Design For Survival
The Story of Plateau Station

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On December 13, 1965, an LC-130F of Air Development Squadron Six (VX-6) landed at 79° 15′S. 40°30′E., to leave six men alone high on the polar plateau. Thus began the execution of a construction project many months in planning.

Eleven months before, to the day, the National Science Foundation set forth its detailed requirements for support of research programs at a station on the polar plateau in East Antarctica. The research was to be much like that at Eights Station in West Antarctica. In addition, it was expected that the vehicles being used on the South Pole-Queen Maud Land Traverse would be overhauled at the new station. To satisfy these requirements, the Foundation suggested a station composed of vans similar to those at Eights and manned by 12 men.

Like Eights Station, the proposed Plateau Station would have to be wholly dependent on Navy airlift, working at extreme ranges and altitudes. The air operations officer of the U.S. Naval Support Force, Antarctica, made a rough analysis of the logistics required to place the materials for such a station at 80°S. 40°E. He found that there were not enough flight hours available to support other scientific programs if a station of the proposed size were to be built. Only half the flight hours needed to place and support an Eights-size station could be allocated to the new project. The scope of the station had to be restricted without loss of capability to support the scientific programs. Within reason, funds were available to develop a smaller station and provide labor-saving devices which would cut the effort necessary to establish and support it, as well as reduce the number of people necessary to operate it. The original wintering-over complement had been fixed at 12, six scientists and six Navy support personnel. With a smaller station and cross-trained personnel, it appeared possible to hold the number to eight. For a time it was thought seven would be enough, if everyone shared the cooking, but experienced men believed a trained cook was essential for health and morale under the expected rigorous conditions.

All aspects of support were considered in the effort to reduce airlift requirements. An expensive energy-conservation system was proposed. The building would be heated by circulating engine coolant from the diesel generators, thus saving an estimated 10,000 gallons of fuel per year, more than 20 percent of the projected normal fuel usage. Eighty LC-130F flight hours, about 5 percent of the total hours available during *Deep Freeze* 66, could be saved.

Like Eights, Plateau Station would probably be composed of vans. Each van would necessitate one flight to Plateau Station. Distance dictated that aircraft payloads be no more than 16,000 pounds unless the aircraft could refuel en route. The vans used at Eights had been 27 feet in length, although the cargo bay of an LC-130F was about 40 feet long. It was found that longer vans could be loaded into the aircraft, and those finally decided upon measured 36 by 8½ by 8½ feet, with a maximum weight of 23,000 pounds. Using longer vans, fewer were needed, and a reduction in the number of flights could be made even though refueling at Pole Station would be required. Two additional flights were, thus, required to Pole Station to deliver aircraft fuel for every flight to the Plateau Station site. Even so, this was a more efficient arrangement than direct flights with reduced payloads. Such planning brought the construction and support of a station on the polar plateau within the realm of feasibility, at least in theory. The concepts were refined, committed to paper, and sent to the Bureau of Yards and Docks (now the Naval Facilities Engineering Command) for conversion into plans and specifications, the basis for procurement.

Design

The design problem was not routine. The Bureau of Yards and Docks' engineers and architects had to design for survival at the highest and coldest location yet occupied by the United States in Antarctica, 11,890 feet (3,624 meters), with temperatures expected to drop to -90° C. (-130° F.).

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The designers had to make the station as livable, as capable of supporting complex scientific equipment, and its operations as free of physical labor as possible, without sacrificing reliability and simplicity. While low temperature was a problem, wind was not expected to be. The designers were informed that the location of the station was thought to be such that high wind conditions, similar to those prevailing at most other United States antarctic stations, would not be encountered. In addition to the cold, concern was felt about the rarity of the air. This condition is exaggerated in the polar areas where atmospheric pressures are considerably lower for a given altitude than in the temperate and equatorial zones. For example, the pressure at 12,000 feet in Antarctica is the equivalent of about 13,500 feet at the Equator. Since, at the time, no one knew the exact height at which the station would be located, the designers had to plan for extreme conditions. An examination of the existing literature on the ability of the human body to function for long periods under such conditions revealed considerable differences of opinion. Some mountain climbers reported having slept with oxygen masks to be able to sleep at all. Indian soldiers died of pulmonary edema, a pneumonia-like affliction, in the high Himalayas. Pressurizing the bunk rooms was considered, but rejected as unnecessary and expensive. The Soviets at Vostok occupy a site nearly as high and cold as it was expected Plateau would be, and have experienced similar conditions without needing pressurized facilities, although several cases of altitude sickness have been reported. Lieutenant Commander Paul Tyler, the Naval Support Force Medical Officer, decided, after a review of the available literature, that the answer lay in high physical and psychological standards and gradual acclimatization of the personnel. They would stage at South Pole Station for 10 days to accustom their systems to low oxygen intake. Located at an elevation of 9,184 feet (2,800 meters), Pole Station was ideally suited for this purpose.

The design concept—compact, prefabricated vans—emphasized ease of construction. Plumbing and electrical connections between vans were minimized. Assembly of the vans into a station had to be simple. Shipping schedules and austral summer temperatures dictated the beginning and end of the construction season: the job had to be done in January. Because of support problems, the station construction crew was limited to 10 men and the period to assemble the vans to 14 days.

To meet all these requirements, a decision was made to use four van units, which would, when completely assembled and connected with an interior "permawalk," comprise the main station building. A small balloon-inflation tower and an aurora tower were also to be attached.

The vans were to be prefabricated of a wood framework and plywood wall construction. The outside was to be covered with sheet aluminum. Rigid polyurethane insulation, three inches thick, would be used between the wood studs to insure very low heat transmission. Careful attention was paid to the nailing so that there would be no through connection of any kind between the outside and the inside walls. A strip of ¼-inch cork was to be placed between each stud and the plywood panel to help eliminate the possibility of thermal conductivity and preclude frost buildup on cold spots.

The first van was to contain the meteorology laboratory, observation dome, doctor's office, and two bunk rooms (fig. 1). The meteorological observation domes previously used in Antarctica turned on ring mounts and they were not airtight. A fixed-mount, clear plastic dome, 4½ feet in diameter, was chosen to permit the observer unlimited vision in any direction. Frosting of plastic domes had been a problem in the past, but at Plateau a heat duct, similar to a defroster in an automobile, was designed to distribute hot air over the inner surface to keep it clear.

The doctor's office was made very small and is not suitable for any major surgery. Hindsight shows that this space should have been larger, with more room for equipment and supplies. After the design was finished, the Navy decided on a research program to investigate the physiological and psychological effects occasioned by high elevation and very low temperatures.

Two of the four bunk rooms were planned to be in the first unit. The bunk rooms presented special architectural problems. Privacy in sleeping quarters at stations of this type was something to be desired, but difficult to attain. One man to a room would have been preferable, but space limitations would not permit it. Designing for two men to a room partially solved the problem. In an effort to make available space more enjoyable, the built-in double bunks were made of prefinished wood, with the finest mattresses obtainable, and with curtains which could be closed for privacy. Vinyl wall covering was chosen for its easy cleaning characteristics and continued attractiveness. The color combinations were carefully selected to create a pleasant, unobtrusive atmosphere, one that could be endured for long periods.

The second unit was planned to include all the rooms which required plumbing: the darkroom, kitchen, and bathroom with complete sanitary and laundry facilities. The communications room was also placed in this unit. The kitchen was designed to resemble a residential kitchen, with stained wood cabinets and a brightly colored counter, a counter-top range, a household refrigerator, and an under-counter dishwasher. The idea was to avoid the look of a typical stainless steel Navy galley, and to make it, instead, like a kitchen at home. Further, the use of domestic furnishings rather than industrial kitchen installations reduced the electrical requirements.

The communications room in this unit would house ham radio equipment for contact with the outside world, and that ever-important phone "patch" home. Official communications equipment, and an ultra-high-frequency (UHF) homer, were also included. This equipment was taken from Eights Station and installed in the van at McMurdo before the van was flown inland.

The aurora laboratory, with an aurora tower above it, and the very-low-frequency (VLF) radio research receivers were located in the third unit. The aurora tower was designed to be entered through the laboratory. Colors for laboratory spaces were carefully chosen. The walls in these rooms were also covered with vinyl wall covering, and all the cabinets were made of stained and prefinished wood. The aurora-VLF laboratory had more area than any of the other scientific spaces. The space requirement was not clearly stated during the design stage, and it now appears that perhaps too much area was allotted. Some of it, however, is being used for medical research.

The fourth unit, the mechanical van, was to contain power, heat, and water sources for the main camp. The total-energy concept for the mechanical-electrical system advocated by the planners was adopted by the Bureau of Yards and Docks' mechanical engineers. Normally, diesel generators use about one-third of the heat from the fuel burned for power generation, the rest being lost. The total-energy concept makes it possible at Plateau to reclaim about 40 percent of this "waste" heat. To recover the heat and still protect the engine cooling system, the engine coolant, upon leaving the engines at 82° C. (180° F.), is passed through a liquid-to-liquid heat exchanger. Using a closed primary system like this, the danger of loss of pressure in the cooling system is reduced. The secondary liquid heated in the exchanger is then circulated through a liquid-to-air heat exchanger in the van heating ducts. Heat from this exchanger can be supplemented by electrical heat. The heating ducts were to be run in the floors to help warm them, a luxury in Antarctica. Air from the ducts forced into the rooms at floor level would help relieve the air stratification normally encountered in antarctic buildings. A humidifier was included to add water vapor to the virtually moistureless antarctic air. Plateau Station is the first of the United States antarctic stations in which adequate attention has been given to humidification.

Heat generated by the engines was also used to keep the fuel warm and to provide the station's water. Unless warmed, the fuel stored outside in 25,000-gallon rubber bladders would turn to jelly should winter temperatures drop as low as −90°C. (−130°F.). Heating the fuel is accomplished by circulating it through a heat exchanger warmed by the heat from the engine coolant. Water is obtained by melting snow in a tank through which the engine's exhaust pipe is run.

The two 75-kilowatt Caterpillar diesel generators were specified to be supercharged because of the high elevation. These generators and the rest of the mechanical and electrical equipment, including pumps, fans, switchgear, heat exchangers, and tanks, were designed to fit into a small area. There is no waste space in this unit, although it might have been better to have reduced the size of the workshop and increased the size of the mechanical room. This complete system was designed so that each of its functions could be performed by other, independent systems in the case of failure. Important functions affecting safety would have at least two backups.

The "permawalk" area, which is formed by putting floor and roof panels between the two rows of vans, was planned as a recreation and living space. The floor panels, each 36 feet long, were designed like the floors of the van units. The roof of the "permawalk" was designed in 8- by 8-foot insulated panels, to insure that the SeaBees could easily handle them during construction. "Camlock" connectors were specified to provide ease of erection and allow the builders to make connections with a simple, large Allen wrench without removing their gloves, another example of the effort to simplify construction.

In addition to the main station, an emergency camp, to be located 1,000 feet from the main buildings, was designed and built. It will be available in event of fire, generator failure, or fuel loss, and will also provide accommodations for summer support personnel. It consists of a single van containing a generator room, kitchen, and toilet room connected to a special 16- by 32-foot Jamesway hut designed by the Naval Civil Engineering Laboratory. Provision was also made to supply power from this source for scientific programs at the main station if the generators there should fail.

In addition, Bureau of Yards and Docks engineers designed a ramp of structural aluminum for the specific purpose of unloading and loading the vans from LC-130 aircraft. Built on runners, these

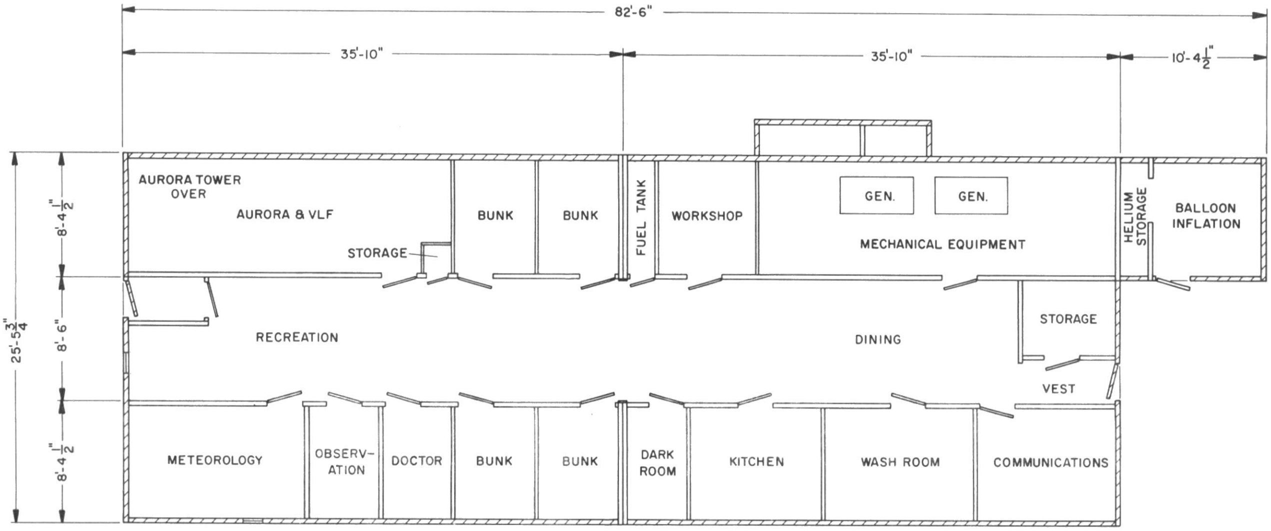

Fig. 1. Plateau Station Floor Plan

ramps could be towed with a van on them by a 955 Traxcavator to the construction site, thereby greatly facilitating the unloading operation.

Procurement

With the completion of the design, the technical officer at the Naval Construction Battalion Center, Davisville, Rhode Island, took over. Negotiations were begun with the Alberta Trailer Company (ATCO) for manufacture of the vans. The Naval Support Force, Antarctica, insisted that a single point of responsibility be established for supplying every item of material and equipment necessary for a reliable station, and further, that the workability be proven before shipment to Antarctica. ATCO, the same company that had built the Eights Station vans, assumed this responsibility and, as evidenced by the results, discharged it successfully.

Training

Mobile Construction Battalion Six (MCB-6), recognizing the necessity for intensive planning and training to insure success in the construction phase, appointed, in May 1965, Ensign David Ramsey, CEC, USNR, as prospective Officer-in-Charge of the construction. He and his senior petty officer, now Chief Builder Gerson Hyatt, picked a vigorous and capable crew who trained together, studied plans, made their schedules, and looked for unforeseen problems. A trip to the manufacturer at Calgary to participate in the factory erection and test of the station was included in the training.

Consumable supplies were ordered especially for Plateau Station and delivery was monitored by using a machine- and computer-oriented system. The list of supplies was checked and cross-checked to insure that nothing was forgotten. Final checking took place just before all the necessities for construction and living were loaded on USNS *Towle* in November for shipment to McMurdo.

On November 29, 1965, a final planning conference took place at McMurdo Station. Each job that remained to be done at McMurdo was assigned to one man as his responsibility. The passenger movement schedules were made for the group going to the South Pole for acclimatization and then onward to the construction site. The equipment, including two 10-ton Traxcavators, vans, supplies, and fuel, was to be shipped in accordance with previously prepared construction schedules. Training, refinement of planning, and constant checking continued.

Execution

On December 13, Captain V. Donald Bursik, Deputy Commander, U.S. Naval Support Force, Antarctica, planted the United States flag at 79° 15′S. 40°30′E. The advance party, including Lieutenant J. L. Gowan, MC, USN, prospective Officer-in-Charge; Robert Flint, Station Scientific Leader; Charles L. Roberts, of the U.S. Weather Bureau; Arthur Weber, architect from the Bureau of Yards and Docks; E. C. Horton, Jr., a Navy electronics technician cross-trained as a radio operator; and Robert Faul, ABC-TV, erected a tent camp and later a Jamesway hut. They determined the prevailing wind direction and insured that the site was satisfactory from a scientific point of view. The test of months of preparation had begun.

Shortly before January 1, 1966, a number of things began to happen at once. The SeaBee construction crew arrived and set up additional temporary camp facilities at Plateau. *Towle* arrived at McMurdo and the vans, which had been deck-loaded, were off-loaded onto the fast ice in front of McMurdo Station. The vans were put on sleds and carefully hauled to Williams Field for final inspection by MCB-6, installation of the communications gear by electronic technicians from the 14th Naval District Industrial Manager's Office, and final loading in LC-130F Hercules aircraft for shipment to Plateau. At Williams Field, the ramp designed by the Bureau of Yards and Docks was not used; the vans were loaded directly from the sleds into the aircraft. The ramp was used at Plateau Station to unload the vans, however, and proved very successful after a few minor difficulties had been overcome.

(U.S. Navy Photo)

Unloading Van at Plateau

At Plateau, the vans were placed on a timber foundation made of a grid of 2- by 12-inch and 6- by 8-inch timbers placed on firmly compacted snow. The snow at Plateau was extremely soft, but was compacted by running the Traxcavator back and forth over the area and then allowing the snow to harden. Placing the vans was accomplished by constructing a small ramp from the snow surface to the top of the foundation and using the winch on the Traxcavator to pull the units into place. The total construction time was a little over three weeks, including the installation of the fuel bladders and piping system, and delivery of 50,000 gallons of arctic diesel fuel in bulk and an emergency supply of fuel in 55-gallon drums sufficient for 16 weeks.

Few unanticipated problems arose. In fact, the entire Plateau operation is a model of what can be done with thorough planning and clear assignment of responsibility for the ultimate delivery to the site of every single item needed. It is interesting that while every effort was made to fix responsibility for getting material to the site, a different management concept, common to United States operations in Antarctica, was employed for the actual construction. At United States stations, independent authority exists for scientific and logistic support programs, integrated only by the concern of the individuals for the success of their mutual endeavor. At Plateau Station, there were seven men on location, each of whom felt himself significantly responsible, in one way or another, for the successful consummation of all of the previous efforts. These included the naval Officer-in-Charge of the station, the Station Scientific Leader, the National Science Foundation representative, the Bureau of Yards and Docks representative, the manufacturer's technical representative, the SeaBee Officer-in-Charge, and the Naval Support Force representative. To attempt to integrate the feelings of responsibility of all these strong and dedicated men on a formal basis in the usual hierarchy of command appeared impossible. It was felt that to do so would have diminished their individual feelings of responsibility and dedication and reduced the effectiveness of the group as a team. Captain Donald R. Pope, CE, USA, the Naval Support Force on-site representative, was instructed that he was in residual charge of establishing the station, but that he would not take over full responsibility unless the informal relationships started to break down. Planning and preparation had been so thoroughly done, and the cooperation was so good, that the construction, supply, and fueling of the station proceeded without a hitch, giving Captain Pope no occasion to exercise his authority.

On January 30, Rear Admiral Fred E. Bakutis, USN, Commander, U.S. Naval Support Force, Antarctica, officially dedicated Plateau Station. That the station was built and works as originally conceived in the minds of the planners, is a tribute to every man who participated in this project. Each of them should find in its successful completion a sense of satisfaction for a formidable job well done.