ENVIRONMENTAL AND GEOLOGIC CONCERNS IN CONSTRUCTION OF THE TRANS-ALASKA PIPELINE

SCHMIDT Ruth A.M., CHAMPION C.A., Office of the Governor, Anchorage, Alaska, U.S.A.

Construction of the Trans-Alaska Pipeline was the result of the discovery in 1968 of a large oil field in the Arctic (Prudhoe Bay, Alaska). The combination, during the early 1970's, of increasing concern for environmental protection and an energy crisis, led the United States Congress to pass a law enabling the pipeline be constructed, but with strict governmental stipulations, which were a prerequisite to granting the Right-of-Way Lease. Although the environmental concerns may have caused delays in starting actual construction, in fact it provided time for very necessary research and data gathering in preliminary design and review.

The geotechnical concerns included the location of sand, gravel and rock (material sites) for construction of a transportation route north of the Yukon, as well as a pipeline workpad and camps. This required detailed geological mapping along a fairly wide swath, which later provided data needed for precise selection of the route. Revisions and design changes are still occurring as actual construction takes place. Major geotechnical problems were encountered in construction of this hot oil pipeline through permafrost, across major faults, and in a zone subject to seismic activity. Different engineering techniques were used for construction in thaw-stable and thaw-unstable ground and various types of insulation were used in both above-ground and special refrigerated below-ground modes. Not all methods for stabilization of ground in landslide-prone areas to insure integrity of the pipeline have been successful. Hydrologic problems include means of minimizing major changes in river re-

gimen, obtaining water supplies where seasonal variations are great, and constructing river crossings only during certain periods to ensure fish passage and prevent stream siltation. Structural designs to account for snow loads in areas of several metres accumulation with and without oil in tanks required broad tolerance ranges.

Environmental concerns include selection of the route and source material sites to lessen the visual impact, both during and after construction. To protect wildlife and its habitat in the last remaining wilderness in the United States, methods of permitting passage of big game animals such as caribou and moose were developed. Measures were taken to preserve fish passage and protect the habitat of endangered species along the pipeline.

Different methods of revegetation, both for initial erosion control and later for rehabilitation, are under continuing investigation and experimentation. There are also problems connected with sewage disposal to prevent pollution of streams and water supplies, and the containment and clean-up of oil spills during construction. Many of the techniques that have been devised were developed as problems arose.

At completion of the pipeline, which is expected to be in 1977, methods of restoring and revegetating access road and material sites will be looked at carefully. This season, many of these will be examined for the first time and the success or failure of these techniques will be documented.

ENGINEERING-GEOLOGICAL PROBLEMS OF UNDERGROUND DISPOSAL OF WASTES IN SALT CAVERNS

LANGER M., Institute for Geosciences and Mineral Resources, Hanover, F.R. Germany

For reasons of safety and economy, the disposal of wastes in salt cavities is one of the most promising methods being considered throughout the world. This is due to special geomechanical properties of salt such as its plasticity, stability, low porosity, isotropy, and uniformity. For these reasons as well as the favourable geologic setting (salt deposits are widely distributed geographically and stratigraphically), salt cavities formed by solution, and salt mines, are recommended as sites for the disposal of radioactive and poisonous chemical wastes in the Federal Republic of Germany. Two projects are presently under way:

- a) radioactive wastes are stored in the former Asse salt mine and an additional cavern is planned;
- b) poisonous industrial chemical waste is disposed of in abandoned parts of the still-operating Herfa-Neurode salt mine.

It is apparent that the need for subsurface space for the disposal of waste is considerable and will increase. Rock salt is also ideal for the storage of items such as oil and gas because of its stability, low

porosity, and cleanliness. Consequently, many more caverns are expected to be produced in salt in the future and the engineering-geological and rock mechanical problems arising during construction and operation of the caverns will become increasingly important. This is particularly true of those problems involving the rheological behaviour (time and temperature-dependent deformation) of rock salt.

In principle, the rheological behaviour of rock salt is the sum of the elastic strain, transient creep, and plastic deformation. It can be described mathematically with the aid of a modified nonlinear SCHOFIELD-SCOTTBLAIR body. It can be shown that logarithmic creep and the so-called ANDRADE Creep occur in rock salt and are dependent on temperature and stress level. The theoretical calculations can be verified by laboratory tests and in-situ measurements. A new triaxial press has been developed to evaluate the time and temperature dependent stress-strain relations of salt. The results can be correlated with the convergence of the walls of salt cavities.