. The S.T.A. route followed the line of a proposed coaxial cable (which it had been intended to lay in the current financial year) necessary for local Canberra TV programmes, and a suitable length of a 6-tube cable was rushed from Melbourne for laying in the trench opened across the lake bed.

This work was completed on 7/10/61 and provided the necessary increase in junction cable plant to permit the establishment of all portable exchanges as repeater branches of Manuka and Barton. This would allow subscribers connected to those exchanges to remain on their temporary numbers and allow some 250 external extensions and private lines to remain in the junction cables.

TRANSPORT OF PORTABLE UNITS

Possible difficulties involved in transporting the portable exchanges were avoided by the outstanding co-operation of the New South Wales Police Department in providing escorts for the vehicles on the road. At one stage there were five portable exchanges converging on Civic simultaneously.

The two units from South Australia were transported on a single low loading semi-trailer, the unit being 66 ft. overall and the load width 13 ft. 4 in. The preferred route for the 900 mile trip was through Victoria via Murray Bridge but the load height exceeded the capacity of the river bridge at that point and the alternative route via the Murray Valley to Mildura was taken. A problem existed at Blanche Town vehicular ferry which has a 58 ft. deck, and at low river levels involves a fairly steep descent from the roadway. With the co-operation of the South Australian Highways Department, the unit was loaded with the end gates on the ferry open, and moved safely across the Murray River. The semi-trailer averaged 200 miles per day on the long haul to Canberra. A mixture of Commonwealth and private contractors transport facilities was used in moving the portable exchanges, and no difficulties were experienced, all units arriving at Canberra without damage.

One interesting facet was the examination by the Newcastle Engineering Division, in conjunction with the R.A.A.F. at Williamtown, of the possibility of transporting a portable exchange by Hercules aircraft. However, while the weight lifting capacity of the transport was adequate, the rear loading opening was only 10 x 10 ft. and would not take the building which was 12 x 13 ft. The principle of using the large capacity aerial transport facilities, which are undoubtedly now a permanent feature of our defence forces, for emergency communications relief works, is one which merits serious consideration. The aircraft in question can transport a weight equal to a 600-line exchange and physical dimensions are the only limit. Portable exchange units suitably dimensioned to fit these aircraft, which are capable of landing on natural surfaces, could be a valuable asset as automatisation of country areas proceeds.

LINE DEPOT BUILDING MODIFICATION

Implementation of the decision to use the Line Depot building for a replacement M.D.F. and exchange started on the morning of Friday, 22nd, and building work to make the structure suitable for this purpose was commenced immediately. As shown in Fig. 6 it was of fabricated steel truss construction with a corrugated asbestos cement roof, no ceiling, and a concrete floor which was raised 4 in. under the offices along the northern side. It was clear that temperature fluctuations and condensation problems would be severe unless thermal insulation was installed beneath the roof. This work was carried out immediately as the restricted ceiling height would have made it difficult after equipment was installed. A

hardboard covering was provided as a ceiling.

The speed with which the building alterations were made was no less remarkable than all other aspects of the emergency project. The floor layout of the new exchange was determined generally by 11 a.m. on the Friday of the fire, and the removal of line depot stores and demolition of unwanted office and amenity partitioning, chain wire safe areas and pipe stands commenced without delay. Plumbers and electricians cleared unwanted water, drainage and electrical services. By 4 p.m. the area required for initial M.D.F. and equipment installation was clear. Two of the existing offices were retained for use by the installation team.

While the clearance of partitioning was proceeding, supplies of insulating and ceiling material were being secured and erection of this commenced at 4.30 p.m. Because of the urgency of establishing the M.D.F. and the low roof clearance which would have made subsequent building work most difficult, the ceiling was completed over the M.D.F. area first. The remaining ceiling area was then completed progressively, avoiding conflict with the installation of racks which, by this time, was taking place concurrently. At the same time the Works Department also carried out a considerable amount of minor building work in the form of cutting away concrete kerbing, filling drainage holes and levelling uneven sections of the floor. All minor building works inside the new exchange building were completed during Sunday, 24th.

In addition to the internal re-arrangements necessary, external additions shown dotted in Fig. 3 were required to make an effective exchange. A room was built about the cable racking, which was erected during Saturday, the 23rd, at the rear of the line depot building, and an extension along the side of the building 13 ft. wide provided a 27 x 13 ft. Test Desk Room, 15 ft. 6 in. x 13 ft. Lunch Room, Locker Room and Supervising Technician's Office. A temporary shelter of galvanised iron had been erected over the cable joints on the Saturday, and construction of the permanent extension along the side of the main building commenced on Tuesday, 25th. This was of timber frame, asbestos cement roofed construction on a concrete floor. The target of having a complete, acoustically treated Test Desk Room available by 2/10/61 was bettered by a day. The completion of the extension to include the Lunch and Locker Room and, finally, replacement of the temporary roof over the cable joints followed.

NEW M.D.F. AND CABLE ENTRY

The erection of the M.D.F. was commenced at 9 p.m. on Friday, 22nd, using cut-down 200/300 verticals and ironwork which had arrived from Sydney a matter of hours before. Forty-five verticals were erected by 6 a.m. the following day and this established a reference for the location of the new cable terminating frame to carry the paper to silk insulated cable joints. The urgent need to have silk insulated cable tails for the M.D.F. available as soon as the cable jointing could commence, resulted in a decision to make these locally, and 13,200 pairs of cable tails were made in the open from 100 and 200 pair lead covered plastic insulated cable. This work continued round the clock under specially erected flood lighting.

The cable trench from the coaxial cable Mort Street break-off manhole, to the location of the new pot-head joints at the rear of the line depot building, was dug during Friday and was completed by 2 a.m. Saturday, 23rd. Ironworkers had been despatched from Sydney early Friday, 22nd to construct the new cable racking, which was completed during the night of Saturday, 23rd and 13,200 pairs of street and junction cables were brought up ready for terminating by 6 a.m. Sunday, 24th.

From this time there was a clear programme of line works ahead; the 13,200 pairs had to be connected via pot-head joints and silk tails to the new M.D.F. and the new lead-in cable had to be jointed to the existing cable available in the Mort Street manhole (Fig. 3). The first tails were dropped on to the M.D.F. at 8 p.m. on Saturday, 23rd, and forming, lacing, fanning out, identification and terminating of the 13,200 pairs were completed in 7 days. At one stage five cables were being jointed simultaneously at the rate of 200 pairs/cable/12 hr. shift, and three of the cables were being identified and terminated on 8 adjacent M.D.F. verticals. With the simultaneous dropping, terminating and jumpering of cables to the first portable exchanges, the M.D.F. became a scene of almost indescribable activity.

ESTABLISHMENT OF PORTABLE EXCHANGES

The portable exchanges (1) and (2) (Table I) together with an empty long line equipment portable building, which had been despatched from Sydney early on the 22nd for possible use as a cable terminating cabinet, were at the Civic site at daybreak on Saturday morning but, because of the siting requirements, it was necessary to secure the services of suitable cranes before these buildings could be placed in position. These three units were sited by 5.30 p.m., the empty long line equipment unit being located beside the line depot building to accommodate a temporary 50V power supply for the portable exchanges. A panoramic photograph of the site is shown in Fig. 7.

Experience with the first three buildings made it clear that because of the restricted space and careful siting necessary to accommodate all portables, a single crane capable of lifting a complete unit would be most useful. A 25 ton capacity crane which was engaged in bridge construction work in Canberra was made available, and this greatly simplified the siting of later arrivals. It was possible for one man to rotate a portable unit supported by the crane through 360°, and siting time was reduced to an average of 20 minutes.

Lack of time and the temporary nature of the portable exchange installation made the provision of normal portable exchange foundations and piers impracticable and unnecessary, and all buildings were located on piers built up with 16 x 8 x 8 in. concrete blocks which were purchased locally. Subsequent levelling and height adjustment was made by jacking and fish plate insertion while installation work was in progress.

The buildings were located so that they used a common cable trench for cabling to the new M.D.F. with 50 pair

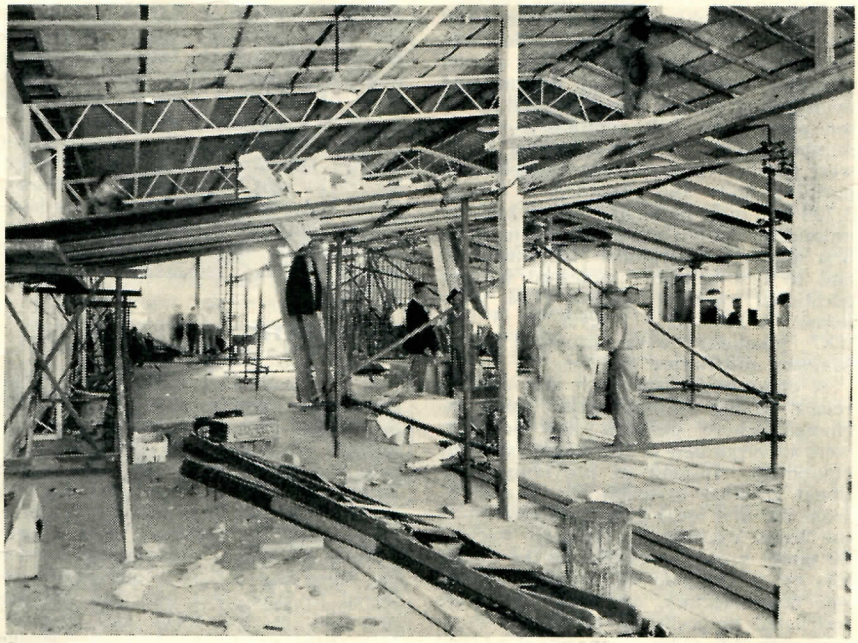


Fig. 6.—Scene inside the Line Depot Building on the Day of the Fire. New M.D.F. is being Erected and Roof Insulation is in Progress.

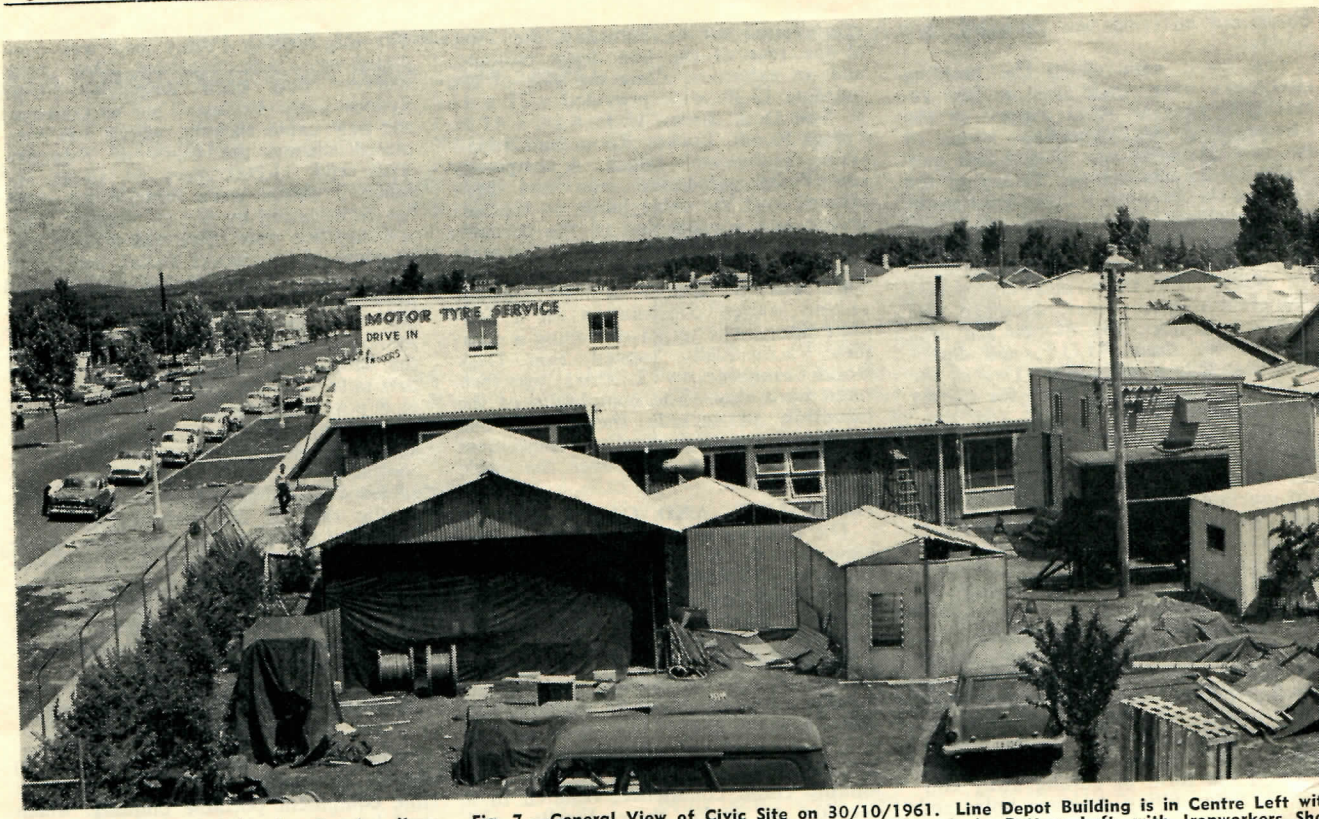


Fig. 7.—General View of Civic Site on 30/10/1961. Line Depot Building is in Centre Left wit Extensions Complete, Temporary Installation Store is in Bottom Left, with Ironworkers Sho adjacent. Portable Exchanges are in Centre Foreground.

P.V.C. sheathed and insulated subscriber distribution cable run in 4 in. asbestos cement ducts buried approximately 18 inches. Two ducts per portable exchange were necessary and heavy plastic conduit was used in the final run from the rigid asbestos ducts into the portable buildings.

All portable exchanges had M.D.F. arrestors cabled to final selector-uniselector numbers and in most cases these arrestors were jumpered permanently to an equal number of fuses. In normal use, subscriber cables terminated on pin strips to conserve space in the portable exchanges, and protected numbers were jumpered as required to cable pairs. At Civic the protected numbers were connected via the tie cables to allotted pin strips on the M.D.F., appearing as normal exchange numbers, and these were then jumpered as required to cable pairs. Because of this arrangement it was possible in the later stages of the project to terminate the M.D.F. end of tie cables to portables and to jumper allotted emergency numbers to the appropriate cable pairs before the portable exchanges with the numbers were on site, considerably expediting relief.

For dispersion of effort on the M.D.F. and to conserve equipment side space, the portable exchange tie cables were split into two feeds with approximately half terminating on the equipment side link strips and half on line side link strips. A.C. power was reticulated in G.I. pipe from a central distribution associated with the power supply portable, and 50 V.D.C. was fed to portable exchanges without power equipment from the power portable via the tie cable ducts.

ADDITIONAL TRUNKING AT BARTON AND MANUKA

In the final scheme, three of the four available first selector levels in Canberra were used for emergency numbers of four or five digits as shown in Fig. 8. The levels '2' and '3' were used in conjunction with penultimate switches in portable exchanges, to provide 1,100 emergency 4 digit numbers, while three racks (240 switches) of '5' level second selectors were installed at Barton, and by trunking outlets direct to final selector units gave 500 additional 4 digit numbers. Five '5' selector outlet levels were trunked to penultimate switching in portable units and provided a further 3,700 five digit numbers. The subscriber uniselector outlets were trunked to spare first selectors at Manuka (173 junctions) and to first selectors increased by one additional rack at Barton (184 junctions). A total of 411 level '2', '3' and '5X' junctions were provided from Manuka and Barton to Civic.

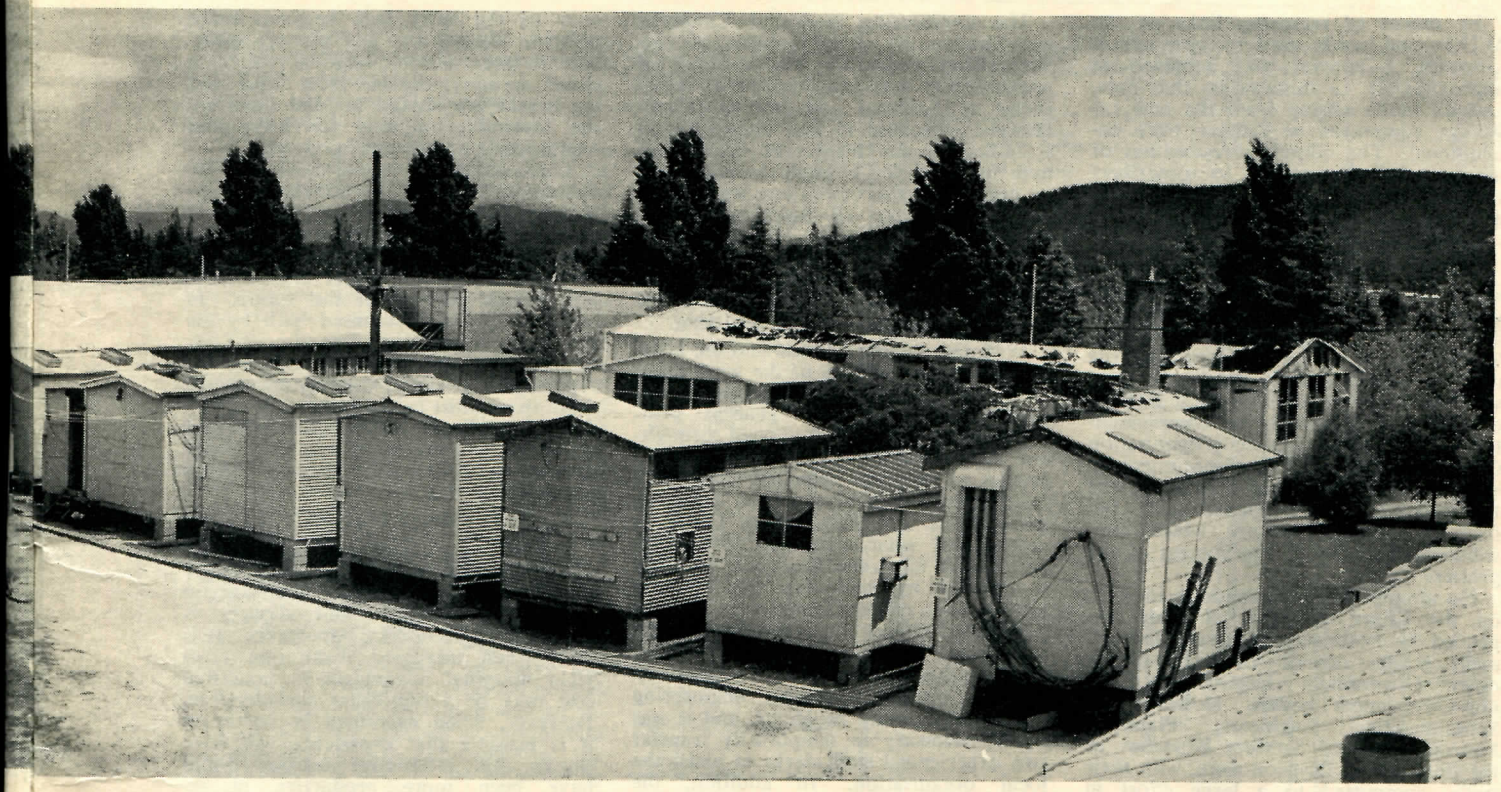
A compromise approach was used in regard to the semi-automatic trunk exchange where network first selectors were incorporated in the trunk exchange equipment. Instead of providing additional gradings to levels '2', '3' and '5', from the first local motor uniselectors at the trunk exchange, a recently vacated 20 outlet group accessible by the operators on a '13' code was trunked to Barton first selectors, and operators were instructed to prefix all emergency numbers with '13'. This arrangement worked well, and avoided additional work in the trunk exchange.

The connection of over 300 urge subscriber services to spare numbers Manuka and Barton resulted in a traf unbalance on some uniselector gradin and necessitated regrading work to ov come traffic blocks. However, the ad quacy of junction cables and the re tive ease with which it was possible increase trunking at Barton and to u lise spare lines at both Manuka a Barton, was a basic factor in enabli implementation within such a sh time of a relief scheme giving f emergency service to all subscribers.

The installation of the additional fi selector and three level '5' second sel tor racks was commenced on Frid 22nd, and was completed ten days la The gradings had to be modified p gressively as the number of porta exchanges was increased during t period.

ALLOCATION OF EMERGENCY NUMBERS

It was estimated initially that 2, emergency numbers would be provi in portable exchanges, and a list of s scribers who would be given such vice had to be prepared. The Dist Telephone Officer commenced this t early on the Friday morning by re ence to the Subscribers' Service Ca held in his office. An emergency n ber satisfying certain requirements, ferred to later, was allocated and prepared in the form Old Num New Emergency Number. Enginee officers provided subscribers' cable l tions for these urgent services from



M.D.F. cards and cable records, by working from the old Civic number.

The clerical task at this stage was of considerable magnitude and was complicated by the fact that several hundred priority subscribers had been allocated spare numbers in Barton and Manuka but a large number of these connections had not been implemented because of the delay in locating the subscribers in cable joints and cross connecting to junction pairs, or for technical reasons such as excessive loop resistance. This information had to be fed back so that alternative service could be given from Civic.

In addition, as all subscribers' cables, Fig. 4, had to be established on the new M.D.F., it was obviously desirable to determine a priority order in which termination could be effected to provide the greatest yield in emergency services provided. This required an analysis of yield per cable and even an analysis of yield distribution within a cable. One 1,800 pair cable, for example, served the greater part of the business area of Civic, but most urgent services were in the last 500 pairs.

By mid-day, Wednesday, 27th, it had been established that a full 5,300 emergency numbers would be provided and this made largely redundant the priority allocation based on limited 2,400 number relief. Schedules were then prepared for all subscribers to be given emergency numbers and this was completed by Friday, 29th, one week after the fire. From this point the yield of each cable was determined by total services included in the cable and not the relative priorities.

In the initial allotment of emergency numbers under the 2,400 line relief scheme, some order was introduced to facilitate possible later re-allocation of equipment (perhaps with new numbers) to subscribers still without service, as permanent exchange equipment became available. In addition the scheme allowed the possible recovery of complete portable exchanges with the completion by stages of the permanent exchange.

The numbering plan followed the form shown in Table II.

TABLE II

Emergency Numbers	Old 'J' Number
3,100-3,199	J1XXX
3,200-3,299	J5XXX
3,400-3,499	J4XXX
3,700-3,799	Mixed

In this scheme the re-establishment of a 'J' 1,000 number group would release complete 100 number blocks in the portable exchanges, which could then have been re-allocated with the same or different numbers to subscribers still without service. By retrunking it was envisaged that complete portable exchanges could have been recovered if necessary. It was impossible to introduce complete order into this scheme, and hence it was necessary to allocate some mixed groups. However the problems which would have arisen in clearing up the relatively few such groups were not comparable to the difficulties which would have arisen in re-allocating number blocks if all emergency number groups had served subscribers from the complete 'J' range.

In the final scheme with full emergency number provision it was not necessary to re-allocate emergency numbers to subscribers still without service or to recover portable exchanges progressively, as it became apparent that the replacement exchange could cutover from emergency numbers in one action. However, the orderly number allocation would have been useful in different circumstances.

ESTABLISHMENT OF REPLACEMENT CIVIC EXCHANGE

It was decided that a basic layout providing for 8,400 new 'J' numbers was practicable in the line depot building, and such a floor plan was available at the site by the afternoon of Friday, 22nd. Installation duplicating the destroyed unit commenced as soon as the line depot building was cleared. Survey and marking of the floor was completed by 12 mid-day, Saturday 23rd, and the laying of plinths commenced.

At 1 a.m., Sunday, 24th, the first load of racks arrived from Sydney Stores, and these were stored temporarily on the footpath outside the exchange and covered by tarpaulins. By 6 a.m., Sunday, the laying of plinths was completed and the first racks were stood in position. In all, 86 racks weighing approximately 60 tons were erected between 6 a.m., Sunday, 24th, and 8 a.m. Monday, 25th. The first drum of cable was used on Tuesday, 26th, and all cabling was completed by Monday, 9th October.

The initial target date for completion of installation and cutover was 18/11/1961, which date allowed for normal testing safeguards and an abnormally large amount of checking of cable records and subscribers master cards. However as the work progressed, it proved possible to advance this date by one week to 11 p.m., Saturday, 11/11/1961.

By means of removing links on the M.D.F. and cords used to open-circuit arrestors, a cutover was achieved in approximately 1½ minutes on that date, and no faults arising from the new exchange equipment or cutover were encountered. The complete restoration of almost 5,500 'J' numbers to subscribers within 51 days of the fire was a remarkable achievement.

ORGANISATION

The extensive organisation which was set up at Canberra to meet the emergency covered a wide field of activity and is set out in the Organisation Chart, Fig. 9. At its peak, some five days after the fire, the project directly involved a total staff in Canberra of 536, including 21 engineers. In addition, the complementary effort shown on the Organisation Chart involved a large commitment in staff and resources, not only from the Postmaster-General's Department but from other organisations, which contributed materially to the success of the project.

No attempt has been made to indicate on the Chart the level of effort expended by Postmaster-General's Department groups outside Canberra or by other Government Departments and non-Government bodies. However the Superintending Engineers, Planning, Metropolitan and Services Branches of the Engineering Division were, with their staffs, committed to a large effort in ensuring the smooth flow of work on the engineering project. At the same time the Assistant Director, Telecommunications Division and the Superintendent, Buildings Branch had large responsibilities in the handling of subscriber records, priorities and emergency services in the first case and the determination and oversight of building and allied works in the second instance. In the same manner, a large complementary effort flowed from bodies outside the Department.

The engineering works at Canberra were under the direct control of two Supervising Engineers whose areas of responsibility fell into the broad categories of External and Internal Plant. However, because it was impossible in a 24-hour a day project of the magnitude involved for a single individual to be present all the time, there was a considerable overlap of functions in the managerial sense. This greatly facilitated operations in that decisions were reached under the guidance of the alternate Supervising Engineer if the one directly concerned was not available.

With the passing of time and the completion of some phases of the work there were naturally changes within the organisation. However, the general principles outlined in Fig. 9 applied throughout the period of maximum effort and proved to be most effective. The very close co-operation between the Telecommunications and Engineering Divisions necessitated what amounted to a composite staff for some functions, and this is covered by side-ways ties between engineering officers and the District Telephone Officer at several points in the chart.

The influx of over 400 men augmenting the normal Canberra engineering staff created many problems, and it was found necessary to temporarily transfer two experienced staff clerks to assist the local organisation. In addition, the Staff and Industrial Officer personally visited Canberra to assist with advice on industrial matters such as accommodation, transfers, leave and pay arrangements, as well as the maintenance of harmonious staff relationships.

It has been demonstrated many times that in an emergency all staff will give of their best, but it is human nature that if maximum effort is maintained for more than a few days there must be compensating factors to make up for the diminishing novelty and sense of urgency as the work task becomes more defined. Temporary, and perhaps mediocre to poor, accommodation receives a closer scrutiny, regular meal times and tea breaks are looked for and there are the inevitable requests for leave and assurances on pay arrangements.

The availability of the Staff and Industrial Officer and the attentions of experienced clerical staff to all aspects of the issues referred to achieved a notable degree of smooth staff relations and would always be of great assistance at any similar project in the future. In addition, it was recognised both by the Postmaster-General's Department administration and the industrial unions represented at Civic, that on emergency work there must be a degree of flexibility in the application of regulations and principles. It was a source of encouragement to both parties that no friction occurred on this score.

CONCLUSIONS

In meeting a major emergency in the communications system, the first target is restoration of service, and cost in manpower, materials and services is generally of secondary importance. It is only when increased restoration costs yield marginal advantages in time that cost may be a significant consideration. However, when examined in retrospect it is possible that experience will have shown that alternative courses would have been more productive in results or less costly in effort and materials. The particular circumstances existing at the site and time of occurrence of an emergency are of course fundamental, and decisions will have been based on such considerations as:—

(i) The speed with which relief can be provided.

(ii) The ease of implementation of relief measures from the point of view of availability of materials, manpower and general resources.

(iii) The departures from standard prac-

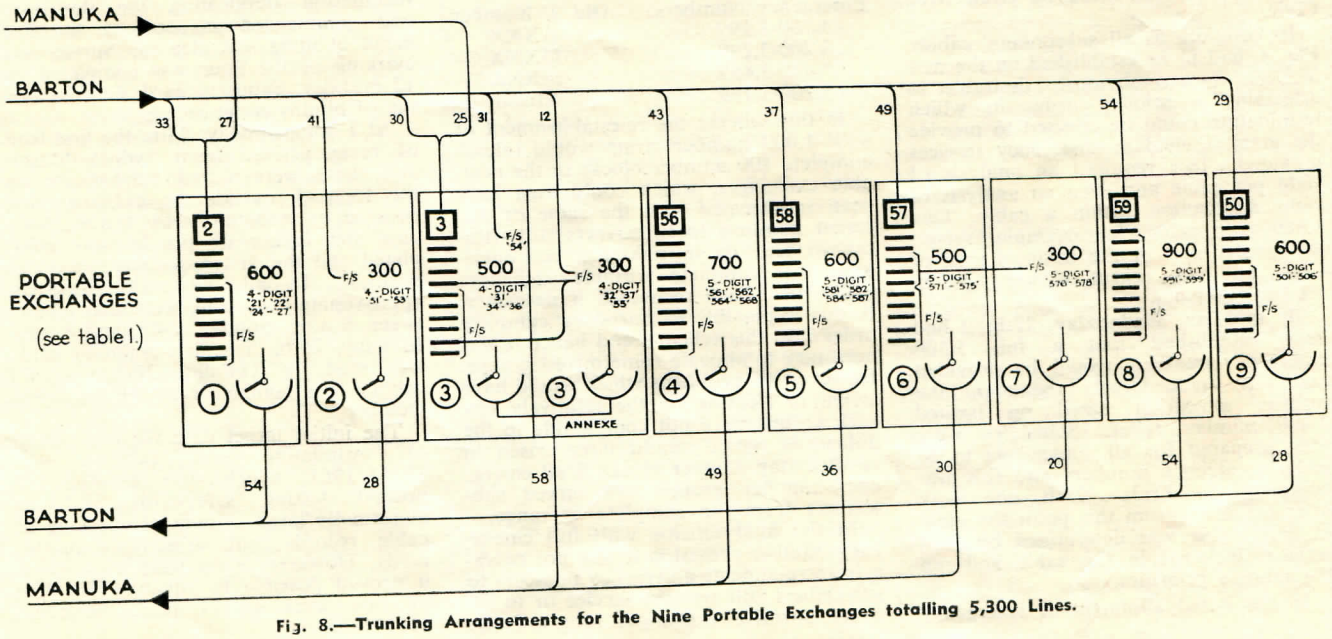


Fig. 8.—Trunking Arrangements for the Nine Portable Exchanges totalling 5,300 Lines.

tices which could require considerably increased direction and result in lower productivity.

(iv) The permanency of relief.

(v) The cost.

It was most significant that, after a critical examination in retrospect of the course of relief measures adopted at Civic, no one involved in its initial determination could see any better alternative. Any changes which seemed desirable were in matters of detail rather than basic action and this was a source of considerable satisfaction to all concerned. It was apparent that, in the engineering organisation existing at this time, there was an inherent capacity to mount a large-scale emergency relief operation. Of equal significance is the skillfullness with which this was done. This skill was undoubtedly obtained from experience in the handling of materials, machinery and staff made necessary by the large expansion in scale of engineering works carried out by Departmental staff during the last 10-15 years.

There were no significant bottlenecks in the Civic project and it was not necessary for any individual to carry out functions any different from his normal duties — the only difference was an increased sense of urgency of completion of each task. In this particular case, the emergency was met by the Engineering Division, Country Branch, within whose sphere of control it arose, complemented to the degree necessary by the diversion of additional planning, installation, maintenance, external plant, materials and staff resources. Each of the complementing sections was self supporting in that it brought its own key staff of manipulative, supervisory and engineer grades and arranged generally for its own material supplies. Because of this, the additional load placed on the normal Country Branch organisation was kept to a minimum. This is a logical arrangement and should occur naturally in any similar circumstances.

Because of the great number of decisions which have to be made during the progress of a major relief work, the dispersion in the nature of concurrent activities and the considerable diversity in the problems encountered, there is good justification for adopting the Civic procedure of not attempting to enforce a too rigid line of command and to permit a degree of overlapping of responsibility.

For example, the Supervising Engineer, Regional Works and Services, under whose control the Canberra Regional Engineering Division came, was naturally involved in many discussions and conferences not directly related to the execution of relief works. These concerned such aspects as the Fire Committee investigations, co-ordinating conferences with the Telecommunications Division and Assistant Director, Canberra, discussion on re-siting of the Line Depot and co-operation with other Commonwealth organisations assisting in the relief measures. At the same time, the Supervising Engineer, Long Line and Country Installation, was frequently involved in material conferences, discus-

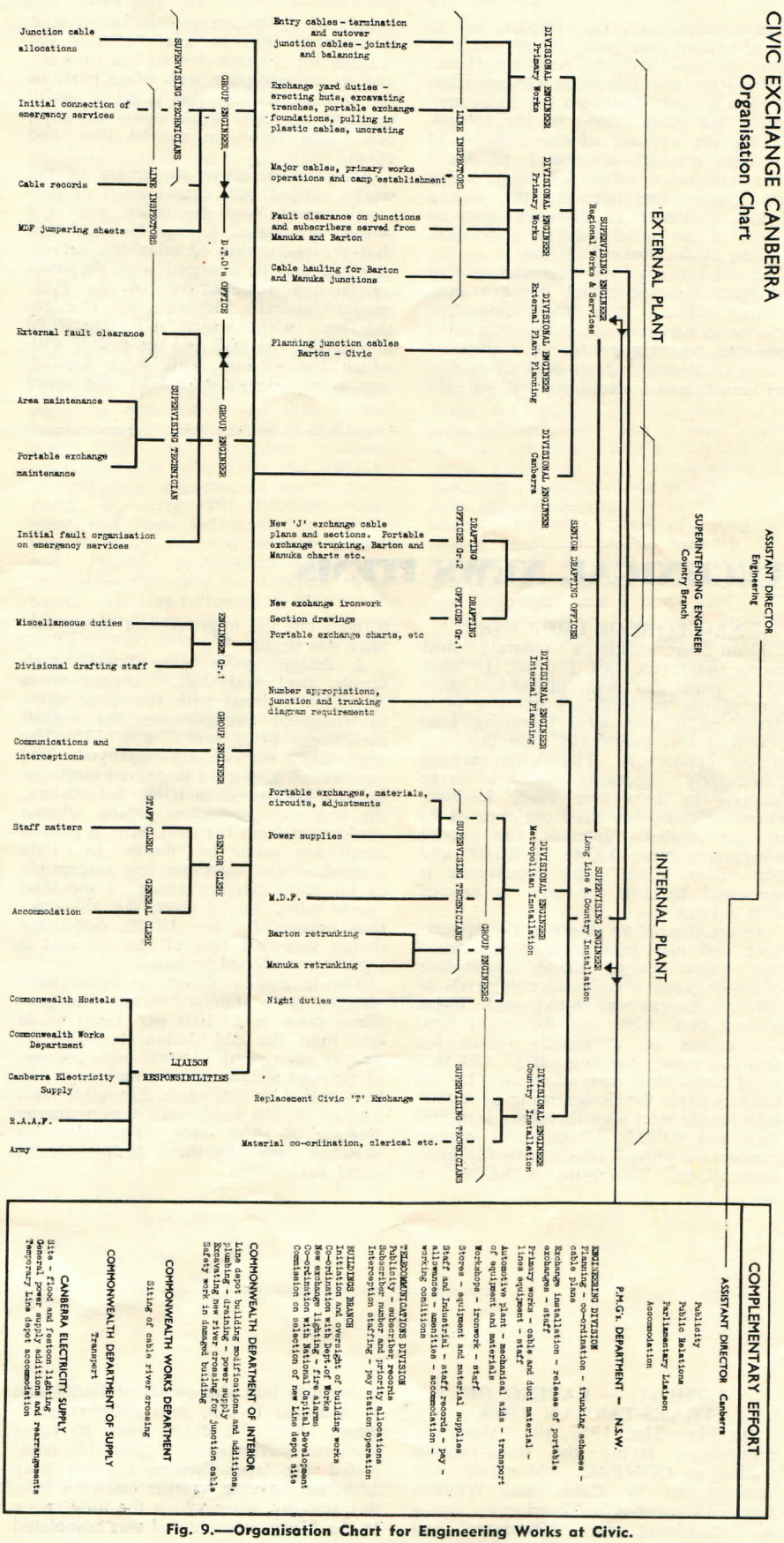


Fig. 9.—Organisation Chart for Engineering Works at Civic.

sions relating to press releases, setting up of special emergency telephones and other matters, with the Assistant Director and District Telephone Officer, Canberra, and had to make a trip to Sydney during the early course of the project. During the absence of the Supervising Engineer directly concerned on some issue, the other officer of equal status was usually available and this was a significant factor in ensuring that no aspect of the relief work was delayed, waiting high level discussion.

Experience at Civic has shown that adequate communication between controlling officers is a most important feature in carrying out emergency relief measures under pressure. In a situation where of necessity each controlling officer must make decisions without the benefit of discussion and deliberation, it is essential that he know exactly the reasons for a particular section of work and its inter-relation with other parts of the project. Unless this is so, a faulty concept through weak communication can easily result in wasted time and effort.

After an objective inspection of the works carried out, examination of personal reports and discussion with the officers concerned, it must be concluded that the restoration of telephone service at Civic can be grouped with the most outstanding achievements of the Postmaster-General's Department. The enthusiasm with which all concerned approached the task and the energy with which the various skills were applied, was amply demonstrated by the speed with which emergency service was given to all subscribers and the very short time involved in complete restoration of all telephone numbers.

ACKNOWLEDGEMENTS

Acknowledgement is made to the Superintending Engineer, Country Branch, New South Wales, and his staff, and the many other Departmental Officers for their assistance in preparing this report. The conclusions reached are not necessarily those of any individuals concerned in the relief works.

REFERENCE

1. C. G. Hammersley, "Removal of 600 Number Portable Exchange from Sydney to Launceston"; The Telecommunication Journal of Australia, Vol. 10, No. 4, page 115.

TECHNICAL NEWS ITEMS

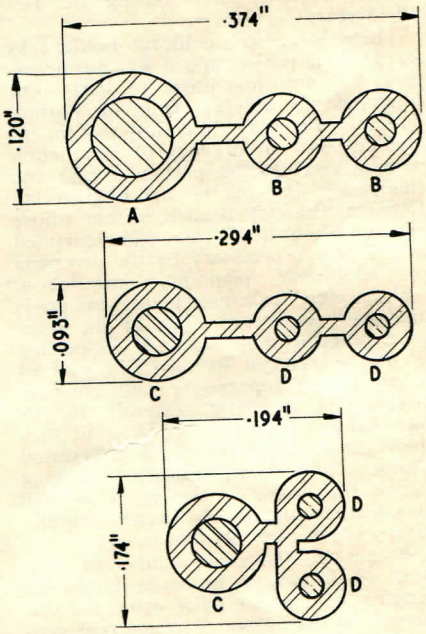
NEW ITEM OF DROP WIRE

Drop wire using a separate steel bearer wire (see this Journal, October 1957, page 58) was introduced into general use in 1956. It consists of a 0.080″ mild steel wire (breaking load 300 lbs.) and two 0.355″ (20 lb./mile) copper conductors. The design proved particularly successful and a large increase in drop wire usage resulted. However there has been criticism of its use on aesthetic grounds, the overall dimensions being 0.374″ by 0.120″ and the colour black. The appearance is worsened because the wire is erected with a twist.

In an attempt to improve the appearance and also because it was thought that lighter gauge copper conductors could be used, a series of field trials of different designs was commenced. These proved that .020″ (6½ lbs./mile) conductor was not sufficiently robust for drop wire use but that .025″ (10 lb./mile) conductor was adequate. In the trials, a triple flat design using an 0.048″ high tensile steel wire (breaking load 300 lbs.) and 0.025″ (10 lb./mile) copper conductors proved satisfactory for most applications. This wire is 0.0294″ x 0.100″, but the improvement in appearance was slight.

A design again using 0.048″ high tensile steel and 0.025″ copper wires was then evolved with the three wires in triangular configuration, the overall dimensions being 0.193″ x 0.170″. The appearance was greatly improved. The new design also gave improved electrical balance compared to triple flat designs, the copper conductors being almost equidistant from the steel wire. It proved much less prone to "flutter" in windy conditions and therefore less susceptible to vibration fatigue failure of the steel bearer wire. For a given sag, the erection tension for the 10 lb. conductor design was half that of the old and it could be tensioned by hand.

The triangular design has now been adopted as a standard item. The purchase price is £3.10.0 per 1,000 yards less than the old design, resulting in annual savings of £15,000 and, because of reduced weight and dimensions it will be supplied on 500 yards disposable reels instead of 220 yard reels, thus reducing wastage of short ends. The following sketches show the three designs to the same scale.



	DESCRIPTION
A	·080" MILD STEEL (30 T.S.I.)
B	20 lb. COPPER CONDUCTOR
C	·048" HIGH TENSILE STEEL (90 T.S.I.)
D	10 lb. COPPER CONDUCTOR

COMPAC — LAYING OF TRANS-TASMAN LINK

On May 21st, 1962, the "Monarch" commenced laying the trans-Tasman section of COMPAC. "Monarch" was accompanied by Cable and Wireless Limited's cable-ship "Retriever", acting as navigational pilot. "Retriever" had previously laid shore-ends at Bondi and at Muriwai (N.Z.), plus radar-reflector buoys along the cable route to assist accurate navigation. "Monarch" completed the trans-Tasman lay on May 30th, but adverse weather caused a two-day standby, after which the final splice to the Muriwai shore-end was completed on Saturday, June 2nd. The first con versation between Sydney and Aucklan took place at 8.30 a.m. (Sydney time that day. Transmission tests are now i progress and will be completed befor the link is officially opened by the Prim Ministers of Australia and New Zealan on July 9th.