

## POWER DEVELOPMENT AND TRANSMISSION

The role of science and technology in the management, conservation and development of natural resources is clearly demonstrated in four very important activities of the Office of the Assistant Secretary-Water and Power Development. These are:

1. The third powerhouse at Grand Coulee Dam on the Columbia River in the State of Washington.
2. The proposed direct-current transmission lines in the Pacific Northwest-Pacific Southwest Intertie.
3. "Super-voltage" Power Transmission.
4. Improvement in the technology of placing electric power transmission lines underground.

Careful scientific study, aided by modern computer technology, has made it possible to accurately predict the streamflow at various locations on the Columbia River. This has enabled the planning of a large capacity powerhouse—9 million kilowatts—at the Grand Coulee site.

These studies demonstrated that generators of 600,000 KW capacity can be efficiently and effectively utilized. This will result in lower unit cost for the generators and lower cost for the third powerhouse. No generators of this size are in existence today, so considerable design and development must be accomplished. This can be done only through the fullest utilization of the scientific resources available.

The procurement of such generators will naturally involve certain modern model studies and other considerations along very advanced scientific lines. It will be necessary also to provide high-voltage cables and circuit breakers with very high short-circuit duty, both involving advanced scientific capabilities.

After much study and careful investigation of the use of direct-current transmission in other sections of the world, sufficient scientific data were available to warrant the consideration of two 750,000 volt 835-mile direct-current transmission lines as part of the Pacific Northwest-Pacific Southwest Intertie. No such transmission lines exist today in the United States. Again, advanced scientific principles and know-how will be involved in building, operating, and maintaining these lines.

The expected use of "super-voltage" power transmission in the 750,000 to 1,000,000 volt range will require extensive developmental studies and research to determine design criteria. Serious doubt exists in the possibility of extrapolating present design parameters to these higher voltages. Possibly entire new design concepts will be involved. Investigations are currently in progress to define the transient voltages created when switching high tension transmission lines. Improved understanding of electrical system behaviour and of equipment capabilities would assist materially in extending the limits of high voltage power transmission techniques, both for overhead lines and for underground cables.

In the area of underground transmission, stemming from President Johnson's 1965 White House Conference on Natural Beauty, a research and development program for advancing the technology of underground high-voltage lines has been developed by the Department of the Interior. This program has been submitted to the President, and initial funds are being sought in the Department's budget for F.Y. 1968. President Johnson has directed the initiation of this program. The technical problems are formidable and can only be solved by the free and extensive use of scientific know-how and research.

This program will utilize the scientific talents of not only the Department of the Interior, but the entire industry. We will be working with all segments of the electric power industry and with the Electric Research Council of which the Department is a member. Examples of the types of research needed include:

1. Development of new and different cable insulating materials which are not only applicable for high voltage but less costly to supply and simple to splice and terminate.
2. Development of forced cooling methods for increasing current carrying capacity without a proportionate increase in cost.
3. Development of new and improved methods of trenching and placing cables. This would involve new boring or excavation techniques. In this we would expect to draw heavily on the expertise of the Bureau of Mines.
4. Optimization and systems studies to determine the characteristics required for harmonious integration and utilization in existing power systems.
5. Determination of the characteristics of underground cable for direct-