The writer began work in connection with W41MM, FM's largest area project, in October of last year. Most of the major design features had been settled by that date, and orders had been placed for considerable equipment, including the G.E. transmitter, three 75-kva Caterpillar diesel generators, one similar 15-kva machine, and switch-gear for use with them. Two of the large generators will be required to power the 50-kw transmitter which is authorized, leaving one for a stanby. The small machine is intended to be used during "off " periods eventually, and, more immediately, will supply the 3-kw transmitter which we plan to put into operation while installation of the remainder of the equipment proceeds through the summer.

When it became apparent that for many months there would be little power required for use much of each day, an automatic gasoline-engine-driven 1.5-kva machine was procured for use during these periods. This made it possible to select standard equipment for oil burners, refrigerators, etc., without having to run an AC 110 volt plant for 24 hours of every day. This was considered preferable to using auxiliaries designed for 32 volts, which would be off standard and possibly a greater source of interference to radio reception.

This installation was planned by Glenn D. Gillett consulting engineer of Washington, D. C., and the major items of equipment were selected by him.

In October, the one-mile road which had to be built along the side of the ridge from the state road to the site was roughed out. for perhaps half of that distance. Design of the building was begun at that time and work was rushed as fast as possible on the road. By the time the building contractor was ready to begin, the road had been pushed through, but was so muddy as to require the help of a tractor to get a truck up it. Work on the road had to be stopped to permit materials to move to the site, for the Blue Ridge Parkway, which must be followed for 12 miles en route to the location, and over which we had permission to move, was to be closed to our hauling on December 1, and we tried to deliver materials enough in advance to keep going. The road is single-lane and so time was lost by each crew in getting out of the way of each other that we found it impossible to do road work and any significant amount of hauling simultaneously. The plate transformer for the 50-kw transmitter and the antenna mast were amoung the heaviest items moved at that time. This hauling had finished making the road impassable when winter came to the mountain and everthing, including the road froze. From then until now it, his taken chains, courage, and luck to get to the peak.

Hollow-tile walls and wood-joist floors and roof were chosen for the building, because of the critical conditions applying to steel. The engine room. which will have a concrerete floor, was Iocated at grade on bedrock so that the floor will need little steel reinforcement. The building will be stuccoed, when the weather permits, and will be in the form of two stair steps on the side of the mountain, facing the southeast, and in the lee of the peak. It contains the transmitter room, studio-office, shop, storage space and living quarters for four persons permanently or six temporarily. Permanent living quarters are on the lower level, and are reached by a stairway from above. They include two bedrooms, kitchenette-dinette, pantry and entryway with a door to the outside. From a large plate-glass window in the living room the staff will have an imcomparable view, when clouds permit.

No provision is made for visistors inside the house, but the roof of the living quarters is covered by a built-up roof, as is all of the building, and with a balustrade and flooring will constitute a terrace from which visistors may look into the transmitter room through a large plate-glass window. They will be able to see into the studio too--or, if they choose, admire the view below for which this terrace will be a superior vantage point.

The men engaged in constructing the building have lived through the winter in a frame bunk-house erected for the purpose. The nearest buildings of any sort are a mile away, and those are designed for summer use. This bunk-house is almost twenty feet down the slope from the road, and a hand-line is used to get up and down.

All building foundations are on bedrock. The earth was frozen hard before excavation could be completed, and the final removal of overlying earth was accopmplished by literally blowing it over the cliff with dynamite. Brickmason worked on into the winter, using calcium chloride in the mortar to prevent its freezing at temperatures above twenty degrees. When the temperature was below twenty, the masons waited.

Water for use at the station will be pumped by an electric pump front a point 1,600 ft. from the house and about 600 ft. below it in elevation. The contractor installed a gasoline-engine pump at this location last fall to provide water for construction work. The pipe line is drained when not in use, yet collected condensation froze solid at one point in it during an idle period. The moisture conditions at the top of the mountain range, where the rain clouds for the state form, are appalling. Equipment even when under shelter, stays wet.

A month ago a 4-foot snowfall isolated the men on the job for two weeks. Two men came out on foot to get assistance, walking all day and covering a distance of 20 miles before reaching an open road.

It was impossible to procure the type of antenna which was originally planned. A steel tubular mast 90 ft. high and 20 ins. in diameter at the base is to be used to support an 8-bay Lingo turnstile until materials can be obtained for erecting a higher structure with a greater number of bays. This mast was erected while temperatures ranged below zero, with winds of high velocity blowing gustily. Riggers spent not more than ten minutes at a time aloft. The pole is set in bedrock on top of the peak. beside the building and about 30 ft. from it. During the snowstorm mentioned earlier, it was observed to sway over 3 ft. at the top where its diameter is over 8 ins. Almost every morning sees it coated with an inch or more of rime where the wind swept fog against it during the night.

The officials of the Blue Ridge Parkway, or *"the Scenic"* as it is known locally, have, fortunately been very generous in permitting hauling over their road. Otherwise our operations could never have continued through the winter. The heaviest single items to be delivered to the station were the three large diesel-generators mentioned above, which weigh 9.000 pounds each. Such a heavy load on the Parkway which is not surfaced over this section, is in danger of damaging it severely if moved during a thaw. At the elevation of this road, freezes and thaws tend to alternate on a daily cycle throughout the winter, and it is for this reason that the permit to haul which we had been given was to be ineffective from December 1 to May 1. We found it impossible to get these machines from the factory until the last of January. When the first two arrived at the railhead, we made arrangement with those in charge of the Parkway to permit their being moved during the early morning hours of a specified day, following a check of road conditions by the Parkway engineer. The suppliers crew started as planned taking two machines on a tractor-trailer and the third, which had then come into to Marion, on a truck. From Marion to the mountain is 35 miles, of which the first several are over a surfaced state road, quite steep and crooked. The next section is the Scenic. at the end of which it is 7 miles by single-lane unimproved mountain road, the state's and ours, to the transmitter location This section involves many sharp turns and tight places and one switch-back where a vehicle must turn around and go out as it came in.

The plan was to haul the machines individually by 1 1/2-ton truck from the end of the Parkway. One had been taken up as planned when snow began falling. Our foreman offered to take one of the two remaining on our truck, making one more trip from the Scenic to finish the job. He was much upset when, after the supplier's men went down and failed to return, he hiked 7 miles down the mountain to find all trace of men and machines gone! They had become fearful of the weather and left going over 100 miles to the home office of their company. It took days to get them back and they had the misfortune to find worse weather than before on top, but delivery was made. The heaviest loads were thus transported three full trips over the Parkway, instead of one.

It has been our good fortune that a camp for conscientious objectors was established in the valley below the portion of the Parkway which we find it necessary to use. The men from this camp have worked on the Parkway all winter. keeping it open when it would have been closed. There have been several

washouts and slides. At the time this is written, work is still proceeding daily on the clearing of one slide which occurred a month ago and which for a time blocked the road completely.

To get the road re-opened after the big snow took a week. Our foreman got the help of the state in getting a snowplow onto their road from Marion to the Parkway. There the Federal men took over, taking the foreman and a tractor mechanic - our bulldozer had broken down - to the end of the Parkway on a snow-plow. Parts of two days were required for this trip. From there, the men hiked to the station, repaired the bulldozer and used it to plow clear the remaing 7 miles of road.

Circumstances have delayed our work so that it has been necessary to change our plans many times. Originally it was expected that operation would begin at low power in November, and later we hoped to start at some time during the winter. Now, we hope to get 3-kw. FM transmitter on the air by May. These changes have kept all plans in a constant state of flux.

For example we planned at first that about 30,000 gallons of fuel oil would be stored in buried tanks, and about 10,000 gallons of water. It was not possible to obtain the tanks and get them up last season, so other arrangements had to he made. Study indicated that it might be possible to pump water from the source we had I picked during most of an a average winter, and that the longest period in many years during which No. 2 fuel oil stored above ground would have remained non-fluid was two weeks. The largest tanks then procurable were of 2,500 gallons capacity and were of much lighter construction than desired. Three of these were ordered and rushed to the mountain ahead of the hauling deadline, and it was planned to use two for oil and one for water temporarily, and to bury the two oil tanks this season for cold-weather use, since two of them will supply station needs through any expected period of temperatures ranging below the oil pour-point. The ground froze before the water tank could be buried, so that a smaller tank had to he pressed into service by building a mound over it. This froze during the storm mentioned, so that water was then only obtainable melting ice.

A shallow-well water system, installed in the engine room, will pump water for the building from whatever tank is finally buried for storage, and supply it under pressure for use. The main pump at the source will be wrapped with heating cable, thermally insulated and held above freezing temperature by electric heating under thermostatic control. The pipe line will be drained by an automatic valve whenever this pump is not running and this pump will fill the tank by manual starting at the house, stopping automatically when the tank is full.

Lack of availability of materials has been a problem as would be expected and has necessiasitated changes in plans A copper tank for storing distilled water for tube cooling is being constructed locally of 20-ounce sheet a copper in an angle-iron framework. Wiring will be installed partially in home-made ducts. Careful shopping has procured many neccssities just before they hey became unavailable. Perhaps our luckiest break was in buying a truck in the nick of time, for no supplier of materials would send his own truck up during average winter weather.

It had been planned to use waste heat from the diesel engine radiators to heat the house. More than enough for the purpose will be available when the 50-kw transmitter is running, even in the coldest weather. We intended to use the air passed through the radiators, rather than passing water through the engines, so as to avoid complications and vibrations troubles. Since the engines are to be rubber mounted on concrete blocks, and these supported in turn by cork pads over individual piers on bedrock, we wanted to avoid extra piping which might transit vibration.

When it became probable that early operation would be at reduced power, and that fulltine operation would not be economically justified for some time, the whole question of heating was reopened. There had been some fear, too, that oil odors might be circulated through the house. It developed that the use of this source of heat would require such large air volume as to present a problem in duct design, and so the plan was abandoned, and an oil furnace chosen. The heating system is so designed that waste heat from engines can be used at a future time if it becomes desirable by installing one partition and changing two

ducts. Should this be done, the oil plant will serve as a booster to inrcease the temperature of the air as required in the coldest weather, so that the volume of air handled will not need to be increased.

In a similar manner it had been proposed that hot water be supplied by heat interchangers on the engine exhaust stack. Special equipment would be required, and a standard oil-fired automatic heater was chosen as more readily available and more immediately satisfactory.

For cooking and distilling water a bottled gas will be used, making a total of three types of fuel that must be stored. These are: No. 2 fuel oil for diesel engines, house heating, and water heating: gasoline for the automatic electric plant which will supply lights, refrigerators, oil burners. etc.. as required when the station is off the air; and bottled gas as mentioned above.

From main tanks storing 30,000 gallons at some distance from the house, fuel oil can be transferred by a gear pump into either of the two 2,500-gallon buried tanks or to the house, and from either of these tanks to the house. There it will be metered, filtered and stored in two 500-gallon day tanks, one for the engines and one for heating.

Cleanliness is extremely important in diesel fuels, and is best obtained by care in handling and by the allowing oil to settle well before using, the sediment and water being drained at intervals. We are taking great care in designing our oil-handling facilities to assuring cleanliness of the oil.

The day tanks, under the engine-room floor, are manifolded together in such a manner that all demands can be supplied from either, while the other is cleaned. A pit, entered through a manhole in the floor, will I give access to the ends of the tanks and to all valves associated with them. Here the water and sediment can be drained off. The various machines will each have a supply line picking up from the manifold in this pit, and an overflow line returning to the manifold. These tanks will be insulated from the outside by 6 ft. of earth, and the engine room by only 1 ft., and should maintain the oil in a fluid condition. They can be heated if it becomes desirable to do so.

The oil meter can be present for the amount it is to deliver, and will automatically stop the pump when this amount has been discharged. This is desirable in that almost an hour will be required to fill a day tank.

Gasoline will be stored in a 500-gallon tank under the same floor, with filling and venting from the outside and with all piping buried under concrete and, none passing through the pit described above.

The quantitites of gasoline and fuel oil mentioned will be sufficient to last through the worst of an average winter.

Wiring in the engine room will be in conduit rather than trenchways. because of the possibility that oil or water might run into any trench. No lead-covered cable will be used in this installation. Junctions between the lengths of large-diameter conduit involved will be concrete boxes, metal lined, beside the wall in each case and raised above the floor surface. Two banks of heavy-duty batteries, 32 volts to each bank, will be arranged for interchangeable use in starting the various engines, These will he charged by a Tungar type of charger: All of the engine room equipment is to be installed and all piping put in place before the concrete floor is poured and the power plant will I be put into operation one unit at a time. The gasoline plant is already in service supplying lights for the bunkhouse, for indoor work on cloudy days and driving small power tools.

A heater-room in the form of an alcove to the engine room, will contain the furnace for house heating, water heater, water cooler for the transmitter, distilled water storage tank, and water still.

The diesel power generating equipment will he controlled from the transmitter room, where a switchboard of appearance harmonizing with that of the transmitter will be a part of the right hand wall of the room. Air

circuit breakers are provided to tie each machine to the main bus, and to connect from the main bus to each load, with adequate provision for metering all generating and bus operating parameters.

From this board any machine can be started. brought into synchronism, tied to the bus, and loaded as desired. As many or as few machines as desired can be operated simultaneously Self-regulated generators are used, and capacitor banks are provided for adjusting power factor and, through it, the voltage All diesel generators are 3-phase. 220-volt units, and the switchgear is designed for these characteristics.

When all diesel machines are to be shut down, the operator must throw a switch which will start the 110-volt, single-phase gasoline machine and transfer to it all house-lighting and similar toads. Thereafter, this machine will run whenever a load is present on these circuits, and will shut down when there is no load. The main plant can then be closed down without throwing the house into darkness.

An alarm circuit will be arranged to awaken the staff of the station if the engine room temperature drops to freezing during the night, as might occur due to failure of either the heating plant or its electrical supply. Were this not done, such a failure might freeze the machine radiators and the water-cooler.

The one transportation problem which should be simplest, but may not be, is that of getting program service to the mountain. An S-T circuit on 837 mc. will be used; The distance is over a hundred miles, and line-of-sight either barely does or doesn't quite exist. Rhombic antennas will be installed at each end for our initial transmission.

The problem of access to the station has been greatly complicated by the war, for the state had intended to rebuild the road up from the Parkway last summer, and went so far as to call for bids on it. Unfortunately for this project, no one bid, and it seems probable that we shall have to do the best we can with the road that is there for the duration. The soil at these elevations is almost pure 'humus, and so greasy when wet that several tons of crushed stone spread near the building have completely disappeared into the mud.

This has been an exciting job, and an interesting one. Many problems have been met, while many of the hardest yet remain. Many solutions already decided on have yet to meet their test in practice. Electrical installations are just beginning, but one of these days *"Mount Mitchell's Voice,"* from the top of the North Carolina mountains will be the loudest, clearest voice for many radio listeners over an area of 70,000 square miles.

FM/April, 1942 C.M. Smith, Jr./engineer W41MM, Winston Salem, NC