Title

Design and Application of A Mega-Moment Electromagnetic Dipole Source

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Publication Date

1979-05-01

LBL-9273
Abstract

To be presented at the 49th International Meeting, Society of Exploration Geophysicists, New Orleans, LA, November 4-8, 1979

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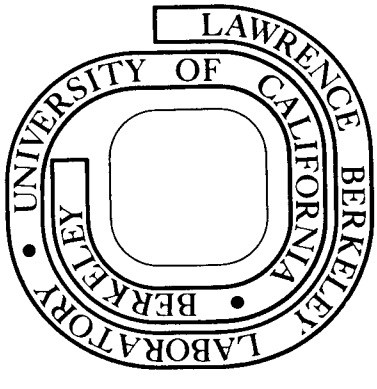
May 1979

Prepared for the U. S. Department of Energy under Contract W-7405-ENG-48



DISCLAIMER

DESIGN AND APPLICATION OF A MEGA-MOMENT ELECTROMAGNETIC DIPOLE SOURCE

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An electromagnetic transmitter capable of generating a magnetic dipole moment in excess of 10^6 MKS over a wide frequency range was designed and field tested in connection with geothermal exploration surveys. This paper will deal primarily with the engineering aspects of the transmitter pertinent the design and construction of similar transmitters for various geophysical applications.

The Lawrence Berkeley Laboratory, in association with the Engineering Geoscience Group, University of California, has been involved for several years in the Department of Energy, Division of Geothermal Energy's Exploration Technology Program. As the result of studies and evaluations of all geophysical techniques, it appeared that the controlled-source EM technique offered certain site-specific advantages over the commonly used dc resistivity and magnetotelluric methods for mapping the subsurface resistivity distribution. This seemed particularly true where it would be difficult to put sufficient current directly into the ground or where complex geology requires many MT stations for even a partial interpretation.

Existing EM transmitters were tested and found inadequate because they were too limited by the inductive nature of their loads to produce a sufficiently large dipole moment. We therefore designed a prototype transmitter specifically suited to, but not requiring adjustments for, the

reactive nature of the transmitter loop. This prototype was built around an existing 60 kW motor-generator set mounted on a one-ton 4-wheel-drive truck, and was designated as the EM-60 Controlled Source.

Field tests were carried out with a horizontal loop transmitter in both Grass Valley, Nevada and on the flanks of Mount Hood, Oregon. During these tests the magnetic moment exceeded 1×10^6 mks (rms) over the frequency range .02 to 500 Hz although only 1.4 to 1.6 km of #6 welding cable was used. The current was switched between ± 63 amperes. Field tests indicated that the transmitter design provides a safe and reliable system. As no special tuning or adjusting is required for frequency changes, the transmitter is easily operated by one man. However, in field tests we found it convenient to operate the entire system with a four-man crew, the same crew size used for dipole-dipole d.c. resistivity. Crew comments suggested that the EM technique is faster and easier than d.c. resistivity work in the flat, open terrain of a Basin and Range Valley.

Abstract submitted to the 49th International Meeting, Society of Exploration Geophysicists, 4-8 November 1979, New Orleans, Louisiana.

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